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T A X O N O M I C   S T U D I E S   I N   T H E
C R U C I F E R A E
O F   T H E   N E A R   E A S T

by

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A thesis submitted for the degree of

Doctor of Philosophy

1963.

With Particular Reference to the

Systematics of the Genus

_A L Y S S U M_ in Turkey

C O N T E N T S

VI. /

(a)/

8 /

8: A. sulphureum (holotype)

9: A. sulphureum (magnification of fruits, sepals and a sterile shoot)

10: A. harputicum (holotype)

11: A. niveum (holotype)

12: A. corsicum (habitat)

13: A. discolor (holotype)

14: A. discolor (supplementary specimen with mature fruit)

15: A. huber-morathii (holotype)

16: A. caricum (holotype)

(3) Distribution Maps

No. 1: Distribution of Aurinia saxatilis subsp. saxatilis subsp. orientalis & subsp. megalocarpa

2: Turkish distribution of Aurinia saxatilis subsp. orientalis, subsp. megalocarpa & intermediate; Aurinia rupestris subsp. cycolocarpa & Aurinia uechritiziana.

3: Distribution of Alyssum linifolium var. linifolium & var. cupreum.

4: Oriental distribution of A. aureum, A. meniocoides & A. heterotrichum.

5: Turkish distribution of A. huetii, A. blepharocarpum & A. stylare.

6: Distribution of A. foliosum var. foliosum, var. megalocarpum & A. strictum.

7: Turkish distribution of A. fulvescens var. fulvescens, var. stellato-carpum, A. macropodum var. macropodum, var. /

var. heterotrichum & intermediate.

8: Oriental distribution of A. smyrnaeum & A. szowitianum.

9: Distribution of A. umbellatum & A. contemptum.

10: Distribution of A. minus var. minus & var. micranthum.

11: Distribution of A. strigosum subsp. strigosum, subsp. cedrorum & intermediates.

12: Distribution of A. hirsutum var. hirsutum, var. caespitosum & A. stapfii.

13: Turkish distribution of A. xanthocarpum, A. cephalotes, A. bulbotrichum & A. trichocarpum.

14: Distribution of A. repens subsp. repens, subsp. trichostachyum var. trichostachyum & var. stenophyllum.

15: Turkish distribution of A. pseudo-mouradicum, A. artwinense & A. erosulum.

16: European and Turkish distribution of A. stribrnyi, A. ochroleucum & A. armenum.

17: Turkish distribution of A. mouradicum, A. praecox var. praecox & var. albiflorum.

18: Turkish distribution of A. argyrophyllum, A. bornmuelleri & A. lepidotum.

19: Turkish distribution of A. aizoides, A. aurantiacum, A. caespitosum & A. propinquum.

20: Turkish distribution of A. paphlagonicum, A. thymops A. lycaonicum, A. harputicum, & A. niveum.

21: Turkish distribution of A. baumgartnerianum, A. corningii, A. lepidoto-stellatum, A. sulphureum & A. tetrastemon.

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22: Isoflor of Species in Sect. Gamosepalum.

23: Turkish distribution of A. davisianum, A. discolor, A. constellatum, A. masmenaeum & A. oxycarpum.

24: Turkish distribution of A. callichroum, A. eriophyllum, A. huber-morathii & A. longistylum.

25: European and Oriental distribution of A. borzaeanum, A. cassium, A. gehamense, A. pateri subsp. pateri, subsp. prostratum & intermediates.

26: Oriental distribution of A. condensatum subsp. condensatum, subsp. flexibile & intermediates.

27: Turkish distribution of A. anatolicum, A. cypricum, A. filiforme, A. haussknechtii & A. syriacum.

28: European and Oriental distribution of A. murale subsp. murale var. murale, var. pichleri, var. haradjianii, var. alpinum & subsp. stoijanoffii. Also A. akamasicum, A. tenium & A. subspinosum.

29: Turkish distribution of A. corsicum, A. crenulatum, A. cilicicum, A. giosnanum & A. elatum.

30: Turkish distribution of A. trapeziforme, A. peltarioides subsp. peltarioides & subsp. virgatiforme.

31: Turkish distribution of A. caricum, A. dubertretii, A. floribundum, A. lesbiacum, A. pinifolium, A. samariferum & A. virgatum.

(4) Separate of "Some New Alyssa from the Near East".

I. INTRODUCTION

A lucid systematic survey of the genus *Alyssum* has long been necessary, because it is not only by far the largest genus of *Cruciferae* in Turkey (87 species represented, of which 51 are endemic) - accounting for approximately 20% of the *Cruciferae* taxa in that area - but also because *Alyssum* has been the subject of a considerable amount of revisionary work (at least the perennial species of Sect. *Alyssum* and Sect. *Odontarrhena*) without attaining much consistency of treatment and taxonomic agreement. The very extensive, mostly unidentified, Near Eastern collections made within the past 20 years, primarily by Dr. P.H. Davis and his co-collectors and Dr. A. Huber-Morath have added to the necessity of a re-assessment of the morphological characters, evaluation of variation, and a more stable definition of specific and infra-specific taxa, all leading to a more natural classification and a more convenient method of field and herbarium identification.

Prior to the present study, the only practical procedure of identification was to painstakingly compare individual specimens with correctly determined herbarium material. This method was found to be a very dangerous practice because of the lack of taxonomic agreement between the identifiers or monographers due to differing interpretations and stress placed on the taxonomic characters of the same "raw" material, and /

and the fact that as much as 40% misidentification (in the author's view) exists in many herbaria. The lack of conformity or agreement resulting in extreme taxonomic confusion since the first major contribution to the taxonomy of Alyssum (De Candolle, Syst. Nat. 2, 1821), is pointedly exemplified by the taxonomic heirarchies of Baumgartner (1907 - with particular reference to A. montanum) and Nyárády (1926-1949 - Sect. Odontarrhena), which differ considerably from the systematic treatment proposed in the following study. Taxa such as A. montanum, A. sibiricum, A. tortuosum, A. murale, A. minus, A. minutum, A. alyssoides and A. linifolium have very wide geographical distributions and are subject to a considerable amount of morphological variation within and between populations. This variation is difficult to evaluate unless the whole range of variation throughout the entire specific distributions is subjected to careful analysis; otherwise, chaos results (cf. Nyárády, 1926-1949) from the segregation and recognition of minor uncorrelated variations.

The safest, clearest and most useful taxonomic treatment of any genus, or for that matter, any group of plants, can only be forthcoming from a careful examination of all the taxa in the distributional range of the genus. For this reason, in the following study those strictly European or Asiatic taxa (accounting for 35 species) which are most closely allied to the Turkish representatives, are keyed and enumerated. However, the study must be considered as primarily a systematic revision of the Turkish species.

It was found that in order to establish the limits of Alyssum as a genus, a subsidiary study had to be made of the limits and definition of /

of the other genera in the Tribe Alysseae. The results of this study are given on page 9 . Likewise, a synopsis of Aurinia, a key and an enumeration of the Turkish representatives of that genus had to be provided. This was necessary because one of the major relevant conclusions of the critical survey of the tribe was the resurrection of Aurinia as a genus distinct from Alyssum, to which Aurinia had long been subordinated as a section.

The Synopsis of the genus Alyssum contains a systematic listing (as far as possible in order of increasing complexity) under the appropriate infra-generic groups, i.e. sections, subsections and series, of the accepted species over the entire generic range. This synopsis should be of value for future workers to place correctly any new taxa in the appropriate natural group, and to determine to what groups the previously described taxa belong. In the synopses of Alyssum and Aurinia each species is followed in parenthesis by one or several capital letters which indicate the general geographical area in which these species are known to occur. These areas are: E - Europe (excluding the Balkan Peninsula); B - Balkan Peninsula (including the Aegean Islands and Crete); N - North Africa; T - Turkey (including Turkey-in-Europe); and O - the Orient (including Cyprus but excluding Anatolia).

As far as the geographical limits of this study are concerned, the entire political area known as Turkey (including Turkey-in-Europe) as defined in Duran's Büyük Atlas (corrected and emmended edition, Istanbul:1962) is followed; likewise, the place names in this Atlas are given whenever possible and necessary. The European and extra-Turkish /

Turkish Asiatic boundaries and place names are used as given in The Times Atlas of the World, 2, 1959; 4, 1956. Upon occasion the names of the Roman Provinces in Turkey have been used as detailed by Davis (1953). In addition to all the islands included in Rechinger's "O" district of the Aegean (cf. Flora Aegaea, 1943), Imbros, Tenederos, Rhodos, Chalki and Alimnia are considered in the treatment of Turkish taxa.

In the systematic revision (p. 272) the nomenclature, taxonomy and specimen citations of each taxa are dealt with in detail. This revision is largely based on material available in the herbaria listed in Sections I and IV, in conjunction with very recent collections made in Turkey in 1962. Any additional data garnered from field data and cultivation experiments which pertains to the taxonomy and biology of the taxa is also included. Most of the 130 species of Alyssum and Aurinia in this study are accompanied by discussions of synonymy, systematics and variation, when necessary. These discussions have been omitted when they were considered unnecessary and superfluous to the present studies.

Distribution maps are provided for most of the Turkish taxa (in the Appendix). In the construction of these maps, the author departed slightly from the usual procedure of denoting specific or infra-specific distributions. Rather than using the various symbols (square, triangles or circles) to indicate distributional spread, the first letter or rarely the first two letters of the specific or infra-specific epithet were used. For example, on Map 2, the "C" refers to the /

the first letter of subsp. cyclocarpa of Aurinia saxatilis. Illustrations are provided for the major types of hairs from the least to the most complex and specialized. Similar illustrations are also furnished for the petal and filament types, and for the fruit, pedicel and style types. These figures (1A, 1B and 2) as well as a floral diagram, and side and lateral views of a representative Alyssum flower (Fig. 3) are to be found in Section VII, part 4. All the new species described, except A. corningii, are illustrated with figures in the Appendix.

The following study attempts to combine the best information from the earlier workers, and the present knowledge of morphological variation in conjunction with patterns of geographical distribution and replacement. When the systematic treatment of Sect. Alyssum and Sect. Odontarrhena (as well as the other sections) in the following study is compared with those of Baumgartner (1907-1911) and Nyárády (1926-1949), the classification proposed here should be found the most natural and workable for the collections now available.

Of the 128 species of Alyssum keyed and enumerated, 87 are found in Turkey. Forty-nine of these are endemic to Turkey, and 10 are new to science.

Collecting in Turkey, 1962

For two months in 1962 (May-June) the author had the opportunity to travel in Turkey under the auspices of a collecting expedition organised by Dr. P.H. Davis, University Department of Botany, Edinburgh. Apart from making a general collection (c. 1800 numbers, including 26 live collections) in Turkey-in-Europe, the Mediterranean and Irano-Turanian vegetational regions in Asiatic Turkey, approximately 160 collections were made from populations of Alyssum. The study of these populations was extremely valuable to the following study, not only for extending the distribution ranges of many species (of the 10 new species described in the following text, 4 were collected), but also in permitting an insight into the morphological variation among plants within contained populations and between separated populations. Of particular interest was the intensive study and collections in populations of Alyssum minus and A. strigosum, which have previously been usually treated together as "A. campestre". It was discovered unquestionably that these species are indeed very distinct with no intermediates occurring. The notes made in many populations of Alyssum referring to ecology and associated species supplement considerably our pre-existing knowledge of them. The methods of fruit dehiscence and seed dispersal were also observed for a number of species.

For two weeks at the beginning of the expedition the author was accompanied by Dr. Huber-Morath of Basel, Switzerland, whose extensive knowledge of the Anatolian Flora was invaluable to the author who was familiar with very few of the representative species, except Alyssum. The itinerary of this trip is shortly to be published.

ACKNOWLEDGMENTS

Without the co-operation of the Directors of numerous herbaria, clarification of the taxonomic confusion within the genus *Alyssum* or the definitive typification of taxa could not have been attempted. From the following herbaria approximately 1,500 type and additional specimens were borrowed: British Museum (Natural History) London; Herbarium, Royal Botanic Gardens, Kew; Hartley Botanical Laboratories, University of Liverpool; Rijsherbarium, Leiden; Muséum National d'Histoire Naturelle, Paris; Universitetes Botanisske Museum, Bergen (Afghanistan collections of *Wendelbo*); Instituto Antonio José Cavanilles, Madrid; Conservatoire et Jardin Botanique, Geneva (Delessert Herbarium - G, Herbarium of Barbey-Boissier - G-BB, Edmund Boissier Herbarium - G-B and B.V.D. Post Herbarium - G-Post); Botanischer Garten und Museum der Universität, Zurich (Anatolian collections of *Markgraf*); the private collection of Dr. A. Huber-Morath, Basel; Botanische Abteilung der Würtenbergeschen Naturaliensammlung, Stuttgart (Anatolian collections of *Kühne*); Naturhistorisches Museum, Vienna (General Herbarium including the private collection of Rechinger - W, Hálacsy Herbarium - W-Hal.); Botanisches Institut und Botanischer Garten der Universität, Vienna; Institut fur Spezille Botanik und Herbarium Haussknecht, Jena; Slovenské Múzeum, Bratislava; Botanical Department of the Natural Museum, Prague Institutum Botanicum Universitatis Carolinae, Prague; Komarov Botanical Institute of the Academy of Sciences, Leningrad; Botanical Institute of the Academy of Sciences of the Ukrainian S.S.R., Kiew; Department of Botany, Hebrew University, Jerusalem; and the Gray Herbarium and Arnold Arboretum of /

of Harvard University, Cambridge (Massachusetts).

Acknowledgment is also due to the Botanischer Museum, Berlin-Dahlem for sending photographs of important specimens in the Willdenow Herbarium; likewise, to the Institute Antionio José Cavanilles, Madrid for sending a photograph of a Pau type collected in Mesopotamia.

When individual important collections are separated in various herbaria, for example the Edmund Boissier Herbarium in Geneva (G-B), the abbreviations given above for these collections are cited in the enumeration of taxa when necessary. This should allow future workers to locate with ease the specimens referred to.

Special thanks are extended to Dr. J.E. Dandy of the British Museum, Natural History, London; to Professor M. Geiger-Huber of the Botanischer Institut der Universität, Basel; and to Mr. B.L. Burtt, Royal Botanic Garden, Edinburgh for their assistance regarding the typification of the binomial A. minus, and the dropping from usage, "A. campestre". Acknowledgment is necessary to Miss R. Smith for her execution of Figures 3, 4, 5, 6 and to Mrs. A. Dyer for Figures 1A, 1B and 2. To Mrs. E.C. Dudley, my wife, the author owes a very special gratitude not only for her drawing of Tables 4, 6, 7, and Figures 7, 8 but also for her continual encouragement. Thanks are due Miss Morag MacKenzie for her typing of the entire manuscript, and for the organization of Table 3.

The author gives sincere recognition to Dr. A. Huber-Morath, Basel and to Dr. J. Cullen of the University Department of Botany, Edinburgh for their useful suggestions and criticisms. For his careful and constant attention and advice during the preparation of this manuscript, the author is indebted to his supervisor, Dr. P.H. Davis of the University Department of Botany, Edinburgh.

II. KEY and SYNOPSIS of PROPOSED RE-ORGANIZATION of the TRIBUS ALYSSEAE

Tribus Alysseae Hayek, Fl. Steierm., 1, 194, 242 & 506 (1909); Hayek in Beih. Bot. Centralbl., 27, 220-254 (1911); Schulz in Nat. Pflanzenfam., 17b, 268, 280 & 486 (1936); Janchen in Öst. Bot. Zeit., 91, 19-28 (1942).

Syn.: Tribus Alyssineae DC., Syst. Nat., 2, 147 & 280 (1821), pro parte.

Tribus Alysseae Subtribus Alyssinae Hayek., Fl. Steierm., 1, 242 & 506 (1909).

(1) KEY to the OLD WORLD GENERA

1. Flowers solitary in the axils of cauline leaves — 1. Buchingera
1. Flowers in more or less ebracteate racemes
  2. Stigma lobes spreading
    3. Ovary 10-40-ovulate; hairs bifid; seeds broadly winged — 2. Farsetia
    3. Ovary 5-8-ovulate; hairs stellate; seeds wingless or with narrow wing
      4. Sepals deciduous; seeds narrowly winged — 3. Strausiella
      4. Sepals persistent; seeds wingless — 4. Clastopus
  2. Stigma lobes closely adpressed
    5. Sepals strongly saccate
      6. Silicules strongly inflated, ± globose

7. /

7. Silicule valves soft; plant very canescent

8. Silicules c. 20 mm. diam.; sepals deciduous

5. Physoptychis

8. Silicules 10-12 mm. diam.; sepals persistent

6. Degenia

7. Silicule valves stiff; plants greenish or slightly canescent 7. Alyssoides

6. Silicules compressed

9. Petals yellow or purple; indumentum harsh, asperous; rosette and cauline leaves all linear-oblanceolate, often repand-dentate 8. Fibigia

9. Petals white; indumentum soft, not asperous; rosette leaves broadly spathulate, cauline leaves linear-oblong, all entire 9. Hormathophylla

5. Sepals not saccate

10. Bifid hairs present; stellate hairs present or absent

11. Petals bifid; stellate and medifixed hairs both present 12. Berteroa

11. Petals entire; all hairs medifixed (few hairs 4-fid)

12. Filaments untoothed; 2 nectaries, 1 long and 1 short at each side of short filament

10. Lobularia

12. Filaments with a basal tooth; 1 nectary at each /

each side of short filaments

11. Bornmuellera

10. Bifid hairs absent (furcate stellate hairs occasionally present)

13. Silicules indehiscent, winged or covered with barbulate hairs; always annuals 15. Clypeola

13. Silicules dehiscent, or if indehiscent then plants perennial; silicules never winged in annual species; barbulate hairs absent

14. Lower cauline and sterile shoot leaves often repand-dentate, (20-) 40-60 (-100) mm. long, bases swollen and persistent on ± indurated stock; calyx cup-shaped, buds spherical

13. Aurinia

14. Lower cauline and sterile shoot leaves entire (2-) 5-15 (-20) mm. long, bases never swollen or persistent; calyx not cup-shaped, buds elongate, ± oblong 14. Alyssum

(2) Enumeration of Genera

1. Buchingera Boiss. & Hohen., Diagn., 2 (8), 29 (1849).
Type species: B. axillaris Boiss. (monotypic).
Distribution: Iran, Caucasus & Russian Armenia.

2. Farsetia Turra, Diss. Farsetia, 1, t.1 (1765).
Type species: F. aegyptiaca Turra. (12 species as recognized by /

by Schulz, op. cit., 486).

Distribution: A predominantly Saharo-Sindian genus extending from the Sahara to N.W. India.

3. Strausiella Hausskn. in Mitt. Thür. Bot. Ver., n.f., 11, 69 (1897).

Type species: S. purpurea (Bunge) Hausskn. (monotypic).

Distribution: Iran.

4. Clastopus Bunge & Boiss., in Boiss., Fl. Or., 1, 261 (1867).

Type species: C. vestitus (Desv.) Boiss. (2 species as recognised by Schulz, op. cit., 487).

Distribution: Iran.

5. Physoptychis Boiss., Fl. Or., 1, 160 (1867).

Type species: P. gnaphalodes (DC.) Boiss. (2 species as recognized by Schulz, op cit., 488).

Distribution: N. & W. Iran, Russian Armenia & Turkey.

6. Degenia Hayek in Öst. Bot. Zeit., 60, 93 (1910).

Type species: D. velebitica (Degen) Hayek (monotypic).

Distribution: Yugoslavia.

7. Alyssoides Miller, Gard. Dict. Abr., ed. 4 (1754).

Syn.: Vesicaria Adans., Fam. des Pl., 2, 419 (1763).

Cistocarpium Spach, Hist Nat. Vég. Phan., 6, 471 (1838).

Aurinia Sect. Leptoceratium Griseb., Spic. Fl. Rum. & Bith., 1, 271 (1843). (lectotype: Au. sinuata (Alyssum sinuatum L.)).

Cystocarpum Spach emend. Hook. in Benth. & Hook., Gen. Pl. /

Fl., _1_, 73 (1862).

Alyssum Sect. _Scleroptychis_ Boiss., Fl. Or., _1_, 266 (1867).

Lutzia Gand. in Bull. Soc. Bot. Fr., _67_, vii (1920).

Alyssum Sect. _Chrysites_ Schulz in Engl. Bot. Jahrb., _66_ (1), 94 (1933).

Type species: _Alyssoides utriculatum_ (L.) Medik. (_Alyssum vesicaria_ L.). This genus has been expanded to include _Alyssoides creticum_ (L.) Medik. (type of _Alyssum_ Sect. _Scleroptychis_ & _Lutzia_); _Alyssoides sinuatum_ (L.) Medik. (type of _Alyssum_ Sect. _Chrysites_); _Alyssoides macrocarpum_ (DC.) _ined._ (_Alyssum macrocarpum_).

Distribution: S.W. Alps, Balkans & Turkey.

8. _Fibigia_ Medik., Pflanzengatt., _1_, 90, t. 23 (1792).

Syn.: _Farsetia_ Sect. _Fibigia_ (Medik.) DC., Syst. Nat., _2_, 288 (1821).

Type species: _F. clypeata_ (L.) Medik. (12 species as recognized by Schulz, _op. cit._, 489).

Distribution: S. Europe & Levant to Iran and Transcaspian.

9. _Hormathophylla_ Cullen & Dudley, _gen. nov._

Affinis _Fibigia_ Medik. sed petalis albis, foliis dimorphicis maioribus rosulatis latis spathulatis, indumento molli, siliculis minoribus differt.

Plantae perennes, fruticosae vel suffruticosae vel saltem ad basi induratae, caudicibus (vel ramis) crassis lignosis tortuosis /

tortuosis cicatricosis, in partibus inferioribus denudatis, indumento albo obtectis. Surculi steriles numerosi conferti. Folia caulina inferiora et omnia folia caulium sterilium rosulata conferta, ovato-spathulata, integra, ± obtusa vel truncata, 20-60 mm. longa (cum petiolo) (5-) 7-30 mm. lata, petiolis longis (5-30 mm. longis) munita, in petiolum abrupte constrictum, nervo mediano prominulo provisa, pilis stellatis mollibus argenteo-albis denso obtecta. Caules floriferi erecti vel laxi, parce foliati. Folia caulina superiora lineari-oblanceolata, basi sensim attenuata, ± acuta. Racemi contracti, subcorymbosi. Sepala lateralia saccata. Petala alba, obovata et integra vel spathulata et bifida. Filamenta omnia bilateraliter alata, basi dilatata saepe breviter dentata. Siliculae glabrae vel glabrescentes, rhomboideo-rotundae, 4-10 mm. longae, 4-7 mm. latae, loculis 2-4 ovulatis, valvis compressis valde reticulato-nervosis. Semina alata.

e/ Type: H. reverchonii (Degen & Herv.) Cullen & Dudley, comb. nov. (type of Ptilotrichum (Alyssum) reverchonii Degen & Herv. in Mag. Bot. Lap., 5, 2 (1906) & in Bull. Acad. Int. Géogr. Bot., 16, 224: 1906). "Hab. in Hispaniae meridionalis provincia Jaën. In saxosis calcareis vallem Barrancon de Valentina imminentibus alt. c. 1800 m.s.m. Julio 1904 fructiferum detexit dein a 1905 in paeruptis calcarsis montia Sierra de la Cabrilla alt. c. 2500 m.s.m. iterum legit cel. Elisaeus Reverchon (Exsicc. 1904 et 1905, No. 1365) cui species nova dicata." /

dicata." (orig. ? n.v., authentic specimens, 1906 & 1907 MA, K,E).

The genus includes: H. pyrenaica (Lap.) Cullen & Dudley, comb. nov.; H. longicaule (Boiss.) Cullen & Dudley, comb. nov.; H. cadevallianum (Pau) ined. (no material seen); H. spathulata (Steph. ex Willd.) Cullen & Dudley, comb. nov., (type of Berteroa spathulata (Steph. ex Willd.) Meyer.)

Distribution: Spain & Altai.

10. Lobularia Desv., Journ. Bot. Appl., 3, 162 (1814), nomen conserv.

Syn.: Konig Adans., Fam. des Pl., 2, 420 (1763), nomen reject.

Alyssum Sect. Lobularia (Desv.) DC., Syst. Nat., 2, 318 (1821).

Koniga R. Br., Obs. Pl. Denh. & Clap., App., 214 (1826).

Glyce Lindl., Synops. Brit. Fl. 26 (1828).

Octadenia R. Br. ex Fisch. & Meyer., Ind. Sem. Hort. Petrop., 3, 41 (1836).

Type Species: L. maritima (L.) Desv. (type of all synonyms). (At least two species following Schulz, op. cit., 494.).

Distribution: W. & E. Mediterranean from the Atlantic Islands and N. Africa to Syria.

11. Bornmuellera Hausskn. in Mitt. Thür. Bot. Ver., n.f., 11, 70 (1897).

Type species: B. tymphaea Hausskn. This genus has been expanded to include B. baldaccii (Degen) Heywood ined., (Ptilotrichum baldaccii Degen); B. dieckii (Hayek) Degen; B. cappadocica (DC.) Cullen & Dudley, comb. nov. (Iberis cappadocicum DC. & Ptilotrichum cappadocicum (DC.) Boiss.); B. glabrescens (Boiss. & Bal.) Cullen & Dudley, comb. nov. (Ptilotrichum glabrenscens (Boiss. & Bal.) Boiss.); B. /

B. draboides (Rech. fil.) Cullen & Dudley, comb.nov., (Ptilotrichum draboides Rech. fil.).

Distribution: Greece, Albania & Turkey.

12. Berteroa DC., Syst. Nat., 2, 290 (1821).

Type species: B. incana (L.) DC. (6 species as recognized by Schulz, op. cit., 495, but excluding B. spathulata Steph. ex Willd. which is to be transfered to Hormathophylla, gen. nov.).

Distribution: Widely distributed from Europe to central Asia.

13. Aurinia Desv. in Journ. Bot. Appl., 3, 162 (1814). (cf. Synopsis of the genus Aurinia, page 167).

Type species: Au. saxatilis (L.) Desv. (Alyssum saxatile L.). Originally treated as a section of Alyssum, but better regarded as a separate genus. The genus Lepidotrichum is included here.

Distribution: S. France, Italy, Balkans & Turkey.

14. Alyssum L., Gen. Pl., ed. 5, 293 (1754). (cf. Synopsis of genus Alyssum, page 181).

Lectotype species: A. montanum L. About 160 species, including A. canescens DC. (lectotype of Ptilotrichum Meyer); A. dasycarpum Steph. ex Willd. (type of Psilonema Meyer); A. tortuosum Willd. (lectotype of Odontarrhena Meyer); A. linifolium Steph. ex Willd. (type of Meniocus Desv.); A. lepidoto-stellatum (lectotype of Gamosepalum Hausskn. & Bornm.); A. spinosum L. (lectotype of Alyssum Sect. Tetradenia (Spach) Dudley; A. pinifolium (Nyár.) Dudley (type of Triplopetalum /

Triplopetalum Nyár. Six sections are to be recognized in Alyssum: Meniocus, Psilonema, Alyssum, Gamosepalum, Tetradenia & Odontarrhena.

Distribution: Widespread European and Asiatic genus, mostly S. of 50 degrees latitude.

15. Clypeola L., Gen. Pl., ed. 5, 293 (1754).

Type species C. jonthlaspi L. (8 species as recognized by Schulz, op. cit., 497).

Distribution: Africa, E. Europe, Turkey, Caucasus, Iran & extending into central Asia.

16. Athysanthus Greene in Bull. Calif. Acad., ser. 3, 1, 72 (1885).

Type species: A. pusillus (Hook.) Greene (monotypic).

Distribution: N. America. (not seen).

(3) Discussion

It became evident at the beginning of the following study of the genus Alyssum that the limits and definition of the other genera Tribus Alysseae as recognized by Schulz must be subjected to a more careful examination. This was particularly true of Ptilotrichum Meyer, to which past and present workers have added numerous taxa which have progressively widened the limits of the genus to such an extent that all its distinguishing characters are shared separately or in combinations with several other genera. These include Alyssum, Alyssoides, Aurinia, Hormathophylla (gen. nov.) and Bornmuellera, into which all the species at one time or another included in Ptilotrichum have now been transferred. (see Table No. 2).

Furthermore /

Furthermore, careful examination of the type specimens of Alyssum canescens and Alyssum elongatum (A. tenuifolium Willd.) in Geneva (herb. De Candolle) which served as the basis of the genus Ptilotrichum are in all characters clearly correlated with and to be included in Alyssum L. Meyer distinguished the genus by the presence of a single seed per locule, unappendaged filaments, and white flowers. The presence of a single seed in each locule of the fruit is by no means consistent and does not serve to distinguish Ptilotrichum from Alyssum. In both Ptilotrichum and Alyssum Sect. Alyssum 2 ovules are always present in each locule, and the feature of only one developing into a mature seed also appears in Sect. Alyssum. The character used by Schulz to distinguish Ptilotrichum in his key- the untoothed nature of the filaments - is similarly shared by Alyssum Sect. Psilonema & Sect. Tetradenia. However, examination of Ptilotrichum sensu orig. (also Pt. purpureum (Lag. & Rodr.) Boiss.) has shown that the wings of the filaments, particularly those of the short filaments, are significantly dilated towards the base and a small tooth frequently develops from this basal dilation. Flower colour is often an unreliable generic character in the Cruciferae. Pale or white, or even pink coloured flowers not only occur in Ptilotrichum sensu stricto but also in Alyssum Sect. Alyssum, Sect. Gamosepalum, and Sect. Tetradenia.

The advisibility of recognizing Aurinia as a distinct genus from Alyssum has long been a matter of opinion. It is notable that Kotov in Fl. Ukraine, 5, 329 (1953) follows the view maintained here. /

here. Unquestionably the regularity of the habit, the form and size of the leaves, the persistent leaf bases, and the form of the calyx of all the component species of _Aurinia_ enable it to be feasibly and easily distinguished from all the sections of _Alyssum_. The other alternative, that of maintaining _Aurinia_ as a section of _Alyssum_, is certainly less appealing than the former since it involves a widening of the generic limits of _Alyssum_ until it becomes nearly as heterogeneous as the ill-defined _Ptilotrichum sensu lat._! Any present affinities of _Aurinia_ with _Alyssum_ are tenuous, and no taxon in _Alyssum_ shows the resemblance of facies which holds the species of _Aurinia_ together; there is some resemblance between _Aurinia uechtritziana_ and _Berteroa_. The overlap between _Alyssum_ Sect. _Meniocus_ and _Aurinia_ in the number of ovules per locule is not significant, in that this feature is not associated with any of the other correlated characters which define _Aurinia_. The best argument for maintaining _Aurinia_ as a separate genus distinct from _Alyssum_ is that it may be easily separated and identified using the diagnostic leaf and facies and calyx characters.

The transferring of _Lepidotrichum_, which has previously been considered as a monotypic genus, to the genus _Aurinia_ may be unpopular. Reference to Table No. 3 will show that on the grounds of the characters used, there appears to be no basis in maintaining _Lepidotrichum_ as a distinct genus. The correlation of the distinctive habit, the form and size of the basal leaves, and the form of the calyx is especially convincing when all the representatives /

representatives of _Aurinia_ are compared side by side. The inflated and globose silicule is not unique to _Lepidotrichum_, but is also present in _Aurinia petraea_ and _Au. corymbosa_. White flowers are likewise present in _Au. ruprestris_.

The characters of _Meniocus_, retained here as a section of _Alyssum_, are less clearly defined than those which distinguish _Aurinia_ and _Alyssum_. The distinctly marginal placentation and 2-8 ovules per locule are characteristic of all representatives of _Meniocus_ and serve to maintain it as a natural section. There are no definite correlations of vegetative or floral attributes or overall resemblances which may be used to define _Meniocus_ as a distinct genus, as is the case with _Aurinia_ and _Hormathophylla_, _gen. nov._, or which ally _Meniocus_ to any genus of the tribe other than _Alyssum_. _Meniocus_ shares in common many characters with _Alyssum_ Sect. _Psilonema_ and Sect. _Alyssum_, to which it is most closely allied. _Meniocus_ cannot be justifiably separated as a genus from the remaining sections of _Alyssum_.

The expansion of _Alyssoides_ (_Vesicaria_) from one to four species is a departure from previously accepted interpretations of this genus. However, the obviously saccate sepals, the large inflated silicules with 4-8 ovules per locule, and the usually deciduous style of all the species to be included in _Alyssoides_ are unifying characters which are not to be found correlated in _Alyssum_. The removal of _Alyssum creticum_, _A. sinuatum_ and _A. macrocarpum_ not only allows _Alyssum_ to be defined with fewer exceptions to the general patterns /

patterns of variation but their inclusion in Alyssoides also permits a more convincing recognition of this genus as a natural group. The presence of simple and medifixed hairs, which has been used to distinguish Alyssoides from Alyssum, was found to have no correlation with the other characters which hold the species of Alyssoides together. It is to be remarked that the habit of all the species of Alyssoides is remarkably similar, and that the formation of the leafy rosettes at the base of the plant or along the stems is consistent. The view that Alyssum creticum and sinuatum should be included as species of Alyssoides is not a new one, for in fact Medikus (Philosophische Botanik, 1, 189: 1789) made the transfers. Lamarck (Ency. Meth., 8, 770: 1808) likewise considered these two species distinct from Alyssum, but included them as species of Vesicaria, a later synonym of Alyssoides. (see note p.26)

Another important feature of this proposed re-organisation is the recognition of a new genus, namely Hormathophylla with the rare and beautiful chasmophyte H. reverchonii (formerly Ptilotrichum (Alyssum) reverchonii Degen & Herv.) serving as the type. It is clear from the following Tables No. 3 and 4 that the affinities of this genus are not with Alyssum or Ptilotrichum (no longer recognised as a distinct genus), but rather with Fibigia and Degenia. Akin to the separation of Aurinia from Alyssum, the separation of Hormathophylla from the allied genera is dependent in large part on its distinctive habit, and the form and size of its leaves.

Berteroa spathulata (Willd.) Meyer has long been an anomaly. Willdenow /

Willdenow (1800) described it as an _Alyssum_; Meyer (1831) transferred it to _Berteroa_, a placement accepted by Schulz and others. More recently Nyárády (1929) considered it as a possible synonym of _Alyssum obovatum_ (Meyer) Turcz. However, in the Willdenow herbarium at Berlin, Nyárády indicated on the original material that this species was to be considered as a component of _Alyssum_ Sect. _Aurinia_, presumably by virtue of the bifid petals and edentate (_sic_) filaments. It cannot be denied that the distributional pattern of the genus is very disjunct, with all but one species (_H. spathulata_ from the Altai) occuring in Spain. This situation is not unique in the tribe; _Alyssum purpureum_ Lag. & Rodr. (_Alyssum_ Sect. _Alyssum_) from Spain most closely resembles _Alyssum canescens_ DC. & _Alyssum tenuifolium_ Willd., both of which are found in Siberia, the Altai and as far east as India.

The vegetative characters, i.e. long petiolate, spathulate and rosulate leaves and the habit of the plants which unite _Berteroa spathulata_ to _Hormathophylla_ are of higher diagnostic value than any floral or fruit characters. The diagnostic vegetative characters used to recognize _Hormathophylla_ and _Aurinia_ show a great degree of constancy in the respective genera, and are of infinitely greater value than the floral parts, which for example do not enable separation of these two genera from one another, let alone from any of the other genera in the tribe. There is no reason, in such cases, why vegetative characters may not be used to delimit genera quite as well as characters of flower and fruit, and instead of the last two features if /

if these do not provide diagnostic characters. It is the end result that is important, i.e. the formulation of natural recognizable groups (genera in this case), composed of taxa which show definite affinities. Towards the accomplishment of this end vegetative characters often present evidence which may be as important or in some cases more important than the floral morphology. The limits of any group cannot be established by individual dissimiliar characters, but are formulated by the constancy and correlation of combinations of characters which ultimately results in overall resemblances, either in the vegetative or sexual organs.

In an attempt to use Schulz's key to the tribes, p. 268, it was found that the character of "Haare einfach oder fehlend" for the Lunarieae and "Haare verzweigt" for the Alysseae was not only unsuitable, but in fact was not true. Examination of several species of Peltaria and Ricotia revealed that medifixed hairs were definitely present, although very sparse. It was found that medifixed hairs were also present on Leptoplax. Several species of Alyssum Sect. Meniocus are unique in Alyssum by possessing simple setae on the silicules. The removal of Leptoplax from the Alysseae to the Lunarieae is supportable on the basis of general resemblances including facies. It must be stressed that the hair character alone does not distinguish these two tribes from one another, and it is imperative to utilize other characters associated with facies and resemblances, and perhaps the positioning of the cells of the replum (often absent or very poorly developed in some genera of the Lunarieae). However, we are not prepared to propose a re-organization of the Lunarieae or any other tribe at the present time.

Both Hayek in Beih. Bot. Centralb., 27, 220-254 (1911) and Janchen in Öst. Bot. Zeit., 91, 19-28 (1942) have organized the Cruciferae into a tribal and subtribal classification which differs considerably from that of Schulz. Whereas Schulz recognizes no subtribes in the Alysseae, Hayek has six, namely the Hesperidinae, Brayinae, Euclidiinae, Lunariinae, Alyssinae, and Drabinae. The only generic difference of note between Hayek's Subtribus Alyssinae and Schulz's Tribus Alysseae is that Hayek includes Farsetia as a member of the Subtribus Lunariinae, rather than Subtribus Alyssinae. Janchen's Tribus Alysseae comprises only three subtribes, the Lunariinae, Alyssinae, and Drabinae. Following Schulz however, he maintains Leptoplax in the Subtribus Alyssinae, rather than in the Lunariinae where it correctly belongs.

Much of this axillary study of the generic limits must be understood to be provisional, until such time as additional material may be examined and ontogenetic evidence pertaining to the floral parts, and possibly indumentum, may be gathered. There is, however, no question that Ptilotrichum as a genus must be reduced to synonomy under Alyssum Sect. Alyssum, and that its component species be dispersed into the other genera in the manner indicated in Table No. 2 and in the preceeding synopsis. The provisional re-organisation presented here is an attempt to bring order out of chaos, to present more natural and recognizable groups which are closely correlated by virtue of overall resemblances and continuity of facies. It is not claimed that these proposals are entirely correct, but for the purposes /

purposes of the visual recognition of the genera by the species, and the tribe by the genera this re-organization is certainly preferable to the pre-existing order. I would like to acknowledge that without the effort, thought, and time expended by J. Cullen, the proposed re-organization would not have materialized.

Table No. 1 shows a comparison of the taxa considered by Schulz in the Tribus Alysseae, and those of the suggested re-organization. It is important to recognize that the altered genera were extremely heterogeneous as defined by Schulz, and whereas great stress was placed on the characters of flower colour, filament structure and hair types, little attention was paid to overall resemblances and the correlation of characters.

Table No. 3 tabulates the characters used in this re-organization in one to three states for each taxon concerned. By following the states of the characters vertically the similarities or deviations may be picked out, a plus mark indicating the presence of a state. For example, for Alyssum creticum, character no. 2 is in the "b" state, that is petals bifid, and by following down vertically it is observed that state "b" of this character occurs in all the four species to be regarded as Alyssoides. Where several states of a character are present in a taxon, a plus mark is used for them all. For example, in Alyssum Sect. Psilonema, character no. 1 is present in "a, b, and c" states. The arrow from one state to another is used to show a trend, but not a constant appearance. For example, in Alyssum Subsect. Odontarrhena (Sect. Odontarrhena) character no. 9 /

no. 9 is predominantly in state "b", plants perennial. However, a few species of the subsection are biennials.

Table No. 4 (after Cullen) illustrates in pictorialized form some generic affinities. The point stressed in this table is that natural groups of species are dependent on similarities and overall correlations of characters, not on dissimilarities of individual characters. The blank portions of the table are of equal value in the correlations as the blocked portions.

NOTE. All the taxa to be included in the widened interpretation of of *Alyssoides* have stipitate fruits. This character may be used to distinguish this genus from *Degenia*, *Physoptychis* and *Fibigia*. However, the silicules of most representatives of *Hormathophylla* are also furnished with a short stipe, and though the fruits of most *Alyssa* are estipitate, those of a couple of Anatolian species in Sect. *Odontarrhena*, *A. haussknechtii* and *A. discolor*, have more or less prominent stipes.

(4).

Table 1. COMPARISON OF THE DIFFERENCES BETWEEN SCHULZ'S TREATMENT OF THE TRIBUS ALYSSEAE IN NAT. PFLANZENFAM., 17b, 486-497 (1936), AND THE PROPOSED RE-ORGANIZATION.

Schulz	Provisional Re-organization
Farsetia	unchanged
Strausiella	unchanged
Clastopus	unchanged
Vesicaria	= Alyssoides, gen. conserv.
Physoptychis	unchanged
Degenia	unchanged
Fibigia	unchanged
Alyssum Sect. Chrysites	into Alyssoides
Alyssum Sect. Aurinia	= Aurinia
Alyssum Sect. Scleroptychis	into Alyssoides
Alyssum Sect. Eualyssum	= Alyssum Sect. Alyssum
Alyssum Sect. Psilonema	unchanged
Alyssum Sect. Odontarrhena	unchanged
Alyssum Sect. Meniocus	unchanged
Triplopetalum	into Alyssum
Ptilotrichum, senso lat.	
Pt. canescens (lectotype of Ptilotrichum Meyer, & Pt. purpureum	into Alyssum Sect. Alyssum
Pt. glabrescens, Pt. baldaccii & Pt. cappadocicum	into Bornmuellera
Pt. cyclocarpum	into Aurinia
Pt. reverchonii & Pt. longicaule	into Hormathophylla
Pt. spinosum	into Alyssum Sect. Tetradenia

Bornmuellera	unchanged, but with several species added from Ptilotrichum senso lat.
Gamosepalum	= Alyssum Sect. Gamosepalum
Lobularia	unchanged
Berteroa	unchanged, except. B. spathulata removed to Hormathophylla
Lepidotrichum	into Aurinia
Buchingera	unchanged
Leptoplax	removed to the tribe Lunarieae, where its closest affinities are with Peltaria.
Athysanthus	unchanged
Clypeola	unchanged

(5).

Table 2. PROPOSED TRANSFERS OF SPECIES DESCRIBED IN PTILOTRICHUM

Ptilotrichum	Proposed Transfers*
Pt. canescens (DC.) Meyer (1831)	Alyssum Sect. Alyssum
Pt. elongatum (DC.) Meyer (1831)	Alyssum Sect. Alyssum (A. tenuifolium Willd.)
Pt. longicaule Boiss. (1838)	Hormathophylla gen. nov.
Pt. purpureum (Lag. & Rodr.) Boiss. (1839)	Alyssum Sect. Alyssum
Pt. spinosum (L.) Boiss. (1839)	Alyssum Sect. Tetradenia
Pt. cyclocarpum Boiss. (1842)	Aurinia
Pt. emarginatum Boiss. (1842)	Leptoplax
Pt. cretaceum (Adams) Ledeb. (1842)	Hormathophylla gen. nov. (H. spathulata (Steph. ex Willd.) ined.
Pt. cappadocicum (DC.) Boiss. (1867)	Bornmuellera
Pt. glabrescens Boiss. (1867)	Bornmuellera
Pt. rupestre (Ten.) Boiss. (1867)	Aurinia
Pt. saxigenum Jord. & Fourr.	Alyssoides (Al. macrocarpum (DC.) ined.
Pt. candolleanum Jord & Fourr. (1868)	Alyssoides (Al. macrocarpum (DC.) ined.
Pt. peyrousianum Willk. (1880)	Alyssum Sect. Tetradenia (A. lapeyrousianum Jord.)
Pt. pyrenaicum (Lap.) Willk. (1880)	Hormathophylla gen nov.
Pt. (Koniga) uechtrizianum Bornm. (1888)	Aurinia
Pt. baldaccii Degen (1896)	Bornmuellera
Pt. lapyerousianum (Jord.) Jord. (1906)	Alyssum Sect. Tetradenia
Pt. (Alyssum) reverchonii Degen & Herv. (1906)	Hormathophylla gen. nov.
Pt. dieckii Hayek (1925)	Bornmuellera

Pt. /

Pt. angustifolium Hausskn. ex Bornm. (1936)	Bornmuellera (? B. cappadocica (DC.) ined.)
Pt. thymops Huber-Morath & Reese (1943)	Alyssum Sect. Gamosepalum
Pt. draboides Rech. fil (1951)	Bornmuellera
Pt. cadevallianum (Pau) Heywood (1962) (No material seen)	Hormathophylla gen. nov.

* Where the taxa described in Ptilotrichum are regarded as synonyms, the valid binomials are placed beneath the proposed transfers. The proposed recombinations may be found in the Synopsis of the Tribus Alysseae under their respective genera, and in the Synopses of Alyssum and Aurinia, where applicable.

(6)

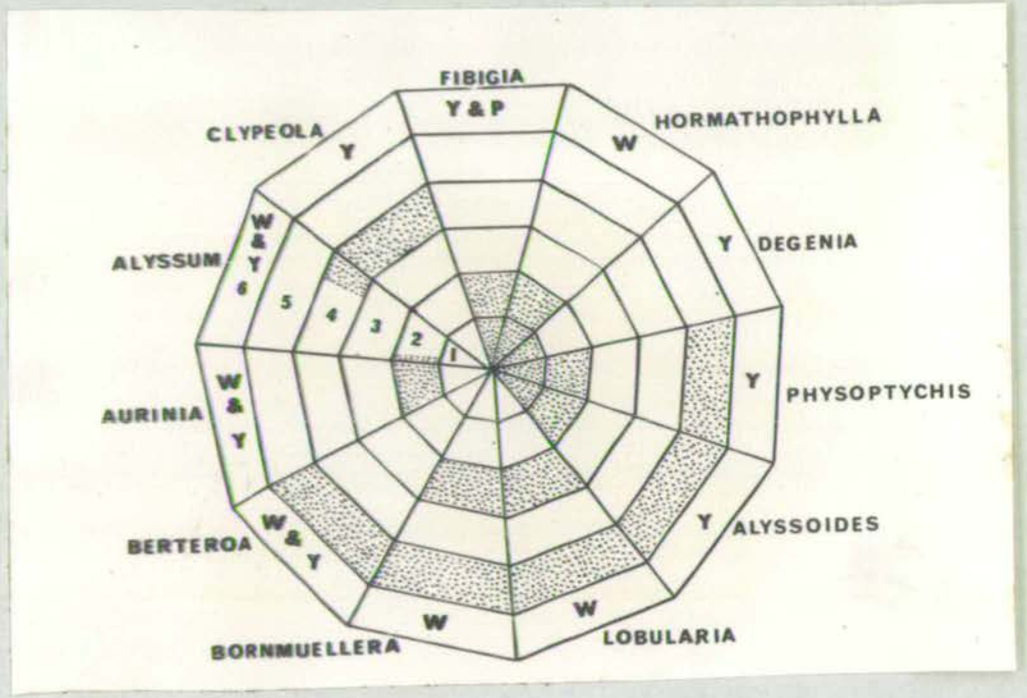
Table 3. TABULATION OF CHARACTERS UTILIZED FOR THE TAXA INVOLVED IN THE RE-ORGANIZATION

List of Characters

	a	b	c
1. Petals	entire	bifid	emarginate
2. Petals	white	yellow	purple
3. Sepals	saccate	not saccate	-
4. Silicules	inflated	subinflated	compressed
5. Valves	=	≠	-
6. Silicules	less than 10 mm. diam.	more than 10 mm. diam.	-
7. Seeds	winged	wingless	-
8. Hairs	simple	bifid	stellate
9. Plants	annual	biennial	perennial
10. Silicules	dehiscent	indehiscent	-
11. Silicules	winged	wingless	-
12. Leaves	broadly spathulate	not	-
13. Pedicels	erect	horizontal	deflexed
14. No. of ovules per locule	-	-	-
15. Inflorescence	compound	simple	-

(7).

Table 4. (after Cullen): PICTORIAL ILLUSTRATION OF SOME GENERIC AFFINITIES



Circle 1: blocked: sepals saccate; blank: not saccate.

Circle 2: blocked: ovules more than 2 per locule; blank: 2 or less ovules per locule.

Circle 3: blocked: hairs always bifid; blank: some hairs stellate.

Circle 4: blocked: silicules indehiscent; blank: silicules dehiscent.

Circle 5: blocked: silicules greatly inflated; blank: silicules usually compressed.

Circle 6: Y: flowers yellow; W: flowers white; P: flowers purple.

III. EVALUATION OF PRIOR WORK

Before the detailed monographs of the perennial species of Sect. Alyssum (Baumgartner, 1907-1911) and of Sect. Odontarrhena (Nyárády, 1926-1949) were completed, several major accounts of Alyssum and attempts to provide an infra-generic classification had been produced: De Candolle (Systemae Naturae, 2, 1821); Fenzl in Tchihatcheff (Asie Mineure, Bot. 1 (3), 1860); Boissier (Flora Orientalis, 1, 1867); and Busch (in Flora Caucasica Critica, 3 (4), 1909).

The sectional classification of De Candolle (1821) was extremely artificial and was based on decidedly uncorrelated and weak criteria, i.e. staminal configuration and flower colour. The result of this was that Sect. Adyseton contains a scattering of representatives of Aurinia, Alyssum Sect. Odontarrhena, Sect. Psilonema and Sect. Alyssum; Sect. Anodontea includes species of Aurinia and Alyssum Sect. Psilonema; Sect. Lobularia contains a mixture of taxa from Aurinia, Lobularia, Alyssum Sect. Tetradenia and Sect. Alyssum (Ptilotrichum canescens and Pt. tenuifolium). Six species, among them three of Sect. Alyssum, were treated by De Candolle as "Species non satis notae". Further, he treated A. linifolium, the type species of Sect. Meniocus, as the sole component in the genus Meniocus, distinct from Alyssum. To preclude nomenclatural confusion, lectotypes have been chosen for the applicable De Candolle sections and are listed under the respective synonymy of the Synopsis Aurinia (p.167) and the Synopsis of Alyssum (p. 181).

Fenzl (1860) like De Candolle, treated A. linifolium (and two additional Anatolian species) as the distinct genus, Meniocus; but accepted Aurinia as a genus separate from De Candolle's sectional classification /

classification. Apart from that, Fenzl follows the sections as given by De Candolle, but of course including many Anatolian taxa not known to the latter worker. Fenzl reconstituted De Candolle's Sect. Odontostemon, where was originally based on Alyssum hyperboreum L. (Lesquerella), and referred to it two annual species of Sect. Alyssum and two perennials from Sect. Odontarrhena Subsect. Samarifera.

In drawing attention to many Anatolian taxa, Fenzl often established large and unmanageable aggregates, because of his very wide species concept. For example, his A. alpestre L. is interpreted very widely and contains six varieties whose components are not for the most part morphologically or geographically continuous. Fenzl's recombination of Boissier's A. minutiflorum as a variety of A. alpestre is entirely Anatolian and can now be referred to as a synonym of A. sibiricum; however, his A. alpestre var. obtusifolium from the Crimea, A. sibiricum from Anatolia, A. lanigerum and A. bracteatum from Persia, A. euboeum from Greece, and A. tortuosum from Eastern Europe and Central Asia. A. alpestre var. tortuosum, likewise, contains a mixture of A. tortuosum, A. obtusifolium (as A. sawranicum) and A. sibiricum. The other Fenzl varieties of A. alpestre, var. serpyllifolium, var. nebrodense and var. minutulum, are composed of gatherings of A. serpyllifolium from W. Europe and N. Africa, A. lanigerum and A. bracteatum from Persia, A. tortuosum from Caucasia and the Crimea, A. singarense from N. Iraq, A. nebrodense from S. Europe, A. sibiricum, A. pateri, A. syriacum, and A. condensatum from the Levant, A. robertianum from Corsica and A. alpestre sensu stricto from the Alpes.

In /

In spite of his very wide species concept, particularly with A. alpestre, Fenzl presented in an easily used form, the first enumeration of Turkish taxa.

Boissier (1867) was the first worker to utilize a natural sectional classification based on ovule number in conjunction with filament wings, teeth and appendages (see Synopsis of Alyssum p.181), in what amounts to a monograph of the Oriental taxa. Sections Meniocus, Psilonema, Alyssum (Eualyssum) and Odontarrhena are accepted in this study, but Sect. Aurinia and the monotypic Sect. Scleropychis (Alyssum creticum) are referred by the present author to genera distinct from Alyssum sensu stricto; the former as the genus Aurinia, the latter as part of Alyssoides.

Boissier's analysis of the oriental species of Alyssum, which has served in large measure as the guide for the following study, is for the most part excellent and easily used. Several drawbacks need to be indicated, however, apart from the errors due to the lack of sufficient material. Though Boissier recognized many more species in Sect. Odontarrhena than De Candolle or Fenzl, Boissier like Fenzl maintained that A. alpestre (as various varieties) occurred in the Orient. In the light of much new material, Nyárády's conclusion (1929) and an examination of Boissier's Herbarium, it is definite that those specimens referred by Boissier to A. alpestre are distinct from the European alpine species and represent a number of taxa.

Some of Boissier's own species must be carefully viewed in that they are often composed of discordant elements. For example, A. elatum was initially based on three gatherings of three different species, i.e. A. corsicum, A. giosnanum and A. elatum. When this situation has been detected /

detected, lectotypes have always been chosen. Occasionally when Boissier regarded a specific name as inappropriate, such as A. erosulum, he provided a new epithet (in this case A. suffrutescens) referring to the same material; in these cases the original epithet must, of course, be reinstated under the ruling of the International Code. Some of the synonymy which Boissier gives is suspect, for example, A. strigosum under A. hirsutum, and A. polyodon under A. campestre var. micropetalum.

Busch's (1909) systematic treatment of Alyssum corresponds with that of Boissier but in the light of new material is much more detailed and complete for those species occurring in the Caucasus. The descriptions, synonymy, and specimen citations in this work have been of great value in analysing the Caucasine species.

J. Baumgartner's "Die Ausdauernden Arten der Sectio Eualyssum" was published in four parts and represents a very comprehensive treatment of the perennial taxa in Sect. Alyssum. Unfortunately, this survey has not received much attention because of its unavailability and publication in obscure annual reports of "high schools" in Wien-Neustadt (parts 1-3) and Baden near Wien (part 4). In addition to the four new species described from the Levant, Baumgartner's work is valuable for its carefully written and usually accurate diagnoses of the species and the often very long accompanying discussions. Excluding the taxa included in his A. montanum "grex" or aggregate, the key (in part 1) may be used with considerable success.

Baumgartner's analysis of A. montanum, including 3 subspecies (subsp. montanum, subsp. repens and subsp. atlanticum) with 27 infra-specific binary "proles", 6 varieties and 4 forms is taxonomically and nomenclaturally unacceptable. There is a definite problem as to the interpretation of /

of Baumgartner's "proles" in his classificatory heirarchy of A. montanum. As he recognizes subspecies subordinated under A. montanum, his proles within the latter cannot be treated as subspecies (cf. Heywood, 1958); nor can they be equated with varieties or forma as these categories were also used by Baumgartner. Judging from Baumgartner's brief comments regarding his taxonomic concepts (loaded with "Formenkreises" "Artenschwärme", "Sippen" and "Rassen"), he used Wettstein's geographical-morphological method to establish the morphologically distinct and geographically separated "Rassen" or "proles" of A. montanum; however, all the proles are closely related and presumably monophyletic. Any taxon which Baumgartner considered to be morphologically distinct and phylogenetically allied to A. montanum but without an exclusive geographical pattern, he regarded as varieties or forms, depending on the stress and variability of the differential characters. The basic assumption which Baumgartner makes of the derivation of A. repens from A. montanum, thereby treating the former taxon as a large subspecies of the extremely polymorphic aggregate species (the latter), is not accepted here. On the basis of the completely different floral morphology and indumentum types, A. repens (including only two subspecies - subsp. repens and subsp. trichostachyum) is readily distinguished from A. montanum. Hayek's A. repens subsp. trichostachyum corresponds with Baumgartner's A. montanum subsp. repens proles trichostachyum.

As the International Code of Botanical Nomenclature (1961) makes no reference to intercalating groups except in Article 4, paragraph 2 ("Further supplementary ranks may be intercalated or added, provided that confusion or error is not thereby introduced"), it is recommended, that as the present author (and most other workers) find no need for an additional /

additional binary and intercalating category, taxonomic recognition of any of Baumgartner's "proles" be preceded by re-combination of his epithets in the appropriate and universally accepted heirarchy of species, subspecies or varieties (or forms, if necessary).

The contrast which can exist between taxonomic judgements and concepts is exemplified by the comparison of Baumgartner's treatment of Sect. Alyssum (perennials only) with Nyárády's exhaustive study of Sect. Odontarrhena (1926-1949). Whereas Baumgartner subordinated many distinct taxa as "proles" or "races" under three subspecies of A. montanum a vast and indefinable aggregate, Nyárády recognized and applied epithets to a multiplicity of minor variations. The end result was often extreme nomenclatural and taxonomic confusion.

It is extremely difficult to analyze and appraise briefly any monographic treatise, especially one of such magnitude as Nyárády's, which was the result of 21 years of labour. On the credit side, Nyárády's accurate Latin or German descriptions usually give us a clear idea of the taxa he recognized and his detailed illustrations of stellate hairs, leaves floral parts, fruits and seeds, in conjunction with the many photographs of specimens cited in his works, have been of immense value for identification and for assessing the variation of many of the taxonomic characters. There is no doubt that Nyárády's descriptions and illustrations provide a valuable contribution to the study of the genus and draw attention to the value of certain submacroscopic characters in its classification.

On the other hand, 5 major criticisms of Nyárády's revision must be made and discussed in order that the following classification and systematics of /

of Sect. Odontarrhena can be viewed impartially. These criticisms are: 1) the lack of a clear and convenient presentation; 2) the failure to typify any of his taxa; 3) no consistent interpretation of many taxonomic categories and ranks, and the assignment of a magnitude of infra-specific taxa to the wrong species; 4) the taxonomic recognition of inconsequental and superfluous variations without reference to character or population correlations; and 5) violations of the International Code of Botanical Nomenclature.

Criticism 1: The format and presentation of Nyárády's ultimate Synopsis of Sect. Odontarrhena (1949) does not permit easy reference and accurate identification. The present author found Nyárády's Synopsis to be extremely difficult both to understand and to use; it takes weeks - even months - of careful analysis not only to identify many of Nyárády's specific and infra-specific taxa, but also to understand exactly what characters he was using and emphasizing. The mechanisms of the keys are exceptionally complicated (numbers, letters, astericks, etc.) with the whole of the systematic treatment, including synonomy, specimen citations and observations, being built into the keys. The usefulness and convenience of any monographic work should be among the measures of its success, and unfortunately the Nyárády presentation of 1949 has neither of these attributes.

Criticism 2: It is extremely difficult, especially in cases where many specimens are cited, to choose a type gathering which best fits Nyárády's descriptions. The problem of typification is further complicated by the extraordinary number of gatherings and duplicates in different herbaria which are referred by Nyárády to different taxa. The majority of these /

of these do not represent genuine mixed gatherings.

Criticism 3: Nyárády seems to have been unable to "see the wood for the trees". The basic species have often been obscured by a welter of infra-specific taxa. His concept of species and affinity seems to have been unreliable and erratic. An example of erroneous assignment of an infra-specific taxon is provided by A. obtusifolium subsp. cordatocarpum. It is clear after an examination of most of the original material constituting this taxon, that on the basis of its morphological characters and continuities, it must be referred as a synonym to an earlier Nyárády species, A. caliacrae. This evaluation is not merely a matter of opinion between two workers, but is directly related to observation and comprehension of the continuities contained by any given taxon, and the diagnostic discontinuities which delimit the taxa. It is pointed out that in the synonymy of the Turkish and allied species, that approximately 30 of Nyárády's infra-specific taxa were subordinated to the wrong species. An example of the lack of consistency in interpretation of taxonomic ranks and categories is provided by his description of the Balansa gathering (No. 429) from Anatolia. In 1938, Nyárády described a specimen of this gathering in the Haussknecht Herbarium in Jena, and a duplicate in the Paris Herbarium as A. murale var. alpinum. In 1949 (p. 104) he raised var. alpinum to full specific rank, but in the same work (p. 109) he gave var. alpinum subspecific status under A. murale.

Criticism 4: A. lepidulum (now treated as a synonym of A. sibiricum) was said (1949) to contain 9 infra-specific taxa, including 3 subspecies and six forms. These taxa are morphologically indistinguishable. Very often Nyárády's infra-specific (and specific) taxa occur in the same populations /

populations, and may even be represented in different herbaria as duplicates of the same gathering. A. murale was expanded by Nyárády (1949) to contain 27 infra-specific taxa, including subsp. dramense which is a synonym of A. corymbosoides. In the following study of Turkish and allied species, approximately 30 of Nyárády's full species in Sect. Odontarrhena and 130 infra-specific taxa are referred to synonymy.

Criticism 5: The acceptance of epithets which are clearly synonyms of earlier legitimate names. For example, Nyárády (1932) claims that his A. lepidulum (1929) and Willdenow's A. sibiricum (1800) are synonymous, but continues (1949) to refer to this taxon as A. lepidulum. Likewise, he maintains (1927 and 1949) Formanek's A. rhodopense (1898), though freely admitting that A. corymbosoides Formanek (1895) is the earlier epithet. The application of subsp. "genuinum" or var. "typicum", which appear frequently throughout Nyárády's works, are not permitted within the present framework of the International Code of Botanical Nomenclature (Article 24:1961).

The following study attempts to combine an emmended version of the classification of Alyssum as originally proposed by Boissier with the best information from Baumgartner and Nyárády, the whole being interpreted in the light of patterns of variation and geographical distribution discernable from the copious material now available. Advances have been made towards a more convenient infra-generic classification of Sect. Odontarrhena; however, Sect. Alyssum (the perennial members) remains basically as it was considered by Baumgartner, without any subsectional or serial groups. It is to be hoped that future workers, perhaps through a more careful examination of dispersal mechanisms, ontogeny of hair types, etc., may be able to present a more satisfactory classification of Sect. Alyssum than is offered here.

IV. MATERIAL AND METHODS

In addition to the material loaned from various herbaria, the author studied in situ the entire *Alyssum* collections (approximately 6,000 specimens) in the Herbarium of the Royal Botanic Gardens, Kew; the Herbarium at the Royal Botanic Garden, Edinburgh, the Herbaria at the British Museum (Natural History), London (including the Clifford Herbarium); the Linnean Herbarium; The Fielding, Druce and Sibthorp Herbaria at the University of Oxford; the private collection of Dr. A. Huber-Morath, Basel; the Herbaria at the Conservatoire et Jardin Botanique, Geneva (including the De Candolle Herbarium - G-DC.); the herbaria at the Naturhistorisches Museum, Vienna; the herbarium of the Universitesi Fen Fakültesi Botanik Enstitüsü, Ankara; Farmakobotanik ve Genetik Enstitüsü Fen Fakültesi, Istanbul; and the Gray and Arnold Arboretum Herbaria, Harvard University, Cambridge (Massachusetts).

During the course of this study flowers of approximately 1,500 specimens have been dissected. After dissection the floral parts were mounted on stiff black paper so that they could be easily studied later. This procedure allowed many flowering specimens, which in the past because of the lack of highly diagnostic fruits would have been ignored, to be identified. The number of ovules, style length, type and amount of indumentum on the styles and ovaries, and other diagnostic characters can be easily observed in dissected flowers, even if they are in the bud stage. The floral dissections were also of assistance in determining the shape of the petals and their apices, and the presence or absence /

absence of an indumentum on the petals (these petal characters can also be easily seen when the flower has reached full anthesis, without dissection); likewise, the configuration of the wings, teeth and appendages of the filaments was more easily seen and appraised when the flowers were dissected. The characters of the filaments, though diagnostic in establishing natural groups within the genus and relatively constant for species, have been for the most part omitted from the distinguishing keys because of the difficulty of observation. It is recommended that future workers, who are identifying _Alyssum_ specimens in the herbarium or in the field, should dissect the flowers if no fruits are present.

The herbarium specimens which were seen were all analyzed morphologically, and whenever possible, gatherings from the same population (duplicates or different numbers) were compared, so that the amount and type of character variation could be appraised, thereby minimizing the danger of recognizing superfluous taxa based on inconsequential and highly variable characters.

Through the courtesy of the Royal Botanic Garden, Edinburgh, seeds of 35 recent gatherings were cultivated. The resulting plants were compared with their parents in order to determine the constancy of the population and specific criteria.

Studies were conducted on the production of mucilage for seeds of about 70 representative species from _Aurinia_ and all sections of _Alyssum_ occurring in Turkey, and allied European and Asiatic species. The seeds were soaked in luke-warm water and stained with a dilute solution of 50% aqueous and alcoholic toluidine blue. If mucilage was produced, a /

a viscous blue exudate surrounded the seed testa. The results of this study are summarized in Section VIII, part 2.

Information regarding mechanisms of seed dispersal, associated species, phytogeography and ecology which were observed in the field for a number of species were carefully compared and incorporated with the pre-existing knowledge and information provided by herbarium labels.

All of the new species described here by the author are provided with illustrations, except A. corningii. Distribution maps for most of the Turkish species of Alyssum are to be found in the Appendix. Maps were omitted for those species which possess such a general and amorphous distribution that a map would not have added to our present knowledge. The only European species listed in Section 13 which are furnished with maps are those whose distribution is relevant to the Turkish taxa.

Unfortunately time did not allow first-hand cytological investigations of the genus, or the much needed anatomical study of the ontogeny of the various types of trichomes.

By virtue of the fact that a sound taxonomic framework is necessary before experimental procedures can be usefully applied, the approach in the following study is basically "classical". By studying the correlation of continuous or discontinuous external characters from all organs of the plant, it has been possible to provide a systematic ordering of species into natural sections, subsections or series, which in the view of the author is the most "natural" (phenetic) classification of the genus which has been proposed to date.

V. CONSIDERATION OF DISTRIBUTION AND ENDEMISM

The area covered by Boissier's Flora Orientalis is the major centre of diversity for Alyssum. This fact is born out in the following table which lists the number of species and endemics present in each major geographical area. Europe is understood here to include all the land mass from England to the South Mediterranean and east to (but excluding) the Caucasus; however, for the purposes of a clearer analysis of the generic distribution, the Balkan Peninsula - sensu Hayek - is excluded from the European geographical area and is treated as a separate unit. The area of Anatolia includes all the politically Turkish Territory on the Asiatic side of the Bosphorous and some of the coastal Aegean Islands which are politically Greek. The Orient includes all the Asiatic areas eastwards to India, including Cyprus, but excluding Anatolia. Throughout this discussion and in the following table, an endemic is regarded as a taxon which is confined entirely to any one of the 5 geographical areas. The numbers in the table are the actual numbers of species or endemics that are known to occur in any of the geographical areas.

(1) Geographical Distribution of Species in Alyssum

(P = present; E = endemic)

Groups	N.Africa		Europe (excl. Balkans)		Balkans		Anatolia		Orient (excl. Anatolia)		No. of recogn-ized species in each group	No. of endem-ics in each group	% of endemism in each group
	P	E	P	E	P	E	P	E	P	E			
Sect. Meniocus	1	0	1	0	1	0	6	3	4	1	7	4	57%
Sect. Psilonema	1	0	3	0	2	0	1	0	4	2	5	2	40%
Sect. Alyssum	7	2	21	4	26	11	35	16	26	8	69	41	59%
Sect. Gamosepalum	0	0	0	0	0	0	10	8	2	0	10	8	80%
Sect. Tetradenia	2	1	2	1	0	0	0	0	0	0	3	2	67%
Sect. Odontarrhena	1	0	15	5	15	8	35	22	26	13	66	48	73%
Total No. of species in each geographical area	12	3	42	10	44	19	87	49	62	24	Total No. of Recognized species = 161		
											Total No. of endemics = 105		
% of endemism in each geographical area	25%		24%		43%		56%		39%		% of endemism in genus = 65%		

Distribution of Subsections of Sect. Odontarrhena

Groups	N.Africa P	N.Africa E	Europe P	Europe E	Balkans P	Balkans E	Anatolia P	Anatolia E	Orient P	Orient E	No. of recognized species	No. of endemics	% of endemism
Subsect. Odontarrhena	1	0	13	4	12	6	20	11	20	11	47	32	68%
Subsect. Compressa	0	0	2	1	3	2	6	3	5	2	11	8	73%
Subsect. Samarifera	0	0	0	0	0	0	9	8	1	0	9	9	89%

Of the 161 species of Alyssum currently recognized throughout the whole generic range, 87 are found in Anatolia, of which 49 are strict endemics to that area. The next area with a comparable number of species is the Orient which contains 62 species of which only 24 are endemic. The Balkans have 44 species and 19 endemics, and though having a smaller number of species and endemics than the Orient (excluding Anatolia), the percentage of endemism is higher. Alyssum is represented in Europe (excluding the Balkans) by 42 species of which 10 are endemic. The percentage of endemism in Europe is lower than that of N. Africa which has only 12 species and 3 endemics. The Iberian Peninsula with 18 species, of which 3 are endemic to Spain, 8 are shared with N. Africa, and 14 are found elsewhere in Europe, seems to represent a secondary centre of diversity in the European geographical area (excluding the Balkans). It is certainly the centre for Sect. Tetradenia which is known by only 3 species. The other centre of diversity in Europe appears to be a belt extending from Sardinia and Corsica, and Northern Italy eastwards to the Carpathian Mountains. It is evident then that Anatolia has more Alyssum species and endemics for each section than any other land area of comparable size - with the exception of Sect. Tetradenia whose components are never known to occur in Anatolia, and Sect. Psilonema which is represented in Anatolia by only one widespread species. For example, Sect. Meniocus contains 7 species, 6 of which occur in Anatolia and 3 are endemic; Sect. Alyssum contains 69 species, 35 being found in Anatolia and 16 are endemic; the 10 species of Sect. Gamosepalum are all found in Anatolia where 8 are endemic; and Sect. Odontarrhena /

Odontarrhena has 66 species of which 35 are present in Anatolia and 22 are endemic. Eighty-seven or over half the total number of recognized species of _Alyssum_ are found in Anatolia. Keeping these figures in mind, it is evident that the centre of diversity in _Alyssum_ is in Anatolia, and there seem to be no obvious reasons why Anatolia should not have been the main centre of speciation as well.

Further evidence corroborating this argument comes from an analysis of endemism and affinities. Section _Meniocus_, with 57% endemism, Sect. _Alyssum_ with 59%, Sect. _Gamosepalum_ with 80% and Sect. _Odontarrhena_ with 73%, are all represented in Anatolia by the largest number of species and endemics. Of the total number of endemic species in the genus (105 or 65%), those occurring in Anatolia comprise 49, or approximately 47% of the total. The predominant number of Anatolian endemics are perennial; 23 of the 49 endemic species pertain to Sect. _Odontarrhena_, 8 to Sect. _Gamosepalum_ and 12 to Sect. _Alyssum_. The only endemic annuals are 3 species in Sect. _Alyssum_ and 3 in Sect. _Meniocus_. Within Sect. _Odontarrhena_, Subsect. _Compressa_ and Subsect. _Samarifera_, the most highly specialized natural groups in the genus, the largest number of species and endemics for any geographical area are found in Anatolia. Likewise, the most specialized species in Sect. _Alyssum_ (i.e. _A. aizoides_, _A. bornmuelleri_, _A. caespitosum_, etc.), which are very closely allied to Sect. _Gamosepalum_ (a very specialized group centred in Anatolia - see Isoflor, Map 22 in Appendix), are confined to the central /

central Anatolian steppe. The closest affinities to these specialized components in Sect. Alyssum and Sect. Gamosepalum are found in the Balkans, namely the Greek and Yugoslavian alpines A. doerfleri and A. taygeteum. However, in the case of Sect. Odontarrhena Subsect. Compressa, the closest affinities to the Turkish species are found in the Orient. In what is apparently the most primitive section of Alyssum, Sect. Meniocus (see Table under the heading of Habit in Section VII), the 3 endemic species in Anatolia have an almost unique type of fruit indumentum, which is otherwise only formed in the steppe-inhabiting A. heterotrichum of Iran and Afghanistan. A. aureum and A. meniocoides, both in Sect. Meniocus and with glabrous fruits, have continuous distributions from S. Anatolia into Syria, Lebanon, Israel, Iraq and Iran. It is interesting that the type species of Sect. Meniocus, A. linifolium is one of the most widespread species in the genus, extending from England (where it was probably introduced) across Europe and Asia as far east as India. It has also been introduced in Australia. The species most closely allied to the 11 Anatolian endemics in Sect. Odontarrhena Subsect. Odontarrhena are divided equally between the Balkans and the Orient; however, of the species which are not endemic to Anatolia, the largest number are shared with the Balkans. It should be pointed out here that Alyssum illustrates a strong floristic connection between the Balkans and Anatolia. This floristic feature is no doubt related to the fact that these areas were directly connected across what is now the Aegean /

Aegean throughout most of the Tertiary, the Balkans being in fact a peninsula of Asia. Anatolia has the largest number of species and endemics for Sect. Meniocus, Sect. Alyssum, Sect. Gamosepalum and Sect. Odontarrhena, and it is probable that these sections have had their centres of speciation, certainly their present centres of diversity in that area. Section Psilonema is represented in Anatolia by only the type species, A. dasycarpum (also possibly A. alyssoides but this species has not been seen by the author in Turkey), which similar to A. linifolium is very widespread, extending from Europe to India. Two other species in Sect. Psilonema, A. damascenum and A. homalocarpum are strictly Oriental species and can be considered as Saharo-Sindian elements. The components of Sect. Tetradenia (once regarded as species of the indefinable Ptilotrichum) are never found in the Balkans or in the Orient including Anatolia. This section of 3 species is confined entirely to Spain, N. Africa and S. France.

The role of environmental influences as a stimulus of speciation has been discussed at length by Mason (1946) and Stebbins (1952). The large number of Alyssum species endemic to Anatolia - more than in any other geographical area - point to a multiplicity of environmental conditions and habitats within which any given set of genetic potentials can operate, thereby leading to the establishment of many genetically determined and distinct populations. The genetic diversity or its lack controls the tolerance which a taxon may have for any particular environment and permits a taxon to become widespread or in the case of many of the endemics, to be isolated. Claiming that Anatolia is currently the /

the major centre of speciation for the genus, it appears that the influences of aridity have accounted historically (continued to the present time) for the accelerated evolution of taxa. The likelihood of this hypothesis is conveniently illustrated by the fact that the majority of the Anatolian species and endemics are confined to the Western and Southern part of the Mediterranean areas of Anatolia or to the Irano-Turanian steppe. The affinities of these taxa are to be found either in the Balkans or in the Orient. The only species which occur in Northern Anatolia (the Euxine belt immediately bordering the Black Sea) are either those which are very widespread initially or those which inhabit special local habitats similar to those common in the Mediterranean or Irano-Turanian regions.

In addition to climatic aridity as a stimulus for diversity, two other environmental factors connected with aridity act as "catalysts" in the development of species diversity in Anatolia. They are "preferences" for high altitudes and certain edaphic conditions. The 42 species present in Anatolia which are not endemic all appear to have a wide range of environmental tolerance or are more or less distributionally continuous into adjacent geographical areas having similar types of habitat. Examples of wide environmental tolerances are found among the perennials A. sibiricum and A. murale, and among the annuals for A. linifolium, A. dasycarpum, A. minutum, A. minus, A. desertorum and A. strigosum. These widespread species could be interpreted historically as old taxa, as they have developed a series of genotypes which enable the species to survive and perpetuate in many diverse habitats /

habitats. Species with a more or less continuous distribution from Anatolia into adjacent areas, yet with a particular habitat preference, are possibly of a younger evolutionary age than the former class of species, in that they possess the potential for survival and reproduction within only one set of environmental influences. Examples of this type of species are the steppe or Irano-Turanian elements such as A. sulphureum in Sect. Gamosepalum, A. szowitsianum in Sect. Alyssum,,A. aureum and A. meniocoides in Sect. Meniocus and A. eriophyllum and A. crenulatum in Sect. Odontarrhena. Interpreted in this light, i.e. the ability or inability to colonize diverse habitats, it follows that the endemics which are confined to a limited area and/or a particular environment, such as all the species in Sect. Odontarrhena Subsect. Samarifera, and many of the Anatolian high alpines in Sect. Alyssum, have a narrower genetic potential than the more widespread species, though often possessing as is the case with Subsect. Samarifera, a set of very specialized phenotypic expressions.

The species widespread in Anatolia and other geographical areas are primarily found in open communities and habitats, and are characterized by a wide range of environmental tolerance. Likewise, the majority of endemics in Anatolia are found in spatially open habitats also (cf. Davis, 1951), such as the central calcareous steppe, mountain screes and Mediterranean macchie, but are characterized by a narrow range of environmental tolerance. The influences controlling the limited distributions of these endemics appear to be related to two factors: 1) the present tolerance of the taxa permitting survival and perpetuation /

perpetuation in one basic type of habitat and 2) their limited genetic potential to allow the development of a more general tolerance for diverse habitats. Most of the endemics illustrate a pronounced tolerance for only one type of habitat, and are seemingly unable to compete successfully in a different set of environmental influences. In the niches that they presently occupy competition with other genera is relatively low - thereby allowing for the maximum development of Alyssum in these habitats. This is especially true of the perennial alpines in Sect. Alyssum and Sect. Odontarrhena which are confined to either calcareous or serpentine screes. These screes are essentially open and mobile habitats, but competition with other plants is reduced to a minimum.

The predominance of calcicole Alyssum in Anatolia, especially in Sect. Alyssum and Sect. Gamosepalum, is associated with the ability of these taxa to develop to the maximum extent, without the influence of competitive species, because of their genetically controlled unfavorable physiological responses to other edaphic conditions. As a few of these calcareous species have developed a tolerance for serpentine (and in Sect. Odontarrhena, a few serpentine species have developed a tolerance for calcareous substrates), it follows that such species have a wider range of tolerance than those which are strictly confined to either serpentine, or soft or hard limestone substrates. It appears that many species of Alyssum inhabit habitats which, though open to the Alyssum, are closed, because of altitudinal or edaphic factors, to other elements in the flora which would present a competitive threat. Nor in these habitats do the individual plants of Alyssum necessarily

compete /

compete with one another for suitable niches because of the abundance of niches which are otherwise unfilled. This fact is especially important for the maintanance of the population and its gradual spread within the limits of the habitat provided.

Some species, especially in Sect. *Odontarrhena* (i.e. *A. pateri*, *A. condensatum*, *A. anatolicum* & *A. filiforme*, among others), have become adapted for survival in unfavorable steppic areas by growing in the protection of spiny *Astragalus* hummocks. This is a common feature of a number of other steppe elements, and is a method of overcoming the competition for moisture, and permits survival in the favorable micro-habitat created by the *Astragalus*. The development within clumps of spiny *Astragalus* has the added advantage of being a protective device against the marauding goats. *A. murale*, which is very widespread in Anatolia and other geographical areas, is notable in that it is one of the few components of Sect. *Odontarrhena*, in fact the only species in Subsect. *Compressa*, which has a tolerance for a multiplicity of environments and habitats; however, invariably in the Mediterranean region of Anatolia it is found either in biologically closed communities, such as limestone or serpentine rocks, or in the protection of and under sparse *Quercus coccifera* scrub.

A. samariferum, *A. floribundum* and *A. caricum* in Sect. *Odontarrhena* Subsect. *Samarifera* and *A. discolor* in Sect. *Odontarrhena* Subsect. *Odontarrhena* show their best development in biologically closed communities. *A. floribundum* and *A. discolor* are saxatile in the crevices of ledges of weathered limestone crags, *A. caricum* and *A. samariferum* are /

are confined primarily to serpentine and other igneous steep rock formations. It is interesting that these four species in Sect. Odontarrhena are also among the woodiest in the genus, often being fruticose subshrubs.

The following table lists the numbers of species and percentages of endemism within these numbers for Alyssum occurring in Anatolia. A definite association emerges from this table. In Anatolia, the percentage of endemism tends to increase with altitude, a fact which appears to indicate that altitudinal isolation has played a role in maintaining specific differences, if not in specific differentiation itself. Even with this association, it is seen that the percentage of endemism is greater in the uncultivated steppe than it is in the ruderal and segetal habitats.

(2) Comparison of Numbers of Anatolian Species, Habitats and Percentages of Endemism.

Groups	Ruderal & Segetal	Steppe	Montane and Alpine: up to 1000 meters	Montane and Alpine: 1000-2000 meters	Montane and Alpine: over 2000 meters
Sect. Meniocus	6 (endemics = 50%)	6 (endemics = 50%)	3 (endemics = 0)	1 (endemics = 0)	0
Sect. Psilonema	1 (endemics = 0)	1 (endemics = 0)	1 (endemics = 0)	1 (endemics = 0)	
Sect. Alyssum					
annuals	4 (endemics = 0)	14 (endemics = 20%)	12 (endemics = 17%)	8 (endemics = 13%)	1 (endemics = 1000%)
perennials	3 (endemics = 0)	10 (endemics = 70%)	10 (endemics = 70%)	10 (endemics = 70%)	6 (endemics = 83%)
Sect. Gamosepalum	0	9 (endemics = 0)	1 (endemics = 0)	0	0
Sect. Odontarrhena					
Subsect. Odontarrhena	3 (endemics = 33%)	10 (endemics = 70%)	9 (endemics = 78%)	13 (endemics = 77%)	5 (endemics = 80%)
Subsect. Compressa	1 (endemics = 0)	1 (endemics = 0)	3 (endemics = 67%)	5 (endemics = 60%)	4 (endemics = 75%)
Subsect. Samarifera	0	0	2 (endemics = 100%)	8 (endemics = 88%)	5 (endemics = 80%)
Total Number of Species in Each Habitat	18	51	41	46	21
Total Percentage of Endemism in each Habitat	22%	39%	51%	61%	71%

A table of the numbers of species represented in Anatolia and their edaphic preferences reveals that the maximum concentration of species is to be found on calcareous substrates, and that 15 of these may also be found on serpentine. Nineteen species are found solely on serpentine rock, and it is particularly interesting that 17 of these are members of Sect. Odontarrhena, the other two being components of Sect. Alyssum. The 17 serpentine species of Sect. Odontarrhena are all endemic to Anatolia, primarily in the S.W. and W. Mediterranean area, with the exception of A. murale in Subsect. Compressa which has a very wide geographical distribution and environmental tolerance, being found in Anatolia (and the Balkans) and all the substrate categories listed in the following table. The edaphic preference of 21 species of the total number found in Anatolia are either not known, or are of volcanic or igneous nature (probably excluding serpentine). A special type of soil, included in the last category of the table, which very few taxa can tolerate, is that which is impregnated with salt. This type of substrate extends for a relatively wide area, primarily around Tuz Golü in Central Anatolia. The very widespread A. linifolium in Sect. Meniocus and A. dasycarpum in Sect. Psilonema are known to tolerate and occur abundantly in the salt steppe. The only species in Sect. Odontarrhena (in addition to A. murale) which appears to have the adaptive potential to survive saline conditions is the widespread, but entirely Anatolian A. pateri. This species was found to form very sparse populations, in the protection of spiny Astagalus, not more than 10 km. from the margin of Tuz Golü. The author /

author has described a very unusual variety (var. albiflorum) of A. praecox in Sect. Alyssum which forms a relatively large but local population on the margin of a small salt lake to the east of Tuz Golü. The typical expression of A. praecox is found in montane and alpine areas on calcareous or igneous substrates. Variety albiflorum deviates from the typical variety by having white flowers and possibly more succulent leaves (both characters noted on the label). These two characters, particularly the latter, are possibly direct results of adaption to the saline environment. It is notable that more than half of the 15 species occurring on both serpentine and calcareous substrates also tolerate other types of soils. All six species of Sect. Meniocus found in Anatolia are predominately plants of calcareous substrates, a fact which is correlated with their preference for the steppe, which is mainly of limestone structure. Only A. linifolium in this section is tolerant also of both serpentine and saline substrates; likewise A. blepharocarpum is known to occur in the salt steppe. The 10 species of Sect. Gamosepalum all show a marked preference for soft calcareous substrates, especially chalks; but a few of these taxa appear to be gypsicolous. However, A. baumgartnerianum has been recorded as occurring on igneous rocks, and A. thymops in the salt steppe. Our information on edaphic preferences is necessarily very imperfect, and the following table may only approximate to the facts.

(3) Numbers of Anatolian Species and their Edaphic Preferences

Groups	serpentine only	calcareous only	serpentine & calcareous	others including saline & unknown
Sect. Meniocus	0	6	1	2
Sect. Psilonema	0	1	1	1
Sect. Alyssum				
annuals	0	16	5	5
perennials	2	14	2	6
Sect. Gamosepalum	0	10	0	2
Sect. Odontarrhena				
Subsect. Odontarrhena	8	12	3	3
Subsect. Compressa	4	2	1	1
Subsect. Samarifera	5	3	2	1
Total Number of Species in Each Substrate	19	64	15	21

Aurinia is represented in Anatolia by 3 species, none of which are endemic. The Balkans contain the largest number of species in the genus (6), of which, however, only _Au. corymbosa_ is endemic on serpentine. The 3 species found in Anatolia are also found in the Balkans. Europe shares 4 species of _Aurinia_ with the Balkans; however, only _Au. halimifolia_ is confined to Europe, in the Maritime Alps of S. France. _Au. saxatilis_ subsp. _orientalis_ and subsp. _megalocarpa_ are confined in Western Anatolia and the Aegean Islands to calcareous substrates, usually never more than 1500 meters. These taxa are for the most part saxatile on vertical cliffs which are biologically closed communities. _Au. rupestris_ subsp. _cyclocarpa_ is a taxon of Central and Eastern Anatolian calcareous screes, usually 2000 meters or over. _Au. uechtritziana_ in Anatolia and the Balkans is a maritime species which is confined entirely to sandy areas along the Black Sea and the Sea of Marmara.

VI. TAXONOMIC GROUPS

Much has been written about the interpretation of the taxonomic groups we use today, especially of the species and infra-specific taxa (cf. Du Rietz, 1930; Hedberg, 1957; Valentine & Löve, 1958; Runemark, 1961; Raven, 1962, among others). Generic concepts have been discussed and explained lucidly in a series of papers by Bartlett, Anderson, Greenman, Sherff and Camp in 1940. The production of a natural or "general" (Gilmour and Turrill, 1941) classification of the genus Alyssum should be accompanied by a brief statement of the definition of taxonomic groups and the assignment of ranks. Two mental processes come into play; 1) the synthesis of all available information about taxa which leads to their aggregation, because of morphological continuities and over-all resemblances, into genera, sections, subsections or series; 2) the analysis of morphological data (and other information when available) from populations of plants which will allow distinction of these population into species, sub-species or varieties - based on the degree of their morphological discontinuities and the emphasis or weight placed on the characters. These processes do not contradict each other, but rather are complementary and should be regarded together as comprising the mental criteria of any taxonomic judgement. The characters used in the evaluation and assignment of taxonomic groups are twofold, and throughout the following treatment of Alyssum constancy has been maintained by using White's (1962) qualitative definition of characters. Character expressions (basic characters in the sense of Runemark, 1961) may /

may be diagnostic - i.e. they are present inevery individual of a taxon being referred to, and in no individuals with which the taxon is being compared - and that there is a complete discontinuity in the patterns of variation. It is these diagnostic characters which delimit genera, sections, subsections, series and species. The differential characters are less constant than those which are diagnostic and have a continuous variation pattern or, in other words, their discontinuity is incomplete. Differential characters may not be used singly to discriminate species or higher groups, but frequently the analysis of correlated differential characters will yield a discontinuity which can be used with safety for definition of species. It must always be kept in mind that when we refer to characters, either diagnostic or differential, we are implying the expression and/or variation of characters within the fundamental unit of classification which is the species (of one or more populations) and not the individual specimen.

By the genus Alyssum, the present author means to imply that all the species share in common the largest number of diagnostic characters enabling this taxon to be conveniently distinguished as a unit from other groups of species or genera by distinct and different combinations of characters. The genus is accordingly a grouping together of allied taxa which expresses a naturalness in over-all resemblances and is likely to be monophyletic in origin. This is the basic criteria of our present generic concepts and should, by virtue of overall resemblances and correlations of features, over-rule errors which could stem from misinterpreting convergence. The limits /

limits of Alyssum as a genus as proposed by Boissier and Schulz have been accepted here, with a few changes stemming from a reorganisation of the Alysseae based on over-all resemblances and presumed affinities (cf. p. 9). The only major changes in the concept of Alyssum from the two above workers have been; 1) the inclusion of the type species of Ptilotrichum, Pt. canescens into Sect. Alyssum; 2) the resurrection of Sect. Tetradenia, including A. spinosum, A. cochleatum and A. lapeyrousianum; 3) the transfering and reduction of Sect. Scleroptychis and Sect. Chrysites to Alyssoides; 4) the treatment of Aurinia as a genus distinct from Alyssum rather than as a subordinate section.

Within the genus Alyssum, the present author has adopted the use of 3 infra-generic categories, i.e. section, subsection and series. The use of these categories in the following study is an attempt to represent natural lines of evolution for their component taxa and they differ only in the quantity and emphasis placed on their diagnostic expressions. As Alyssum is an extremely large and polymorphic genus (approximately 160 species), it has been advantageous and convenient to apply infra-generic ranks, within the accepted heirarchy, to groups of taxa which show an over-all morphological similarity amongst themselves and which by virtue of resemblances and character correlations are assumed to be closely related.

There are presently 6 recognized sections in Alyssum which are easily separated from one another by prominent and correlated discontinuities (see Key to Sections, p. 219 and Synopsis of the Genus Alyssum p.181)/

p.181), but of course the components of each section are provided with numerous characters which allow their distinction as separate species. It is because of their easily recognized discontinuities that all the currently recognized sections of _Alyssum_ have at one time or another been treated as distinct genera. Even two of the components of Sect. _Tetradenia_, though never as a separate genus, were subordinated to _Ptilotrichum_. The natural sections of _Alyssum_ being the primary convenient divisions of the genus contain the largest number of species, and the additional subsections or series subordinate under the sections have a fewer number of species.

The only section which has been successfully subdivided into subsections is Sect. _Odontarrhena_. These subsections possess all the diagnostic characters of the section, but in addition they possess some diverging expression which, when correlated, allow the natural grouping together of related taxa. For example, Subsect. _Samarifera_ is characterized by samaroid, indehiscent and wind-dispersed fruits pendulous on deflexed and sigmoid pedicels; however, the fruits of Subsect. _Compressa_, though with equally compressed valves as those of Subsect. _Samarifera_, are always smaller, dehiscent and never samaroid. Subsection _Compressa_ has been further subdivided into series (smaller groups of allied species); the presence of a crenulate fruit wing characterizes all the components of Series _Crenulata_. The fragile and sigmoid pedicels of Series _Crenulata_ are not unlike those always present in Subsect. _Samarifera_, but the totally different type of fruit and dispersal for Series _Crenulata_ seems to indicate that the fragile and sigmoid pedicels have evolved more than once.

The /

The only other use of Series is found in Sect. Gamosepalum whose components are divisible into two natural groups; i.e. Series Gamosepalum characterized by cohering long filaments, whitish petals and few-rayed stellate hairs; and Series Libra which may be recognized by free long filaments, yellow petals and many-rayed lepidote or sublepidote hairs. We must not fail to point out, however, that the present infra-generic categories may at a future date be subjected to a more critical examination, and depending upon the opinions of the workers and the discovery of new taxa, the present status of these categories may be changed, but the facts of affinities and relationship expressed by the present orientation of species are unlikely to be altered. At least for the present time, the infra-generic classification proposed here presents the most natural and convenient classification, particularly of Sect. Odontarrhena, that has been proposed to date.

The most important criterion of a species in the normal taxonomic sense is that it must be morphologically recognizable. This morphological recognition is based on the fact that the species must be permanently separated from other species (and their infra-specific taxa) by a set of distinct morphological discontinuities within the whole biotype range. Taxa to be granted specific distinction in Alyssum must express discontinuous variation in 2 or more independent and correlated characters (Hedberg, 1957; Runemark, 1961).

Within the species unit, there may be considerable amounts of variation /

variation and if 2 (or more) populations which are more or less regionally and/or ecologically separated possess at least 1 discontinuity and are usually connected by intermediates, these populations are given the rank of subspecies. They form a more or less distinct regional (in terms of geography or ecology) facies of the species. This is true of the allopatric subspecies, such as A. obtusifolium subsp. helioscopoides and subsp. obtusifolium as well as the numerous partially sympatric or sympatric subspecies. The allopatric subspecies may be distinguished by only one character or several interdependent (often quantitative) characters which morphologically seem to represent an extension of the range of variation from the typical subspecies, but which have by some means or another become isolated from the rest of the species. The allopatric subspecies is very rare in Alyssum and the more usual type is that which is partially sympatric (i.e. A. condensatum subsp. condensatum and subsp. flexibile), and whose variation seems to intergrade with intermediates occurring in the zones of overlap. A. strigosum subsp. cedrorum is an example of a sympatric subspecies which is found entirely within the geographical range of the typical subspecies. In its normal expression subsp. cedrorum is well distinguished from subsp. strigosum; however, the numerous intermediates cannot be ignored and accordingly subspecific rank is applied.

In addition to the subspecies, the only other infra-specific group which is recognized in Alyssum is the variety. The varieties of a species /

species or subspecies tend to be found in more or less purely by localized populations of one biotype, or rarely more. Varieties are usually sympatric within the specific or subspecific range and form what could be called a local specific expression of the species. Such is the case of <u>A. praecox</u> var. <u>albiflorum</u> which is known as only one population in Central Anatolia. The sporadic occurrence of more or less stable, but small and local populations throughout the whole or part of the specific or subspecific range have also been treated as varieties. Intermediates are, more likely than not, to be found distributed sporadically in the same pattern as the variety. This type of variety is illustrated by <u>A. minus</u> var. <u>micranthum</u> and <u>A. linifolium</u> var. <u>cupreum</u>. These sporadic and local patterns of variation could not be interpreted in terms of subspecies, as that category is more or less a geographical race which in its typical expression is well distinguished from the typical form and intermediates are confined more generally to the zones of over-lap.

VII. TAXONOMIC CHARACTERS

Before the systematics of Alyssum (primarily those of the Anatolian taxa) are presented, it is necessary to examine the diagnostic expressions of the characters (analytic and restricted) which comprise the discontinuities delimiting taxa, and the continuous widely occurring expressions (synthetic) which allow the grouping together of species in generic and infra-generic levels. Whenever possible, evolutionary trends, i.e. advancements by specialization or reduction, are indicated. Figures 1A, 1B, 2 illustrate the range of specialization for hairs, petals and filaments, and fruits.

(1) Vegetative Characters

(a) Habit

The habits and life forms present in Alyssum can be divided into two basic types: the annual or therophytes which comprise all species of Sect. Meniocus, Sect. Psilonema, and part of Sect. Alyssum; and the perennials or chamaephytes which always have a more or less woody stock or caudices and constitute the rest of Sect. Alyssum, Sect. Gamosepalum and Sect. Odontarrhena. Boissier records 3 biennials in Sect. Odontarrhena with a hemicryptophyte life form - A. eriophyllum, A. cilicicum and A. cassium - however, among these, recent collections show that A. cassium is the only one with a genuinely biennial habit. The biennial habit is rare in Alyssum and appears to occur only in A. crenulatum, A. cassium and A. libanoticum of Sect. Odontarrhena, and in A. wierzbickii of Sect. Alyssum, though the non-Turkish species of Aurinia (Au. corymbosa and Au. petraea) may be described as "short-lived" perennials and appear to be hemicryptophytes. The Turkish representatives /

representatives of Aurinia, i.e. Au. saxatilis, Au. rupestris and Au. uechtritziana, are all perennials possessing thick woody caudices. The only annual in Sect. Odontarrhena, A. bungeii (described by Boissier) was based on a mis-observation of the number of ovules in the fruit locules and is now treated as a synonym of A. heterotrichum in the always annual Sect. Meniocus. The fact that some plants of annual species, A. alyssoides (Sect. Psilonema) and A. strigosum (Sect. Alyssum) may not accomplish their life cycles in one growing season in artificial environments, is not relevant to the fact that the annual habit prevails in natural habitats. These species may, under cultivation, because of adverse growing conditions, fail to flower or to produce viable seeds within a prescribed growing season, but in the field this phenomenon is never observed. The feature of rare "pseudo-perennation" does not invalidate the basic definition of species which are biologically annuals.

The herbaceous annuals of Sect. Meniocus, which are usually sparingly branched and of short stature are treated in the following study as representing the most primitive morphological state, and accordingly can be regarded as historically the oldest natural group in the genus. The annuals of Sect. Psilonema and Sect. Alyssum, and the perennials of Sect. Alyssum, Sect. Gamosepalum and Sect. Odontarrhena which show various advanced morphological expressions (see table below) are considered to be more advanced (specialized) than the members of the annual Sect. Meniocus. The conclusion that the annual habit is a "primitive" feature in Alyssum is a definite departure from the usually accepted view (e.g. Bessey, 1915; Babcock, 1947) that the woody perennials represent the "primitive" and precursor /

precursor stock. It must be recognized that the morphological criteria with which one is able to judge "primitiveness" or "advancement" in one genus or group of plants may not be readily applicable to other groups of plants.

The acceptance of the hypothesis that the annual habit represents a "primitive" state is, however, acknowledged in the Cruciferae (Lesquerella, Payson:1921) and in the allied family, Capparidaceae (Cleomella, Iltis:1956 and Cleome, Iltis:1959). Payson (1921), in his monograph of Lesquerella comments that the woody perennials with a rosette-forming habit are clearly derived from an ancestral annual stock which was devoid of any woody tissue. Iltis defines the annual habit as "primitive" for Cleomella (1956) and Cleome Sect. Physostemon (1959).

The assumption that the annual habit is "primitive" in Alyssum stems not only from the correlations with other supposed "primitive" expressions, but also that the woody perennial habit has evolved time and time again (convergence) for survival in particular environments. Duration of life form is an adaptive expression - in Alyssum the extreme condition in the long-perenniating species of Sect. Odontarrhena - the significance of which is that as a general rule, annuals by definition grow and perpetuate their race in ecologically open habitats, but perennials can survive and reproduce in open or closed communities. Iltis claims that an annual finding itself in a closed community can either face extenction because of its inability to compete successfully, or will adopt a perennial (or even biennial) life form. The perennial habit (Iltis claims, 1959) in Cleome is a "pseudo-primitive" specialized condition which has evolved from the adaption of precursor annuals in closed environments. This is not /

is not to claim in any way that the development of perennials is monophyletic, or that in fact all annuals are "primitive". In high alpine and rocky scree environments, the perennial Alyssa are much more common than the annual species. It appears that the perennial chamaephytes have a selective advantage as the altitude increases, and are better enabled to survive under the influence of snow protection than are most of the annuals. Many perennials (e.g. A. argyrophyllum) have developed a specialized type of trailing habit. The long, slender and woody caudices of these plants trail among the stones of the screes. The evolution of growth forms has probably occurred many times in different phyletic lines, and whereas the habit of a plant may remain annual it may possess expressions of other characters which may be highly advanced, or vice versa. An example of the retention of the annual habit but with other advanced morphological characters is the fact that all species of Sect. Psilonema have always wingless, toothless and unappendaged filaments. Likewise, some annual species in Sect. Alyssum have superimposed on the annual habit the very specialized ombrochorous and hygrochastic dehiscence and dispersal mechanisms.

In Sect. Meniocus the "primitive" annual habit is correlated with several other expressions which may be considered as "primitive". In the presence of these correlations, as in Cleomella (Iltis, 1956), the assumption that the perennial habit is a specialized state is entirely feasible. Reduction of the number of ovules in the fruit locules has been recognized in the Crucifereae and in the Dicotyledons in general as coincident with specialization. This evolutionary criterion is accepted by Payson (1921) for Lesquerella and by Iltis for Cleomella (1956) /

(1956) and Cleome (1959). Likewise, the simple granular, papillae and/or stiff setae occurring on the fruits of 4 out of the 7 species of Sect. Meniocus can be considered as the "primitive" type of trichome (Payson, 1921). The development of the stellate hair (with or without branched rays) and ultimately the lepidote scale is discussed under the heading of indumentum. The occurrence of the more or less sparse over-all undifferentiated indumentum of the species of Sect. Meniocus is considered less specialized than denser and often differentiated indumentum. Indumentum may be differentiated in terms of density (a manifestation of dimorphism) so that the leaves of many species of Sect. Alyssum and Sect. Odontarrhena may be termed as bicoloured. Differentation of the indumentum can also be the result of a dimorphism of the types of hairs present, leaves, stems, sepals or fruits.

The above and other correlating expressions are listed in the following table. When appropriate the evolutionary trends of these expressions are discussed under their respective headings. In the following table (P) indicates supposed "primitive" expressions; (S) = definite advanced specializations; and (R) = a manifestation of a reversal of evolutionary trends. It must be stressed that the direction of trends of some of the expressions used in this table, such as mucilage production by the seeds, are subject to controversy, and should always be viewed in the light of correlations with other characters such as the anemochorous fruit disseminules of Subsect. Samarifera (Sect. Odontarrhena) which obviously represents a specialized state in Alyssum.

Expressions	Sect. Meniocus	Sect. Psilonema	Sect. Alyssum		Sect. Gamosepalum	Sect. Odontarrhena		
			annuals	perennials		Subsect. Odontarrhena	Subsect. Compressa	Subsect. Samarifera
life form	annual therophytes (P)	annual therophytes (P) or (R)	annual therophytes (P) or (R)	perennial chamaephytes (S)	perennial chameaphytes (S)	perennial chamaephytes (S)		
habit	slender, few-stemmed, sparingly branched herbs (P)	slender, few-stemmed sparingly branched herbs (P) or (R)	slender, few-stemmed, sparingly branched herbs (P) or (R)	± many stemmed, coarse and copiously branched, woody caudices, often caespitose, pulvinate and sprawling; sterile shoots always present (S)	many stemmed and copiously branched, woody caudices, often caespitose, pulvinate or sprawling; sterile shoots always present (S)	± many stemmed, ± copiously branched, always woody caudices, often caespitose, pulvinate or sprawling (S), or erect or ascending (R) sterile shoots always present (S)		
roots	slender, fibrous with few and short secondary roots (P)	slender, fibrous with few and short secondary roots (P) or (R)	slender, fibrous with few and short secondary roots (P)	woody, perennating with net system or strong tap root; secondary roots strongly developed (S)	woody, perennating with net system or strong tap root; secondary roots strongly developed (S)	woody, perennating with net system or strong tap root; secondary roots strongly developed (S)		
overall indumentum disposition	± sparse, homomorphic, concolorous (P)	± sparse, homomorphic, concolorous (P) (or heteromorphic on A. dasycarpum - S)	± sparse, homomorphic (P) or dimorphic (S); concolorous (P) or rarely bicolored (S)	sparse or dense homomorphic (P) or dimorphic (S); concolorous (P) or bicolored (S)	dense, homomorphic (P) or dimorphic (S); concolorous (P)	usually dense and homomorphic, concolorous or bicolored (P, R or S)		
hair type	± minute, few-rayed (P)	few to many and often branched usually long rays (P) or (S)	few or many, often branched and long rays (P) or (S)	few or many, often branched and long rays (P or S) or lepidote scales (S)	few or many, often branched and long rays (P or S) or lepidote scales (S)	few or many often branched rays or lepidote scales (P, R or S)		
fruit indumentum	glabrous or papillose, and/or simple setae (P)	glabrous or stellate hairs (P) or (S)	glabrous or stellate hairs (P) or (S)	glabrous or stellate hairs (P or S) or lepidote scales (S)	stellate hairs or lepidote scales (S)	glabrous or with stellate hairs or with lepidote scales (P, R or S) (rarely papillose, i.e. A. chondrogynum - R)		
fruit dehiscence and dispersal	anemochorous (P) dehiscent (P)	anemochorous (P) (or ombrochorous and hygrochastic in A. damascenum - S) dehiscent (P)	anemochorous usually (P) or ombrochorous and hygrochastic (S) dehiscent (P)	anemochorous (P) dehiscent (P)	anemochorous (P) dehiscent (P)	usually anemochorous (P) dehiscent (P)		whole fruits act as wind dispersed disseminules (R) indehiscent (S)
number of ovules in each locule	4-8 (P)	2 (S)	2 (S)	2 (S)	2 (S)	1 (S)		
placentation	distinctly lateral (P)	apical (S)	apical (S)	apical (S)	apical (S)	apical (S)		
seed mucilage	present (P?)	present (P?)	present (P?)	present (P?) (rarely absent - R?)	present (P?)	usually absent (S?) (rarely present - R?)		occasionally present (R?)

(b) Roots

The roots of Alyssum play very little part in the present systematics of the genus. Most of the annuals are characterized by a fibrous net system with short and slender secondary roots; at the most, the whole root system usually measures 10 cm. long. Annuals growing in very dry and sterile habitats, i.e. the Central Anatolian steppe, form a stronger development of secondary roots than the same species which are found in more favourable environments. The perennials which all have woody caudices and sterile shoots are characterized by strongly woody and long-extending roots either of the net anastomosing type or with a strong tap root. Many of the long perenniating species of Sect. Odontarrhena (i.e. A. caricum and A. discolor have lignose tap roots which may measure 2-3 inches in diameter just below the ground level. Often these roots attain a length of 2 feet or more. The coarse primary and secondary roots of the sprawling perennial A. stribrnyi (Sect. Alyssum), growing in sand dunes in Turkey-in-Europe, were measured by the author to extend (just below the soil surface and more or less horizontally) for 3 feet from the central axis of the plant. Information is not available to show how much difference in the form of root systems is environmentally controlled.

The roots of all the Turkish species of Aurinia are of the coarse and woody tap type with very few secondary roots.

(c) Stems

The fertile stems of most annuals are slender and sparingly branched, erect or ascending. Those of many perennials in Sect. Alyssum, Sect. Gamosepalum and Sect. Odontarrhena are most often copiously branched, decumbent (or procumbent); however, the tallest fertile stems in the genus are found among the perennials of Sect. Odontarrhena. The height of fertile stems was used by Boissier (1867 : 264) to divide the then known species of Sect. Odontarrhena into two major groups; those with "caules pumili" and those with "caules elati". Though the stem height of many species of Sect. Odontarrhena is relatively stable, it cannot be relied upon with certainty as the primary distinguishing character of two natural groups (cf. Nyárády: 1929 & 1949), as it is subject to environmental influences (e.g. A. singarense). Nyárády (1929 : 20 & 1949 :9) used the heightof stems not only for a primary key division in Sect. Odontarrhena ("Humiliores" versus "Elatiores"), but also for implying that the section could be divided into two natural groups. He (1949) refers to his "Humiliores" and "Elatiores" as "tribes" within the section; however, his use of "tribe" appears to impart a meaning to a group of plants equivalent to subsection or series rather than to the genuine Tribus which is the accepted term for a synthetic grouping of genera in a family.

After presenting a more natural and conveniently stable division of Sect. Odontarrhena into subsections (see Key, p. 276) based on fruit type, inflation, dehiscence (or lack of dehiscence) and the configuration of pedicels, the present author uses the height of fertile stems, in conjunction/

junction with their number and the over-all facies of the plant (including the length and disposition of sterile shoots) to separate out species in the key (cf. couplet 16a, p. 251 and couplet 16b, p. 254). Two species, A. singarense and A. cypricum, are very polymorphic regarding the height and number of fertile stems, and are accordingly keyed out twice. It must not be assumed that the author's group of species in Sect. Odontarrhena which is characterised by having tall fertile stems (among other things), is equivalent to Nyárády's "Elatiores"; or that the dwarfed, mat-forming and often caespitose plants constitute a group homologous to "Humiliores". All of the species with samaroid, indehiscent fruits were included by Nyárády, because of their tall fertile stems, in "Elatiores"; however, the present author treats them as forming the natural group, Subsect. Samarifera. Likewise, the dehiscent-fruited species (with compressed fruit valves) which were included in "Elatiores", are now referred to the natural Subsect. Compressa.

Whether fertile stems are strictly ascending or erect, or decumbent, procumbent or laxly sprawling (trailing) is used as a convenient character to separate groups of species in Sect. Alyssum (see key, couplet 24a, p. 230 and couplet 24b, p. 234). This expression is, however, always used in conjunction with other features, such as the consistency of fruit valves, habit of growth (i.e. many-stemmed and cushion forming or few-stemmed and erect or ascending), types of indumentum and the length and disposition of the sterile shoots.

One particularly noticeable feature of most perennial species of Alyssum is that they are basally woody (suffrutescent, suffruticose or fruticose/

fruticose). The most extreme woodiness is exemplified by such subshrubs as A. caricum, A. discolor, A. masmenaeum, A. cypricum and A. troodi, among others, which form large cushions often measuring c. 3 feet in diameter. The basal woody caudices of many species become elongate, erect, copiously branched and leafless (aphyllous) as the plants grow older. Some of the alpine species, such as A. argyrophyllum, have woody and aphyllous though slender caudices which trail along the ground and between the stones of the screes. Many of the suffrutescent, sprawling and decumbent or erect-stemmed perennial species in Sect. Alyssum (i.e. A. pseudo-mouradicum, A. erosulum, A. repens subsp. trichostachyum and the erect-stemmed fruticose components of Sect. Odontarrhena (i.e. A. corsicum, A. masmenaeum, A. caricum, A. murale and A. elatum, among others) have single, often very thick unbranched caudices at soil level (which Nyárády terms the "Mutterstocke"). These single caudices, as the plant increases in size and age, produces a strong, diffuse pattern of branching above the base. Some mat-forming and caespitose perennial species (particularly alpines and steppe inhabiting plants), such as A. aurantiacum, A. praecox, A. aizoides, A. caespitosum in Sect. Alyssum, all species in Sect. Gamosepalum, and A. davisianum (Fig. 4, 22), A. oxycarpum, A. pateri, A. gehamense, A. sibiricum, and A. filiforme, among others, have caudices which are copiously branched, in some cases the branches originate from a woody stock below the soil surface.

That a plant is a perennial can always be seen (on well collected material) from the woody caudices and the presence of leafy sterile shoots which are conferted on the crown of the plant (in the case of mat-forming and/

and caespitose species) or along the lower parts of the caudices or fertile stems (in the case of many erect-stemmed or decumbent species). As the plants increase in age, the stems branch abundantly upwards. The perennial habit can also be recognised by the "girdles" of leaf scars, or the scars (and fragments) of old stems present on the woody caudices.

The disposition of leaves on the fertile stems is often of value in distinguishing species (homophyllous versus heterophyllous). A. filiforme, A. condensatum, A. virgatum and A. obtusifolium of Sect. Odontarrhena, and A. calycocarpum of Sect. Alyssum have basal cauline leaves aggregated in a zone distinct from the evenly distributed upper cauline leaves. The same situation may occur also on the sterile shoots. Homophylly or heterophylly should not be confused with the different character of gradual sizal increase or decrease of leaves upwards on the stems. The increase or decrease of leaf size as well as the dimorphism of leafy zones on the stems may be used to distinguish taxa. For example, the cauline leaves of A. harputicum and A. niveum (Sect. Gamosepalum Series Libra) increase in size upwards, but those of A. lycaonicum, in the same natural group, decrease in size in the same direction. The leaves of the sterile shoots may, likewise (depending upon the taxon) increase or decrease in size upwards.

Occasionally the presence or absence of indumentum on the fertile stems can be used to distinguish taxa; for example, A. borzaeanum has stems (upper portions) which are generally covered with a white and matted indumentum, while those of the allied A. sibiricum are greenish or brownish with a sparse indumentum. The fertile stems of Aurinia uechtritziana are consistently whitish with a dense indumentum, but those of A. saxatilis are/

are greenish with a sparse hair covering. Reddish pigmentation in the epidermal cells of the fertile stems is occasionally of value in distinguishing taxa, but this character must be used judiciously as it may often be inconstant and subject to environmental influences or reflect the age of the plant. The fertile stems of A. cypricum, A. huber-morathii, A. callichroum, and A. eriophyllum are generally a deep wine-red shiny colour for 3/4 - ½ their length, but the fertile stems of A. condensatum, A. haussknechtii, A. filiforme and A. anatolicum are greenish, brownish or yellowish or, if dull red, then only for the lower ¼ of the stems. It was once thought that the best character to distinguish A. rubricaule (Jord. & Fourr.) Burtt from A. murale was its reddish fertile stems (accounting for itsspecific epithet). The author has observed, however, that reddish stemmed plants of A. murale occur throughout its whole specific range; accordingly, it is not justifiable - in the absence of any other diagnostic features - to give taxonomic recognition to A. rubricaule.

In addition to their woody caudices, perennials also form a more or less copious development of sterile shoots (i.e. leafy shoots which in the current year are vegetative, but become fertile stems in the next growing season, or in any succeeding seasons). The number, length and disposition of sterile shoots, in conjunction with other expressions are of value in the construction of distinguishing keys; for example, couplet 25a, p. 231 and couplet 25b, p. 232 in the key of Sect. Alyssum or couplet 2a, p. 247 and 2b, p. 248 in the key of Subsect. Odontarrhena. The form and disposition of the leaves on sterile shoots, as well as the type of indumentum /

indumentum on the leaves and stems (e.g. A. eriophyllum, Fig. 1A, f) may be important in separating taxa. Occasionally plants composed entirely of sterile shoots occur individually and independent of a woody caudex of a fertile plant. These are known to occur in populations of A. corsicum, A. singarense and A. eriophyllum and must be considered as juvenile plants. Because of the similarities between sterile shoots of many species, care should be exercised in using the characters of the sterile shoots alone for identification. They should be evaluated in conjunction with other diagnostic or differential expressions.

The fertile stems of all Turkish representatives of Aurinia are erect or ascending from very thick, indurated and sparingly branched caudices. These caudices are always densely foliate with linear and narrow rosulate leaves or rosettes of leaves. The caudices of the perennial Alyssa are most usually naked, the only evidence of leaves having been present being the remaining scars; however, the caudices of Aurinia saxatilis, Au. rupestris and Au. uechtritziana are covered with a more or less dense layer of persistent and swollen leaf bases. According to Metcalfe and Chalk (1950) and Hollendonner (1909) the blades and most of the petioles of Au. saxatilis become detached when the leaf has matured and at the close of the growing season by the development of an abcision layer of cells. After detachment, the remaining petiole bases develop a large amount of phellogen.

Little is known about the anatomy of Alyssum stems, but Metcalfe and Chalk (1950) indicate that the stems of A. spinosum (Sect. Tetradenia) have /

have a rather anomolous anatomy. In this species, the mature wood is composed of alternating concentric rings of 1) large-vesselled lignified xylem and 2) small-vesselled unlignified xylem. The cambium forms a continuous ring and medullary bundles are absent. The stems of Aurinia saxatilis have bundles of xylem of the same concentric pattern, but are separated from each other by lignified parenchyma (formed from the primary tissue), and a broken cambium; however, Hollendonner (1909) records the presence of an inner cambium in the older stems of this species (as Alyssum arduini). Nyárády (1949) draws attention to the difference in stem anatomy (inflorescence rachis) of A. obovatum (Meyer) Turcz. and A. microphyllum (Meyer) Meyer. The central pith of A. obovatum constitutes the major part of the stem, outside of which there is a relatively wide band of xylem and a narrow ring of cortex. The band of cortex in A. microphyllum is very wide and the ring of xylem and central column of pith are reduced. A more detailed examination of stem anatomy of representative species of Alyssum would be rewarding as an aid in elucidating relationships within the genus.

(d) Leaves

The long (up to 100 mm.) linear leaves of Aurinia with repand, dentate or even pinnatifid margins and persistent petiole bases (densely imbricated) which are situated on indurated caudices constitutes one of the major diagnostic characters distinguishing this genus from Alyssum. Among other considerations, these leaf characters - which are possibly "primitive" in the Cruciferae (Payson, 1921) - have led to Aurinia being placed before Alyssum in the following systematic treatment.

The leaves of Alyssum are always entire (with the rare exception of A. homalocarpum) and are exceptionally more than 20 mm. long. A. homalocarpum in Sect. Psilonema has leaves which have, infrequently, small dentations on the margins towards the apex. For different parts of the plant, i.e. sterile shoots, basal and upper portions of the fertile stems and leaf size and shape, condition of the apex (acute, obtuse, truncate or mucronate), whether long petiolate or sessile, and the indumentum type, disposition and density are constant for any given species and may be used diagnostically once the range of variation and the features of each leaf zone are understood. An example of cauline leaf differences being used to distinguish taxa is seen in the key of Sect. Alyssum (couplet 34a and 34b, p.233). All the cauline leaves of A. montanum are oblanceolate and acute, but those of A. stribrnyi are dissimilar; its lower cauline leaves being obovate, spathulate and obtuse, its upper cauline leaves oblanceolate and acute. This type of leaf dimorphism may also occur on the sterile shoots.

The fact that the cauline leaves of some species increase or decrease in size upwards has been ignored by past workers, but it was found to be of definite distinguishing value for many species. For example, the cauline leaves of A. murale, A. tenium, A. akamasicum and A. subspinosum in /

in Sect. Odontarrhena Subsect. Compressa gradually increase in size upwards, whereas the lower cauline leaves of A. cassium, in the same subsection, are much larger than the upper ones, though of the same basic shape. Very often the attenuation of the petiole, associated with leaf shape, may be used to distinguish species or groups of species; i.e. the usually linear-oblanceolate cauline leaves of A. murale are gradually attenuate to their bases and do not have noticeably differentiated petioles, but the obovate, spathulate-orbicular cauline leaves of A. tenium and A. akamasicum are abruptly constricted below their blades into relatively long and well differentiated petioles.

The disposition of leaves may be important in distinguishing taxa, that is, whether they are evenly distributed along the stems or whether they form distinct zones. The latter condition is an expression of heteromorphism (or dimorphism) and can be further subdivided into 2 types: 1) the lower-most cauline leaves forming a distinct, conferted basal zone and 2) the upper-most cauline leaves being involucrate and subtending the inflorescence. An example of (1) is found in A. virgatum which in many features resembles A. peltarioides, but can be separated from it by possessing a zone of congested basal leaves on the fertile stems. The presence of involucral leaves can be used with certainty to recognize among other species, A. troodi, A. chondrogynum, A. borzaeanum, A. smolikanum, A. obtusifolium, A. bracteatum and A. gehamense in Sect. Odontarrhena; A. tetrastemon, A. lepidoto-stellatum, A. paphlagonicum and A. baumgartnerianum in Sect. Gamosepalum; and A. strictum, A. contemptum, A. umbellatum, A. szowitsianum, A. marginatum, and A. cephalotes in Sect. Alyssum. Frequently combinations of leaf characters can be used advantageously /

advantageously to distinguish taxa; i.e. though both A. smolikanum and A. obtusifolium have involucrate leaves, the fertile stems of the latter are always heterophyllous, and those of the former homophyllous.

The type of indumentum present on the leaves of any particular leaf zone is constant. A homomorphic and concolorous indumentum of stellate hairs is found uniformly on both leaf surfaces of all components of Sect. Meniocus. The leaf indumentum may also be expressed in two dimorphic states: 1) the presence of two types of hairs (dimorphic); 2) density differences on the upper and lower surfaces. The upper cauline leaves of A. baumgartnerianum, A. corningii and A. sulphureum in Sect. Gamosepalum Series Libra have an indumentum composed of appressed lepidote or sublepidote hairs, and divergent-rayed, often furcate and tuberculate hairs. This is an example of dimorphic or heteromorphic indumentum. Differences in indumentum density between the upper and lower leaf surfaces (though usually of the same basic type of hair) are also of distinguishing value, depending upon the leaf zone referred to. In the key of Subsect. Odontarrhena, A. smolikanum is distinguished from A. oxycarpum, among other differences, by having bicolored cauline leaves. The sterile shoots of A. smolikanum are also bicolored, and though the cauline leaves of A. oxycarpum are always concolorous, its sterile shoot leaves are as often bicolored as concolorous. The cauline leaves of A. floribundum and A. samariferum in Sect. Odontarrhena Subsect. Samarifera are of the same size and shape, and have the same type of indumentum covering (concolorous); however, the sterile shoot leaves of A. floribundum are always strongly bicolored (upper surface bright green and sparsely pubescent, and lower surface silvery-white with a dense pubescence), while both /

both surfaces of the sterile shoot leaves of A. samariferum are always silvery-white and concolorous.

Very few taxa are distinguished by having imbricated leaves, such as found on A. sphacoticum. In addition to some other obvious characters, this species may be separated from its allies (i.e. A. lassiticum and A. propinquum) by having two zones of cauline leaves; the lowermost densely foliate zone is composed of broadly ovate or obovate leaves which are appressed vertically against each other and the stem, the upper zone has leaves which are 2-3 times narrower than the lower ones and more or less patent. The leaves on the conferted sterile shoots of A. lepidotum are larger than its cauline leaves, and are imbricated against each other for more than ½ their surface area.

The leaves of most species of Alyssum are flat; however, some species in Sect. Odontarrhena have leaves (particularly the leaves of the sterile shoots) that are always folded or conduplicate. This is true of the linear-oblanceolate and acute sterile shoot leaves of A. huber-morathii and A. heldreichii, and the spathulate, obtuse or truncate sterile shoot leaves of A. cypricum. This expression, which involves the folding of one half of the leaf over the other half, is not to be confused with the subterete leaf type which is also very rare in the genus. In cross-section the subterete leaf is superficially cylindrical (though grooved) and appears (according to Nyárády: 1925, Triplopetalum) to have resulted from the folding over of the leaf margins and by the gradual reduction of the central tissue surrounding the midvein of an ancestrally thicker leaf. Superficially cylindrical leaves of this type are diagnostic for A. pinifolium (Triplopetalum) and appear occasionally, though not consistently, on the /

on the sterile shoots of allied species of Sect. Odontarrhena Subsect. Samarifera - namely A. virgatum and A. samariferum, A. harputicum in Sect. Gamosepalum Series Libra is also characterized by the long superficially cylindrical leaves of its cauline and sterile shoot. There is also a tendency for the sterile shoot leaves of the related A. thymops to be subterete. It is not difficult to visualize that the development of this type of leaf - particularily for the species in Sect. Gamosepalum which inhabit very arid steppe - is a specialization associated with water conservation.

The excellent illustrations of representative species from Sect. Odontarrhena provided by Nyárády (1927: Tables 5 & 6; 1949: Tables 1, 2, 3 & 4) are very useful for identifying taxa, determining the constancy of and evaluating the variation of leaf size, shape, etc. These illustrations are especially important because Nyárády has recognized that different forms of leaves occur on different parts of the plant, i.e. leaves of the sterile shoots, lower cauline leaves, and upper cauline leaves. Likewise, his illustrations (1927: Tables 3, 4 & 5 - as B) of the types of hairs occurring on the leaves are very informative. Care must be taken to know exactly what part of the plant a leaf has come from before using its characters for identification.

(e) Inflorescence

The inflorescences of Aurinia saxatilis and Au. uechtritziana are compound and corymbose characterized by much secondary and tertiary branching. The other Turkish representative of the genus, Au. rupestris, has simple and unbranched racemes.

The inflorescences of Alyssum are basically racemose, but there are several modified types of simple unbranched racemes which in the keys are called spicate, cylindrical, conical, pyramidal, umbellate or candelabriform. The candelabriform raceme (on which the fruits are held in a different direction to the pedicels, and the divaricate pedicels decrease in length upwards on the raceme) characterizes all components of Sect. Tetradenia. The pedicels on this type of inflorescence are arcuate and recurved - the lowermost are 2-4 times longer than the upper ones - and the fruits are born horizontally or erect. Most of the annual species of Alyssum have a simple recemose inflorescence which is basally branched and can be regarded as a simple panicle, in that the branches are seldom equivalent to the length of the main axis. When branching does occur, the ultimate inflorescences are racemose. A specialization of the raceme is observed in the hygrochastic species of Sect. Alyssum, such as A. strictum, A. szowitsianum, A. umbellatum, etc. whose racemes are pyramidal, cylindrical, umbellate or spicate with imbricated fruits and appressed pedicels (when dry). The form of the raceme is diagnostic for these species. A simple raceme may be few-fruited and corymbose, as is the case with A. idaeum, a fact which will help to separate that species from its relative, A. mouradicum, which has elongate, many-fruited and racemose inflorescences. Likewise, the separation of A. praecox from the sympatric A. argyrophyllum /

A. argyrophyllum is facilitated by the former having elongate racemes, the latter condensed racemes.

The general inflorescence, instead of being a simple raceme, may be compound, with many branches, in which case it can be corymbose or paniculate. The branches (excluding the ultimate racemes) of these inflorescences may either be racemose or corymbose. The racemose type of branches occur on such species as A. tortuosum and A. longistylum; the corymbose on the infloresences of all components of Sect. Odontarrhena Subsect. Samarifera. The general inflorescences of the species in Sect. Odontarrhena are primarily corymbose or paniculate: the former if the secondary and tertiary branches terminate at roughly the same height, the latter if the branches do not terminate at the same height. A few species in this section have simple and unbranched racemes which may be elongate (i.e. A. euboeum) or condensed (i.e. A. bracteatum and A. gehamense).

The angle and length of the inflorescence branches may be of significance in distinguishing taxa; for example the corymb branches of A. callichroum are long, arcuate and flexuose, but those of its close ally, A. constellatum, are always rigid, ascending or divergent, and are shorter than those of A. callichroum. Another important inflorescence character which is of use in the construction of keys is the disposition of the fruits on the inflorescence branches. As can be seen from couplets 35a and 35b, p.262 in the key of Subsect. Odontarrhena, the fruits of A. tortuosum and A. longistylum are evenly distributed on the inflorescence branches (racemose) for a distance of 8 cm.; however, the fruits of A. condensatum, A. inflatum, A. pateri and A. lanigerum - all of which have branched corymbs, though often more compact than those of A. tortuosum and A. longistylum - are /

are conferted at the apices of the branches (corymbose) for a maximum of 3 cm. The components of Subsect. <u>Samarifera</u> all have more or less widely branched compound corymbs or panicles (except <u>A. virgatum</u> whose inflorescences are frequently compact with branches no more than 5 cm. long), but their samaroid fruits are aggregated together for a short distance near the branch apices (as simple corymbs). This situation is illustrated on Fig. 6 for <u>A. caricum</u> (no. 1) and on Fig. 7 for <u>A. dubertretii</u> (no. 2).

Very often the length and thickness of the pedicels can be used advantageously in keys; likewise, the angle of divergence from the inflorescence branches, i.e. whether divergent (as Fig. 2, a), ascending (as Fig. 2, c), horizontal (as Fig. 2, f) or deflexed and sigmoid (as Fig. 2, o & p). Once the full range of expression of pedicel length, width and manner of disposition is established for each species, these characters can be used safely to separate allied species (cf. key of Sect. <u>Alyssum</u>, couplets 50a and 50b, p. 239) or to distinguish groups of taxa as done in the key of Sect. <u>Alyssum</u>, couplet 9a, p. 225 and couplet 9b, p. 227.

In the hygrochastic annual species of Sect. <u>Alyssum</u>, the pedicels (when dry) are appressed to the inflorescence axis (Fig. 2, g) but in the presence of moisture, spread to a more or less median and horizontal position. The bases of these hygrochastic pedicels are much wider than their apices, and the lowermost pedicels are 2-4 times longer than the upper ones. The anatomical basis of the hygrochastic movement is explained in Section VIII, part 2 and by Zohary and Fahn (1941).

The pedicels of the species of Sect. <u>Odontarrhena</u> Subsect. <u>Samarifera</u> are always slender, brittle, deflexed and sigmoid or S-shaped (Fig. 2, p). This is a specialized condition associated with the wind dispersed indehiscent and /

and samaroid fruits of the group. The more or less sigmoid and brittle type of pedicel is also one of the diagnostic features of the species comprising Series Crenulata of Sect. Odontarrhena Subsect. Compressa (Fig. 2, c). The pedicels of the components of the typical series of this subsection are always rigid, stout and more or less spreading. Also, the pedicels of most species in Subsect. Odontarrhena are always rigid and stout, and are usually ascending, spreading or horizontal. A. penjwinensis is an exception to this pattern by having pedicels which, though rigid and straight, are most often deflexed. The pedicels of this species also illustrate another character which merits some recognition, that is, their distance apart on the inflorescence branches. Among other obvious characters, this species may be distinguished from A. constellatum, a close ally, by its pedicels being always 3-5 mm. apart and evenly distributed. The pedicels of A. constellatum are never more than 2 mm. apart and are usually aggregated at the apices of the branches.

The type of indumentum present on the pedicels and inflorescence may reflect that which is found on the fruits, such as the dimorphic indumentum of A. strigosum, A. hirsutum (Fig. 2, f) and A. xanthocarpum, or the homomorphic indumentum of A. minus and A. stapfii (Fig. 1A, c). The pedicel indumentum may also be, as with A. idaeum, A. mouradicum, A. praecox and A. argyrophyllum, of the same over-all type (for these species, lepidote scales). Often the pedicels are only very sparsely pubescent and are greenish or brownish; those of the species of Sect. Odontarrhena Subsect. Samarifera are all of this nature.

(2.) Flowers and Fruits

A floral diagram of a representative Alyssum flower (A. fulvescens) is provided in Figure 3. This diagram and the lateral and face views (without perianth) show the basic regular pattern of an Alyssum flower and the relative positioning of the parts. The positioning of the parts is important when comparing the structure of the short filaments to that of the long filaments, as confusion can readily result if the two types of filaments are mistaken for one another. It is seen from these illustrations that the calyx is composed of two whorls, 2 outer sepals in the vertical plane (opposite the fruit sutures), and 2 inner sepals in the horizontal plane (opposite the fruit valves). The corolla is of one whorl of 4 separate petals which are positioned opposite the points of over-lap (or near-overlap) of the sepals. The stamens are of two whorls (tetradynomous); the outer whorl is composed of two short stamens each of which is opposite an inner sepal and is subtended by one nectary or gland at each side; the inner whorl is of 4 long stamens which occur in groups of two, each group being opposite an outer sepal. The ovary in the centre of the flower has a well developed replum in the vertical plane, with the valves, and is always bilocular.

(a) Sepals

The calyces of the Turkish representatives of Aurinia are all cup-shaped and made up of spreading, ovate and obtuse sepals which are more or less as long as wide. The calyces of all species of Alyssum are oblong with erect, ovate or lanceolate (rarely obovate), acute or obtuse sepals which are always longer than broad.

The sepals of Alyssum are never of two distinct types or saccate, though /

though they occur in two whorls, with the exception of all the species in Sect. Gamosepalum. The sepals of these taxa are always distinctly dimorphic; the outer two sepals being wider and longer than the two inner ones. The persistent calyces in this section may become more or less inflated as the fruits mature, a condition exemplified by A. lycaonicum.

The size of the sepals, as related to the over-all size of the flower, is frequently of distinguishing value, as well as their shape and condition of apices (cf. couplets 35a and 35b, p. 262 in the key to Subsect. Odontarrhena). The fact of having persistent or deciduous sepals is often a constant and convenient character to separate taxa or groups of taxa; for example, couplet 33a, p. 233 and couplet 33b, p. 233 in the key of Sect. Alyssum. It must be remarked that few species in Sect. Odontarrhena have long persistent sepals as occur for many species of Sect. Meniocus, Sect. Psilonema, Sect. Alyssum and Sect. Gamosepalum. The only Anatolian exception in Sect. Odontarrhena is A. lesbiacum (Subsect. Samarifera) whose sepals are more or less persistent when fruiting, a feature which helps to distinguish this species from A. dubertretii.

A discussion of the phenomonon of the "pseudo-connation" of the sepals of Sect. Gamosepalum, due to interlocking hairs, is found on p. 208. The sepals of all other sections of Alyssum (with the exception of A. caespitosum in Sect. Alyssum) are always free; their indumentum is never interdigitating so as to cause the sepals to appear fused. Another unique feature of the dimorphic sepals of Sect. Gamosepalum is the presence of an indumentum on their inner surfaces, which may be of different types of hairs depending on the species. The inner sepal surface of A. tetrastemon is covered with two types of hairs, stellate hairs with long /

long sericeous rays of unequal lengths and minute stellate hairs with short and equal rays. The inner sepal surface of A. lepidoto-stellatum and A. paphlagonicum is covered only with hairs with long sericeous and unequal rays. The sepals of no other taxa of Alyssum possess this feature (with the rare exception of A. caespitosum which is closely allied to Sect. Gamosepalum : see tables 6 & 7).

The margins of the sepals are often hyaline and membranous. The width of this margin or wing can be used conveniently to separate taxa, as in the case of A. montanum whose hyaline sepal margins measure 0.1-0.2 mm. wide, while those of the allied A. stribrnyi measure 0.3-0.5 mm. wide. The hyaline sepal margins are also of taxonomic importance in Sect. Gamosepalum, not only as far as their width is concerned - i.e. those of A. baumgartnerianum are 0.3-0.4 mm. wide and those of A. corningii and A. sulphureum are 0.1-0.2 mm. wide - but also that they may or may not be obscured by an indumentum. The species of Series Libra which have a completely homomorphic indumentum (A. harputicum, A. niveum and A. lycaonicum) have hyaline sepal margins which are obscured by the interlocking indumentum, but those species with a dimorphic indumentum (at least on the upper parts of the plants), such as A. baumgartnerianum, A. corningii, etc., have hyaline sepal margins which are not obscured by hairs, but merely overlap.

The indumentum on the sepals is often of assistance in constructing keys and recognizing taxa. For example, the sepals of A. aizoides, A. bornmuelleri, A. doerfleri and A. taygeteum have an apical tuft of furcate, sericeous and often tuberculate hairs intermixed with lepidote or sublepidote scales, but the sepal indumentum of A. caespitosum is always /

always homomorphic, composed of only lepidote scales. The sepals of most species of Alyssum are densely pubescent, however, those of the species of Subsect. Samarifera in Sect. Odontarrhena (as well as their pedicels) being often only very sparsely pubescent. In the case of A. pinifolium in this group, the sepals are almost glabrous and are furnished with pellucid dots which upon closer examination can be identified as crystals in some epidermal cells (cf. Nyárády, 1925).

(b) Petals

It has long been maintained that the petals of Alyssum were always yellow, and plants with whitish petals must automatically be referred to "Ptilotrichum". Ptilotrichum as a genus is no longer recognized by the author and its components have been distributed among other genera (cf. p. 18), including Alyssum. Petals of all members of Alyssum Sect. Tetradenia (once as Ptilotrichum) are whitish and very often purplish or reddish on their claws. Likewise, the petals of Ptilotrichum canescens and Pt. purpureum, now referred to Sect. Alyssum (see p. 29), have whitish flowers, those of the latter species becoming more reddish as the altitudinal range is extended. Most species of Sect. Gamosepalum Series Gamosepalum have whitish petals which are purplish veined, especially at their throats; this feature is discussed more fully on p. 209 . Petal colour is a notoriously difficult character to appraise from dried specimens - a fact which accounted for the initial description of A. thymops in Ptilotrichum because its pale cream colored petals appeared whitish when dry - but as a general rule, it can be said that the petals of most Alyssum species considered in the following study are yellow. There may be various degrees of yellowness, however, which can be used to aid the distinguishing of taxa; for example, the petals of A. ochroleucum are always dullish and pale yellow, while those of the allied A. armenum are always deep flavous. A number of annual species, such as A. linifolium in Sect. Meniocus, A. alyssoides and A. dasycarpum in Sect. Psilonema, and A. desertorum and A. turkestanicum in Sect. Alyssum have very pale petals, a condition which has often been referred to as pallide. Care must be taken, however, that the color of petals on dried plants /

plants is actually as it was before the plants were pressed and dried. Accurate field notes are very valuable for evaluating the flower color of dried material. Two Turkish species of Aurinia, Au. uechtritziana and Au. rupertris, have white petals but the other Turkish representative of the genus, Au. saxatilis, always has deep yellow flowers. Rarely, white petalled variants of normally yellow petalled species occur; one such example has been described by the author as A. praecox var. albiflorum.

The shape of the petals, the configuration of their apices, and the attenuation or dilation of their claws are of taxonomic significance, particularly in Sect. Meniocus, Sect. Alyssum and Sect. Gamosepalum. These features are constant for any given species. The major petal shapes, apex shapes, claw attenuations and dilations are illustrated in Figure 1B, in order of increasing complexity and elaboration. The use of the petal terminology in the keys conforms to that in the explanatory legends accompanying this figure. The apex of a petal may be entire (as Fig. 1B, c) truncate (as Fig. 1B, g), retuse (as Fig. 1B, a, b & f), emarginate (as Fig. 1B, d) or bilobed (as Fig. 1b, e). The shape of the petal may be classified as 1) obovate (as Fig. 1B, b & c) or 2) spathulate (as Fig. 1B, e, f & g). As a general rule the author has applied the term spathulate to any petal which has a relatively wide limb, and which is constricted or often abruptly attenuated at the middle. The claws of petals may be gradually attenuate from the limb to the base (as Fig. 1b, a) or abruptly attenuate (as Fig. 1B, c). The claws may be narrower than the limb (as Fig. 1B, a, b & c) or may be dilated and almost as wide as the limb, following a central constriction (as Fig. 1B, d, e, f & g). The margins of these dilated claws may be entire (as Fig. 1B, d /

d & e), denticulate (as Fig. 1B, f) or pointed (as Fig. 1B, g).

It would be exceedingly risky to interpret the various petal shapes and different elaborations in simple evolutionary sequence. The trends of evolution of petal type and form have probably proceeded in several directions - specialization both by increasing complexity and by simplification. The simplest type of obovate and gradually attenuate petal is found in the annual small-flowered species, while some large-flowered annual species, such as _A. stapfii_ (Fig. 1B, e) and _A. hirsutum_, have a more elaborate, spathulate type of petal which is centrally constricted and whose claw is widely dilated. This elaborate form of petal is also found in many large-flowered perennial species in Sect. _Alyssum_ and Sect. _Gamosepalum_, but is never known to occur in any of the smaller-flowered species in Sect. _Odontarrhena_. There is an interesting correlation between the number of flowers, size of inflorescence and the size and shape of petals. The inflorescences of Sect. _Alyssum_ and Sect. _Gamosepalum_ are generally much shorter and fewer-branched with fewer flowers than those of Sect. _Odontarrhena_. The more elaborate and larger petals are associated with the fewer-flowered and smaller inflorescences. The petals of the species of Sect. _Odontarrhena_ are basically of the simple obovate shape with abruptly attenuate claws, with only rare exceptions (i.e. _A. gehamense_ whose petal claws are gradually attenuate). The large petals of _Aurinia saxatilis_, however, are associated with a large paniculate inflorescence, but though these petals are bifid, their claws are gradually attenuate; the same applies to the petals of _Au. rupestris_, whose inflorescence is a simple raceme.

A petal character which is of considerable taxonomic importance, but has /

has long been ignored, is the presence of an indumentum. This feature is constant for any given species and can be used with certainty to distinguish taxa; for example, in Sect. Alyssum the petals of A. aizoides, A. bornmuelleri, A. doerfleri and A. taygeteum are always glabrous or if sparsely pubescent, the hairs occur only on the limbs, but the petals of A. caespitosum are always densely pubescent only on the claws. In the absence of any significant petal shape differences for most species of Sect. Odontarrhena (though sizal differences can be used), the presence or absence of indumentum is a convenient character (cf. couplets 19a and 19b, p.251&252 in the key to Subsect. Odontarrhena).

Appendages at the bases of petals are diagnostic for two species in Sect. Odontarrhena Subsect. Samarifera, namely A. lesbiacum and A. pinifolium (fig. 1B, c); however, teeth and appendages occur sporadically on the petals of A. borzaeanum, A. caliacrae, A. sibiricum and A. virgatum, among others.

(c) Stamens

Though the size of the stamens and the configurations of their wings and appendages are consistent (within the established range of variability) for any given taxon (a question of debate, e.g. Baumgartner, 1907; Nyárády, 1927) and are valuable aids for identification if fruit is lacking, these characters have been omitted for the most part from the following keys because of the difficulty of observation and the necessity of floral dissection. In only one case, A. pateri are the infra-specific taxa distinguished on staminal characters. The wings of the long stamens of subsp. pateri are narrow with few apical teeth, while those of subsp. prostratum are wider with many apical teeth.

From among all the sections of Alyssum, only one - namely Sect. Psilonema - is characterized by wingless, unappendaged and edentate filaments (Fig. 1B, h). Both Nyárády (1927) and Payson (1921 - for Lesquerella) maintain that staminal appendages, wings and toothing are "primitive" expressions. If this in fact is true - a question which the present author is not prepared to settle at the present time - the lack of these structures on the stamens of the species of Sect. Psilonema probably represents a reduction trend towards simplification. It must be pointed out, however, the presence of staminal appendages and teeth in Alyssum, though possibly "primitive" and ancestral expressions in that genus, certainly must be regarded as specializations in the Angiospermae as a whole. Also, within the Cruciferae, if one accepts Zohary's (1947) conclusions, based primarily on evolutionary trends in fruit development, that the Sisymbrieae /

Sisymbrieae is the most "primitive" tribe in the family, it follows that staminal appendages and teeth are specializations. The genera in the Sisymbrieae never have staminal appendages or teeth. Neither do the Papaveraceae which are thought to be ancestral to the Cruciferae. Most genera in the Alysseae do have staminal appendages or teeth, with the exception of Lobularia. The lack of these structures for Lobularia could be interpreted in the same manner as the lack of them for the components of Alyssum Sect. Psilonema, i.e. a trend towards simplification.

It was found that even the stamens of Ptilotrichum canescens (the type species of Ptilotrichum) were basally toothed, thereby abolishing one of the supposedly diagnostic characters of edentate stamens of that genus, and permitting this taxon and other to be established as components of Sect. Alyssum. The stamens (both long and short) of Aurinia are also basally toothed (cf. Günthart, 1902: Table 5 as Alyssum saxatile and Nyárády, 1927: Table 7, fig. 104 - Au. petraea, as Alyssum microcarpum). Likewise all stamens (particularly the short filaments) of the species of Alyssum Sect. Tetradenia (e.g. A. spinosum and A. cochleatum) have small basal teeth, or are dilated towards their bases or are furnished with rudimentary teeth.

The basic diversity of the wings of the long filaments is illustrated in Fig. 1B (h-r) that of the short filament appendages in the same figure (s-y). These are the main type of configurations found in the species considered in the following study. The long filaments may be unilaterally winged (characteristic of all species /

species in Sect. Meniocus; as Fig. 1B, i), or bilaterally winged (as Fig. 1B, k, l, m, n, p & q), a condition which is characteristic of all the other sections of Alyssum (excluding Sect. Psilonema). The unilateral wings may be unidentate at their apices (as Fig. 1B, i) or occasionally dentate. The bilateral wings may also be dentate (one or both wings) as illustrated in Fig. 1B, k, l, m, n, o, p & q), and may be of unequal widths (as Fig. 1B, l).

Within Sect. Alyssum, a number of annual species have long filament wings which are gradually narrowed towards their apices and dilated towards their bases, i.e. A. hirsutum (Fig. 1B, k). Many perennial species of Sect. Alyssum and all species of Sect. Gamosepalum possess this type of long filament. The only fused filaments occurring within the genus are found for the components of Series Gamosepalum in Sect. Gamosepalum. Their gradually narrowing long filaments are fused along their wing margins; the amount of fusion being diagnostic for some of the taxa, i.e. the long filaments of A. tetrastemon cohere for their entire length, while those of A. lepidote-stellatum, A. paphlagonicum and A. thymops are fused for only ½ or rarely more of their length.

Another trend in the wing development of the long stamens is the length to which they extend on the filament, and the extent to which the wings are connate to the filament. The latter feature is of particular importance in recognizing species in Sect. Odontarrhena, and is used in the key to Subsect. Odontarrhena (cf. couplet /

couplet 31a, p.259 and couplet 31b, p 261). The wide, bilateral and multidentate long stamen wings of A. filiforme (Fig. 1B, p), A. singarense and A. anatolicum are connate to the filaments for less than ½ their length, while the unilateral, narrow and usually unidentate wings of the long stamens of A. tortuosum, A. longistylum, A. gehamense, etc. are connate for more than ½ their length (often their entire length - as Fig. 1B, q). The long stamens of A. pinifolium are rather unusual in the genus in having short deeply bifid or trifid appendages which are connate to the filament bases (Fig. 1B, r).

The appendages of the short stamens (so called because they are always shorter than the long stamens comprise the outer whorl) may be as long as the filaments (as Fig.1B, s & t) or shorter (as Fig. 1B, u, v, w & x); they may be simply acute or variously dentate at their apices (as Fig. 1B, s, t, x, & y). If free, the short stamen appendages may be easily separated from the base of the filaments (as. Fig. 1B, t & u), or they may be connate for various lengths (as Fig. 1B, s, v, w, x & y). The constancy of the configuration of the short stamen appendages for any given species is well illustrated by Günthart (1902) who provides figures on the short stamens of A. montanum with appendages which are all lanceolate or ovate, 1-3-dentate at their apices and connate at the filament bases.

The filaments of both stamen types are usually more or less erect at the time of anthesis; however, some species (especially those /

those in Sect. Odontarrhena which have unequally inflated fruits that are S-shaped in cross-section) have filaments which are bent and incurved over the pistil (cf. key to Subsect. Odontarrhena, couplet 12a, p.249 - A. borzaeanum). After anthesis, the unwinged part of the filaments (terminated by the anthers) move to an erect position. This feature is noticeable for A. borzaeanum, A. sibiricum, A. corymbosoides, etc. and is illustrated by Nyárády (1927: Table 7) for the former two species. He also indicates invurved filaments for A. obtusifolium, but no specimens of this taxon, which the present author has examined, have the incurved type of stamen.

There appears to be no difference between the anthers of the short and long stamens. As a general rule the anthers are obtuse; however, some species have acute anthers. Upon closer examination, this acuteness is attributable to a prolongation of the connective between the anther sacs. This is a very rare feature in the genus, but is known for A. discolor (Sect. Odontarrhena), and A. tetrastemon and A. corningii (Sect. Gamosepalum).

(d) Nectaries

These floral structures which subtend the short stamens (one on each side) play but a small role in the taxonomy of Alyssum; however, several distinct forms need to be pointed out. As illustrated by Nyárády (1927: Table 7, fig. 106), the nectaries of A. alyssoides (Sect. Psilonema) are subulate and erect, measuring up to 1 mm. long. They are particularly notable by being appressed /

appressed to the valve surfaces when the fruit is mature. This type of nectary, which is very rare in *Alyssum*, has occasionally been confused and interpreted as free short stamen appendages. The nectaries of the other taxa in Sect. *Psilonema* are all inconspicuous and reduced. The only other species in the genus which has erect and subulate nectaries (frequently basally dilated) is *A. desertorum* in Sect. *Alyssum*. Because of the similarity of the nectaries of this species to those of *A. alyssoides*, some botanists (cf. Nyárády, 1927) have treated *A. desertorum* as a component of Sect. *Psilonema*; however, the presence of bifid and basally connate appendages on the short stamens (Fig. 1B, x) and the often toothed or abruptly constricted wings of the long stamens clearly indicate that *A. desertorum* should be referred to Sect. *Alyssum*. The erect and subulate nectaries of this species aid in distinguishing it from its close ally, *A. turkestanicum*, which has very reduced and globose nectaries. The nectaries of all other species of the genus are more or less inconspicuous and are either short and peg-like or globose. The components of Sect. *Gamosepalum* are characterized (as well as some allied species in Sect. *Alyssum*, such as *A. aizoides*, *A. bornmuelleri*, *A. caespitosum*, etc.) by having large and frequently noticeably lobed nectaries. These are the only species in the genus with distinctly lobed nectaries.

Fahn (1953) in his paper on the topography and phylogeny of nectaries claims that those of *Alyssum* are placed on the receptable between the sepals and the stamens. The present author, however, finds that the nectaries of *Alyssum* are always located immediately at /

at the base and to each side of the short stamens, not in a definite zone between the perianth and the stamens.

(e) Fruits and Styles

Certainly the most useful and easily observed characters for identifying taxa are those provided by the fruits and styles. The major fruit shapes, apex shapes, types of symmetry and style types encountered for the species of Alyssum considered in this study are illustrated in Figure 2. The fruit characters may be divided into 3 main categories: 1) size and shape, 2) symmetry which is related to the amount and type of valve inflation, and 3) the type and density of the indumentum.

Aurinia uechtritziana is the only Turkish representative of that genus having globose and turgid fruits with equally inflated valves. The fruit valves of Au. rupestris and Au. saxatilis are compressed or occasionally symmetrically inflated at their centres. This type of centrally inflated fruit with a raised central portion and wide compressed margins is characteristic also of a few species in Sect. Psilonema and Sect. Alyssum; for example, A. alyssoides and A. desertorum (Fig. 2, b). The turgid and globose types of fruit with equally inflated valves, such as that of Aurinia uechtritziana, is very rare in Alyssum and is known only, among the species considered here, for A. foliosum, an annual in Sect. Alyssum.

Uniformly compressed fruits (their valves not being inflated to any marked degree) are characteristic of all species in Sect. Meniocus (Fig. 2, a), the species in Sect. Odontarrhena Subsect. Compressa /

Compressa (Fig. 2, n, m & o) and Subsect. Samarifera (Fig. 2, p). That the fruits of the last two natural groups may often be undulate and appear asymmetrical in side view (i.e. A. caricum, Fig. 6, 3; A. dubertretii, Fig. 7, 4) does not influence the basic fact that the valves of these fruits are uniformly compressed.

The types of valve inflation, controlling the symmetry of the fruits, which are commonest in Alyssum are: 1) both valves equally inflated so that the side and transverse views of the fruits are symmetrical (as Fig. 2, c, d & e), and 2) the valves unequally inflated so that the side and transverse views of the fruits are asymmetrical (as Fig. 2, f, g, h, i & l). When both valves are equally inflated - at least at their bases - the cross-section of the fruits may be transversally elliptic, as in the case of A. inflatum, A. aurantiacum, A. xanthocarpum, etc. or orbicular, as for A. haussknechtii (Fig. 2, k). The types and degrees of asymmetrical inflation are diagnostic for any given taxon; for example, the valves of the fruits of A.umbellatum are extremely unequally inflated, one being concave, the other convex, but the valves of a related species, A. contemptum, though inflated unequally, are both convex (as Fig. 2, f for A. hirsutum). A. spinosum, A. cochleatum and A. lapeyrousianum, the components of Alyssum Sect. Tetradenia, have inflated fruits similar to those of A. pseudo-mouradicum in Sect. Alyssum (Fig. 2, h), with a concave and convex valve. The fruits of Sect. Tetradenia, however, are always glabrous and boat-shaped; they /

they are also oriented in a different plane to that of the pedicels, which causes the inflorescence to be candelabriform. The fruits of all other species of _Alyssum_ are never conspicuously boat-shaped and are always oriented in the same direction as the pedicels. A group of species in Subsect. _Odontarrhena_, including _A. borzaeanum_, _A. sibiricum_, _A. euboeum_, _A. caliacrae_ and _A. corymbosoides_, can be recognized by their fruits being S-shaped in cross-section (Fig. 2,l). In these species, the asymmetrical fruit configuration applies not only to the unequal valve inflation, but also to the distorted S-shaped replum. The repla of most other species of _Alyssum_ are straight, even when the valves are extremely unequally inflated (as Fig. 2, i & j).

The size and shape of fruits and their apex shapes are diagnostic for taxa and can be used conveniently to separate groups of species or allied species. For example, the fruits of _A. murale_ (Fig. 2, m) are usually orbicular or elliptic-rotund with obtuse or truncate apices, while those of the allied _A. cassium_ are distinctly obcordate (heart-shaped) and deeply emarginate (Fig. 2, n). The fruits of _A. szowitsianum_ and _A. marginatum_, though of the same basic shape, have different types of apices; the former species has obtuse or truncate fruits (Fig. 2, g) and those of the latter are always emarginate (as Fig. 2, b & h). Likewise, the distinction of _A. erosulum_ from _A. pulvinare_ is facilitated by the former having broadly elliptic or ovate and retuse fruits, the latter more or less orbicular, merely emarginate and smaller fruits. A group of species in Sect. _Odontarrhena_ /

Odontarrhena Subsect. Odontarrhena, including A. filiforme (Fig. 2, j), A. anatolicum and A. singarense have fruits which are oblong and narrowly elliptic, and though their valves are unequally inflated, the basal cross-section of these fruits is distinctly rectangular or quadrangular. A. haussknechtii (Fig. 2, k) has unique conical fruits whose valves are equally inflated and saccate at their bases; the cross-section being orbicular. This type of fruit with saccate and equally inflated valves is known for only one other species in the genus, namely A. fedtschenkoanum Busch.

Occasionally the consistency of the valves has been used in the keys. A group of species in Sect. Odontarrhena Subsect. Odontarrhena, including A. corsicum (Fig. 2, i), A. masmenaeum, A. syriacum, A. discolor, A. troodi and A. chondrogynum have thick, leathery and frequently glaucous and rugose fruit valves. This condition is contrasted with the much thinner and delicate valves of such species as A. davisianum, A. smolikanum and A. oxycarpum. Aurinia rupestris may be distinguished from the other Anatolian representatives of the genus by having thick leathery valves which are always provided with raised marginal (especially towards the apex of the fruit) papillae. This type of marginal papillae is known in Alyssum only on the fruits of A. homolocarpum in Sect. Psilonema and A. euboeum in Sect. Odontarrhena. Very few species of Alyssum have stipitate fruits (or what Payson, 1921 calls a gynophore). A. discolor (Fig. 8) and A. hausskneсktii (Fig. 2, k) in Sect. Odontarrhena are notable in having /

having their fruits raised above the receptacle by a prominent stipe similar to that found in all taxa in Alyssoides. All the taxa comprising Alyssum Sect. Tetradenia also have shortly stipitate fruits.

The presence of a distinct crenulate wing on the fruits is diagnostic for all species in the compressed-fruited group of Sect. Odontarrhena Subsect. Compressa which the author has described as Series Crenulata. This natural group is typified by A. crenulatum (Fig. 2, o), the species which has the best developed fruit wing. All fruits in the genus are dehiscent with the exception of 9 species which comprise the natural group, Subsect. Samarifera in Sect. Odontarrhena. These taxa can always be recognised by having the largest fruits in the genus which are compressed and flat (however, often undulate), indehiscent and pendulous on brittle, deflexed pedicels.

The presence or absence of indumentum and the type of indumentum on the fruits are stable characters for most taxa within the genus; however, a few normally glabrous-fruited species in Sect. Odontarrhena (i.e. A. smolikanum and A. heldreichii) sporadically produce fruits which are sparsely pubescent. This indumentum is especially noticeable on the immature fruits and is deciduous by the time the fruits are mature. One pubescent-fruited variant of a normally glabrous fruited species which forms recognizable and distinct populations has been described by the author as A. desertorum var. himalayensis and is distinguished from the typical variety by consistently /

consistently having a marginal row of stellate hairs. The very asymmetrically inflated fruits of A. pseudo-mouradicum are glabrous, at least on the valve surfaces; however, these fruits are always furnished with a sparse marginal row of hairs. The type of indumentum present in the fruit is usually consistent with the over-all hair type, with some notable exceptions. A. stylare, A. blepharocarpum, A. huetii and A. heterotrichum in Sect. Meniocus all have stiff simple setae as well as apparently granular and minute papillae. This type of fruit indumentum permits easy distinction of these species from the related A. linifolium, A. meniocoides and A. aureum, whose fruits are always glabrous. Though the fruits of A. alyssoides, A. damascenum and A. dasycarpum in Sect. Psilonema are always pubescent, the indumentum on the fruits (and styles) of the latter species is dimorphic and strigose. The dimorphic type of fruit indumentum is relatively rare in the genus and in addition to A. dasycarpum, it is possessed by 7 other taxa in Sect. Alyssum, namely A. macropodum var. heterotrichum, A. strigosum, A. xanthocarpum, A. hirsutum, A. bulbotrichum, A. trichocarpum and A. cephalotes. Only one species in the genus is known to have a fruit indumentum entirely composed of papillae; that being A. chondrogynum from Cyprus. The significance of this type of trichome is discussed more fully under the heading of indumentum.

The length and width of the styles is frequently of value in distinguishing /

distinguishing taxa; for example in Sect. Meniocus, the styles of A. stylare and A. blepharocarpum are always slender (filiform) and 1.5-2.5 mm. long, while those of A. huetii and A. heterotrichum are stouter (in diameter) and only 0.5-1 mm. long. Likewise, the separation of A. linifolium from A. meniocoides and A. aureum is facilitated by the first species having very short styles; the last two species can in turn be separated from each other by having styles of different lengths.

A comparison of the basal diameter of the styles with their apical diameter is also significant. Many species are characterized by having dilated styles, that is, they are 2-4 times wider in diameter at their bases than their apices; for example, A. dasycarpum (Fig. 2, c) and A. haussknecktii (Fig. 2, k).

The absence or presence of an indumentum on the styles (as well as on the fruits) can be used to distinguish taxa, as it can be easily seen macroscopically and is apparently stable for any given taxon. The styles and fruits of A. szowitsianum are always pubescent, and though the fruits of the allied A. marginatum are also pubescent, its styles are always glabrous. The type of indumentum on the styles is also a constant feature of many species. A. bulbotrichum and A. trichocarpum have a style indumentum of appressed and minute stellate hairs though their fruits are densely covered with a dimorphic indumentum, but the styles of the related A. cephalotes are densely pubescent with a dimorphic indumentum similar to that which is on its fruits /

fruits.

Some taxa are characterized by having rostrate styles, i.e. the upper parts of the style is bent over in a hooked fashion. This condition is diagnostic, among other species, for _A. fulvescens_ and _A. rostratum_. The stigmas terminating the styles are of a stable expression for all _Alyssum_ species, and have no taxonomic significance. The stigma is more or less globose and wider in diameter than the immediately subtending part of the style (see Fig. 5, 8).

(f) Seeds

Aurinia saxatilis and _Au. rupestris_ have widely winged and compressed seeds which are nearly orbicular, and those of _Au. saxatilis_ subsp. _megalocarpa_ measure up to 10 mm. long and wide (including the wing). The seeds of _Au. uechtritziana_ are wingless and are not as compressed and flattened of those of the other Turkish representatives of the genus. The seeds of this taxon are transversely elliptic in cross-section, but the other Turkish species of _Aurinia_ are flat in cross-section.

The seeds of _Alyssum_ are usually longer than broad (elliptic or rotund) and are pendulous on filiform funicles from near the top of the replum in all sections, except Sect. _Meniocus_ which has distinctly lateral placentation. The seeds of the compressed-fruited taxa in Sect. _Odontarrhena_ Subsect. _Compressa_ and Subsect. _Samarifera_ are always considerably more compressed, flattened and larger than the seeds from the inflated fruits (symmetrical or asymmetrical) of most /

most of the other sections. The largest seeds in the genus occur in A. murale, measuring up to 4 mm. wide (including the prominent wing). The smallest seeds in the genus occur in Sect. Meniocus. It is noteworthy that the smallest seeds in the genus are found in the section which has the largest number of ovules (4-8) in each fruit locule, and that the largest seeds are found in a group (Sect. Odontarrhena Subsect. Compressa) which diagnostically has only one ovule in each fruit locule. Seed size has not been used in the keys because of the difficulty of assessing the maturity of the seeds on dried material.

Not only is the presence or absence of a wing on the seeds of diagnostic value (cf. couplet 5 in key to Sect. Meniocus), but the width of the wings (when present) is also a stable character for any given species. For example, A. handelii has seed wings measuring 0.5-1 mm. wide, while those of the allied A. praecox and A. argyrophyllum measure 0.1-0.3 mm.

Though the number of ovules present in the fruit locules is diagnostic for the sections (see Key to sections), frequently the number of viable seeds which develop does not correspond with the number of ovules present. Many species in Sect. Odontarrhena Subsect. Compressa though having two ovules in each fruit, develop only one seed. This situation is also quite common among the species of Sect. Alyssum which have asymmetrically inflated fruits. For example, within the extremely convex locule of A. pseudo-mouradicum (Fig. 2, h) two viable seeds are formed; however, the two ovules

in /

in the concave locule usually abort and never develop. Very few examples are known where the number of ovules in the fruit locules is inconsistent with the sectional descriptions and diagnoses. A. akamasicum in Sect. Odontarrhena Subsect. Compressa rarely produces fruits which have two ovules in each locule (both from the same placenta); of 40 fruits examined from specimens of the type gathering of this species, only 4 contained an unexpected number of ovules. In any case, only one of these ovules present developes into a viable seed. The reasons for this "proliferation" of ovule number is not known: however, it is possibly a result of an abnormal division of a single placenta into two.

A detailed study of mucilage production is summarized in Section VIII, part 2.

(3.) Indumentum

The hairs comprising the indumentum on all parts of the plants of Alyssum are stellate, except for the fruit indumentum of 4 species in Sect. Meniocus which have simple stiff setae and often granular papillae (smaller but similar morphologically to the papillae on the fruits of A. chondrogynum in Sect. Odontarrhena: Fig. la, a). The grades of specialization from the simple papillae and stiff setae (Fig. 1A, a and b) through hairs with few and unbranched rays (Fig. 1A, c), branched-rayed (Fig. 1A, d, e, and f), many-rayed hairs (Fig. 1A, j) to the lepidote scales (Fig. 1A, k and l) are well illustrated from many species of Alyssum and are presented in Figure 1A.

The papillae on the fruits of some species of Sect. Meniocus are clearly a less specialized type of trichome than the stellate or lepidote hairs present on the other species of Alyssum; however, it must be remarked that the dense papillae on the fruits of A. chondrogynum (Sect. Odontarrhena), though similar to those found in Sect. Meniocus, are a condition derived from the lepidote scale. This is known because the immature fruits and styles of A. chondrogynum occasionally bear early deciduous lepidote scales terminating the papillae.

Two trends of evolution are displayed in the development of the indumentum of Alyssum (Payson, 1921 - for Lesquerella): 1) the increase in the number of rays (Fig. 1A, j) and the branching of rays (Fig. 1A, f and k) in conjunction with the centripetal concrescence of these rays to form sublepidote hairs (Fig. 1A, k) and ultimately lepidote scales (Fig. 1A, l and m); 2) the development of two types of hairs which intermixed /

intermixed produce a dimorphic or heteromorphic indumentum (Fig. 1A, h and i). The dimorphic indumentum is composed of merely stellate hairs with appressed (as Fig. 1A, n) or divergent (Fig. 1A, h) rays situated around the furcate or simple single rayed tuberculate hairs which are always erect (Fig. 1A, g, h and i) or if present on pedicels are often horizontal (Fig. 2, f). It may be hypothesised that the furcate or simple tuberculate hairs such as occur on the fruits and pedicels of A. hirsutum, A. strigosum, A. xanthocarpum, A. bulbotrichum, A. trichocarpum and A. cephalotes evolved from a simpler stellate hair on which the basal stalk elongated and thickened (similar to Nyárády's abnormally developed hairs from A. murale - cf. discussion of Morphological Abnormalities) to form tubercules. On these hairs from among the few rays present, 2 (rarely more) have become more elongated than the others. Intermediate conditions between the strictly furcate and stellate hair may often be seen on the stems of A. strigosum (Fig. 1A, g), where foreshortened basal rays are present beneath the furcate hairs. Occasionally very short and reduced rays have been observed on the tubercule of the simple single-rayed hair of A. hirsutum (Fig. 1A, i).

The types of hairs and disposition of indumentum (i.e. concolorous or bicolored) are of diagnostic value for species and of synthetic value for groups of species. An example of the latter case is found amoung the annuals of Sect. Alyssum, including A. strigosum, A. hirsutum, etc. which always have a dimorphic fruit indumentum composed of simple stellate hairs and furcate or simple tuberculate hairs. Likewise, among the perennials of Sect. Alyssum, including A. mouradicum (Fig. 1A, m), A. praecox /

A. praecox, etc. the indumentum is composed of always many-rayed sublepidote or lepidote scales. The similar types and/or dispositions which characterize these groups in Sect. Alyssum could permit an interpretation, in conjunction with correlation of other character expressions, that species in these respective groups constitute natural species complexes which have had a common ancestor, i.e. are monophyletic.

There is a tendency for the many-rayed hairs and lepidote scales to have a copious accumulation of lime (particularly Sect. Odontarrhena - cf. Nyárády: 1926-1929) which causes the overall indumentum to be silvery or whitish, whereas the rays of the simpler and less specialized types of trichomes are more often translucent with only a minor accumulation of lime. The development of a heavy lime coating is particularly noticeable on the lepidote scales diagnostic for Series Libra of Sect. Gamosepalum. The accumulation of lime and the increased number of rays combined with ultimate fusion to form lepidote scales appears most frequently on those species which inhabit arid habitats. The specializations of the trichomes appear to impart to the plant an advantage for survival in otherwise unfavourable habitats by reducing the amount of water loss by transpiration.

The centres of the stellate hair or lepidote scale are often punctate. This punctation is caused by the enlargened apex of the central axis (or stalk) of the hair from which the radii radiate. Its presence or absence is diagnostic for a number of species in Sect. Meniocus, Sect. Psilonema and Sect. Odontarrhena, but it is always present for those species of Alyssum which have lepidote scales. The supporting stalk of the stellate trichome is in some taxa elongated

(c. /

(c. 0.5 mm. long), as in A. repens subsp. trichostacyum (Sect. Alyssum) or some species of Sect. Gamosepalum (e.g. A. lycaonicum); whereas in other species the stalk is very reduced and the hair appears sessile.

It is seen from the table under the category of Habitat, that the specialized bicolored disposition of indumentum and the advanced types of many-rayed, branched hairs and lepidote scales occur correlated with some other specialized expressions in the perennials of Sect. Alyssum, Sect. Gamosepalum and Sect. Odontarrhena.

The hairs which make up the whitish or silvery indumentum of the Turkish species of Aurinia are generally smaller and more slender-rayed than those which are present on most species of Alyssum. The prominently lepidote hairs of Au. rupestris are unique for the Turkish representatives of the genus, though the earlier generic name (Lepidotrichum) of Au. uechtritziana would imply that it also possessed lepidote hairs. The hairs of Au. uechtritziana and Au. saxatilis are of a similar form, with few and branched rays which occasionally appear sublepidote macroscopically.

The indumentum (or absence of it) on the cotyledons and hypocotyl of a few taxa of Alyssum and Aurinia grown in cultivation is diagnostic and can be used to advantage for recognition of seedlings. The following table summarizes the data of the species which have been examined in this manner, indicating the types and density of hairs.

Taxa	Cotyledons	Hypocotyl
ALYSSUM		
A. linifolium	glabrous	glabrous
A. desertorum	sparse, minute, appressed	sparse, minute, appressed
A. fulvescens	sparse, minute, appressed	sparse, minute, appressed
A. strictum	sparse, minute, appressed only on margins	dense, minute, appressed
A. contemptum	dense, minute, appressed	dense, minute, appressed
A. szowitsianum	dense, minute, appressed	dense, minute, appressed
A. stapfii	dense, long rayed, appressed	dense, long rayed, appressed
A. minus	dense, minute, appressed	dense, minute, appressed
A. strigosum	dense, long and divergent rays	dense, long and divergent rays
A. hirsutum	dense, long and divergent rays	dense, long and divergent rays
A. repens subsp. trichostachyum	glabrous	dense, long and appressed or divergent rays
A. anatolicum	sparse, minute, appressed	dense, minute, appressed
A. haussknechtii	glabrous	sparse, minute, appressed
A. murale	glabrous	dense, long rayed, appressed
A. elatum	glabrous	sparse, minute, appressed
AURINIA		
Au. saxatilis subsp. saxatilis	glabrous	glabrous
Au. saxatilis subsp. megalocarpa	glabrous	dense, minute, appressed

4. Figures

FIGURE 1A: HAIR TYPES.

(a) A. chondrogynum (Davis 3083), simple papillae on silicule surface, X 200.

(b) A. huetii (Dudley, D. 35230), simple setae on silicule margin, X 200.

(c) A. stapfii (Davis 28694), stellate hair with few and unbranched rays on silicule surface, X 50.

(d) A. xanthocarpum (Davis 19411), stellate hair with few and branched rays on lower surface of a leaf, X 50.

(e) A. pseudo-mouradicum (Davis 38893), stellate hair with few, branched and ± unequal rays on upper surface of a sterile shoot leaf, X 50.

(f) A. eriophyllum (Haussknecht) stellate hair with long, sinuate, sericeous and branched rays from a leaf of sterile shoot, X 50.

(g) A. strigosum subsp. strigosum (Dudley D. 34638), bifurcate and stalked stellate hairs with unequal rays on the stem, X 50.

(h) A. strigosum subsp. strigosum (Dudley, D. 34638), bifurcate and stalked hair with accompanying divergent-rayed stellate hair on silicule, X 50.

(i) A. hirsutum var. hirsutum (Prescott), simple tuberculate hair and accompanying stellate hair on silicule, X 50.

(j) A. corsicum (Dudley, D. 3283), many-rayed stellate hair from lower surface of a sterile shoot leaf, X 50.

(k) A. stribrnyi (Dudley D. 34558), sublepidote stellate hair on lower surface of a cauline leaf, X 50.

(l) A. aizoides (Davis 20328), lepidote scale with long peripheral rays /

rays on upper surface of a basal cauline leaf, X 50.

(m) A. mouradicum (Balls 186), lepidote scale with short peripheral rays from lower surface of a basal cauline leaf, X 50.

(n) A. szowitsianum (Dudley D. 35210a), appressed stellate hair on silicule surface, X 50.

Fig. 1A.

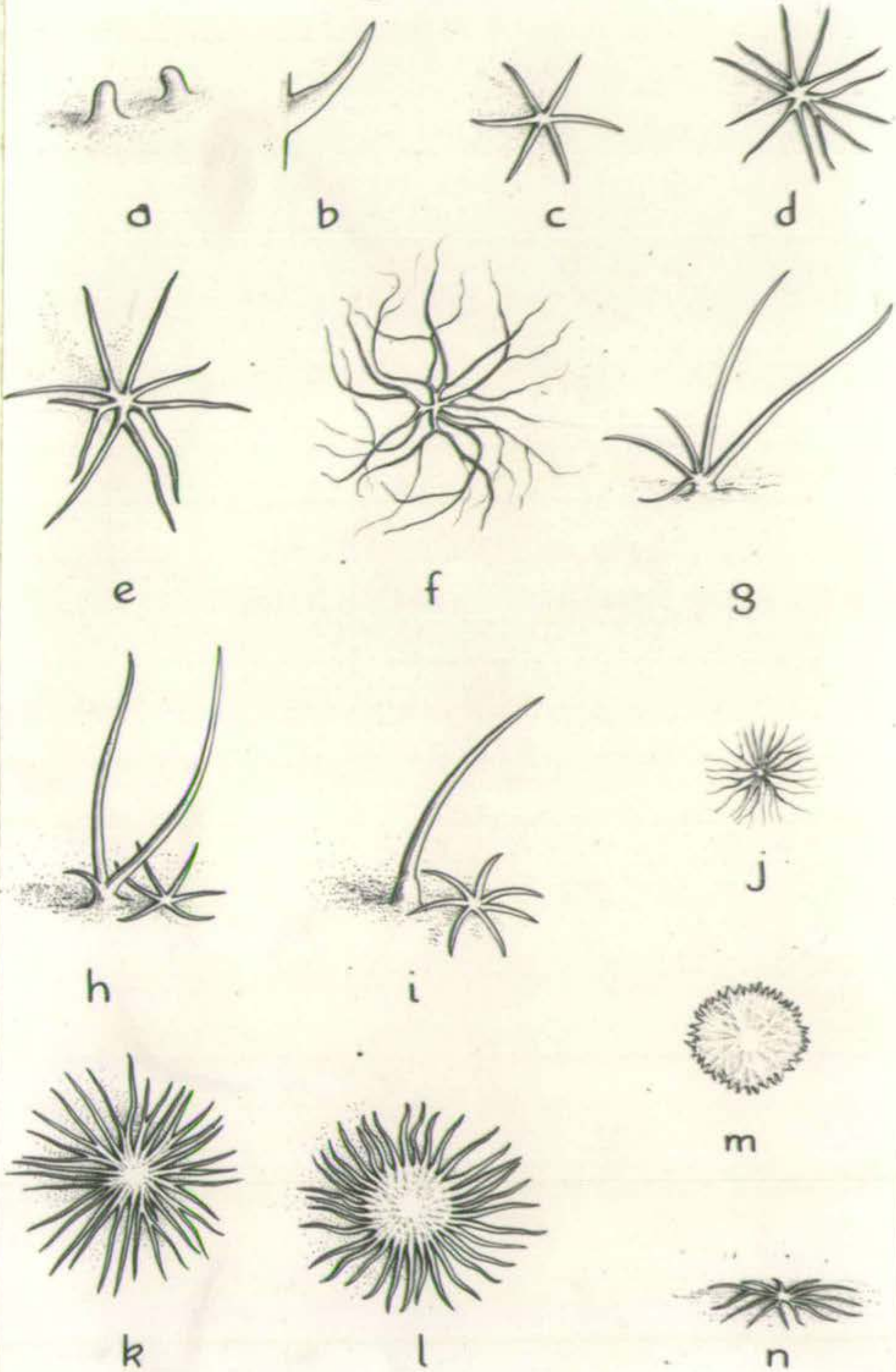


FIGURE 1B: PETAL AND FILAMENT TYPES.

a-g, petals
h-r, long filaments
s-y, short filaments

(a) A. desertorum var. desertorum (Davis 27622), obovate, retuse, gradually attenuate petal, X 20.

(b) A. dasycarpum var. dasycarpum (Davis 29378), obovate, ± retuse, abruptly attenuate to base, X 20.

(c) A. pinifolium (Kirk), obovate, entire, abruptly attenuate petal with basal appendages, X 20.

(d) A. minutum (Davis 18940), emarginate petal with narrow limb and widely dilated claw margins, X 20.

(e) A. stapfii (Davis 28694), spathulate, bilobed petal constricted at middle with widely dilated and entire claw margins, X 20.

(f) A. lepidotum (Davis 18391a), spathulate, retuse petal constricted at middle with widely dilated and denticulate claw margins, X 20.

(g) A. pseudo-mouradicum (Davis 38893), spathulate, truncate to retuse petal constricted at middle with widely dilated and pointed claw margins, X 20.

(h) A. dasycarpum var. dasycarpum (Davis 29378), unappendaged and edentate long filament, X 20.

(i) A. huetii (Dudley, D. 35230), unilaterally winged and unidentate long filament, X 20.

(j) A. minutum (Davis 18940), bilaterally winged and unidentate long filament, X 20.

(k) A. xanthocarpum (Davis 19411), two long bilaterally winged and gradually dilated to the base long filaments, one edentate, the other /

other unidentate at apex of wing, X 20.

(l) A. lepidotum (Davis 18391a), bilaterally winged long filament which is dentate on one wing, X 20.

(m) A. aizoides (Davis 20328), bilaterally winged long filament, dilated at the base and abruptly constricted towards the apex, X 20.

(n) A. strictum (Sintenis 5614), bilaterally winged and arboreously dentate long filament, X 20.

(o) A. repens subsp. trichostachyum var. trichostachyum (Davis 30295), bilaterally winged long filaments which is multidentate at the apex, X 20.

(p) A. filiforme (Davis 29072), long filament with multidentate appendage connate c. ½ its length, X 20.

(q) A. giosnanum (Kühne 1381), long filament with multidentate appendage connate for more than ½ its length, X 20.

(r) A. pinifolium (Kirk), long filament with 2-3-fid, broad basally connate appendage, X 20.

(s) A. huetii (Dudley, D. 35230), two short filaments with basally connate appendages, one acute, the other bifid, X 20.

(t) A. stribrnyi (Dudley, D. 34558), short filament with free, broad and multidentate appendage, X 20.

(u) A. pseudo-mouradicum (Davis 38893), short filament with free, basal and small appendage, X 20.

(v) A. corningii (Siehe 241), short filament with small basally connate appendage, X 20.

(w) A. minutum (Davis 18940), short filament with a unilateral tooth c. at the middle, X 20.

(x) A. desertorum /

(x) _A. desertorum_ var. _desertorum_ (_Davis_ 27622), short filament with connate bifid appendage, X 20.

(y) _A. strigosum_ subsp. _strigosum_ (_Dudley_ D. 34638), short filament with connate bifid appendage, X 20.

Fig. 1B.

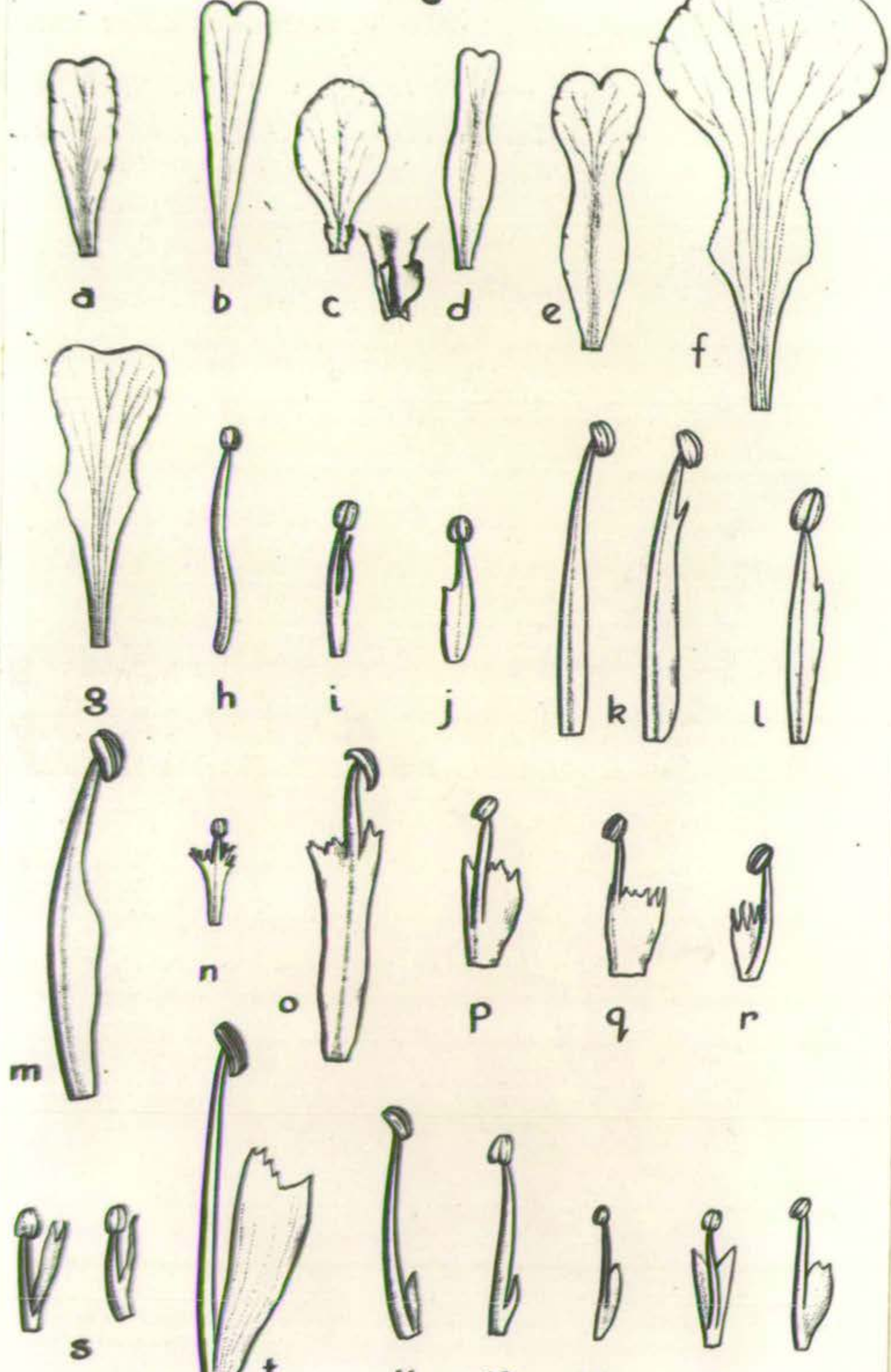


FIGURE 2: SILICULE, PEDICEL AND STYLE TYPES.

(In order to concentrate more thoroughly on the different silicule shapes and configurations, the indumentum which normally is present on the silicules of numbers, a, c, d, e, f, g, j, k, l, m, n and o has been omitted).

(a) A. huetii (Dudley, D. 35230), elliptic, obtuse, valves equally compressed, placentation distinctly lateral, pedicel spreading X 8.

(b) A. desertorum var. desertorum (Davis 27622), orbicular, emarginate, valves equally inflated at centre, widely marginate, placentation from near the top, X 8.

(c) A. dasycarpum var. dasycarpum (Davis 29278), rotund, truncate, valves equally inflated, pedicels ascending, style dilated at base, X 8.

(d) A. xanthocarpum (Davis 19411), ovate, attenuate to apex, valves equally inflated, X 8.

(e) A. aurantiacum (Davis 16192), rotund, truncate or emarginate, valves equally inflated, X 8.

(f) A. hirsutum var. hirsutum (Prescott), broadly ovate, obtuse, valves ± equally inflated, pedicels horizontal with strigose indumentum, X 8.

(g) A. szowitsianum (Dudley, D. 35210a), broadly elliptic or rotund, truncate, valves unequally inflated, silicule and pedicel imbricated and appressed to the main axis (in the dry state), base of pedicel dilated, X 8.

(h) A. pseudo-mouradicum (Davis 38893), oblong and broadly elliptic, emarginate, valves strongly unequally inflated, X 8.

(i) A. corsicum /

(i) A. corsicum (Davis 13283), obovate, obtuse, valves unequally inflated, X 8.

(j) A. filiforme (Davis 31609), oblong, narrowly elliptic, emarginate, valves unequally inflated, cross-section quadrqagular, X 8.

(k) A. haussknechtii (Davis 20351), conical and acute, valves equally inflated and saccate at base, cross-section orbicular, X 8.

(l) A. sibiricum (Dudley, D. 35860), orbicular or obcordate, truncate or emarginate, valves strongly unequally inflated, cross-section strongly S-shaped, X 8.

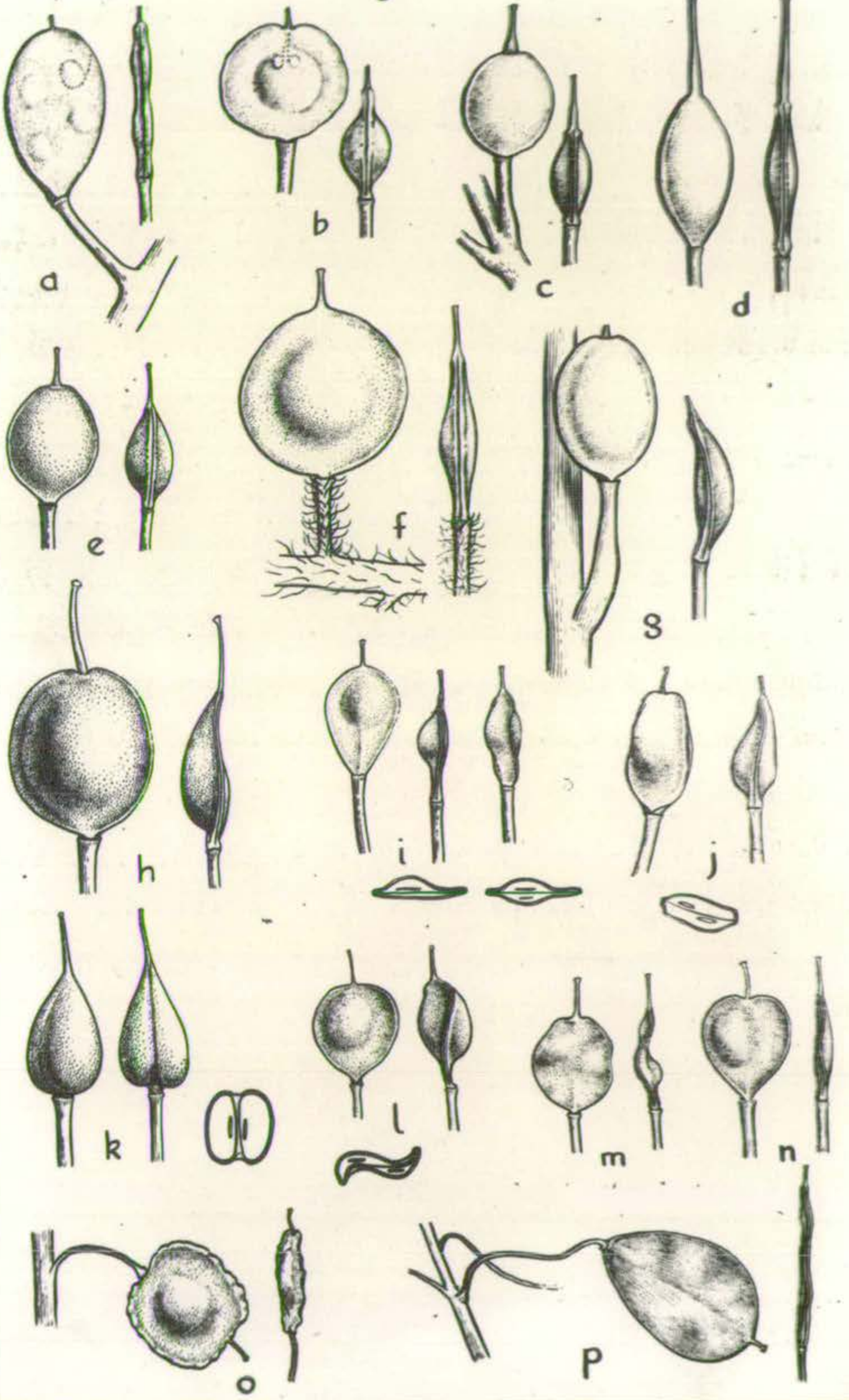
(m) A. murale subsp. murale var. murale (Dudley, D. 35551), orbicular, undulate, valves equally compressed, X 8.

(n) A. cassium (Kühne 1446), obcordate, emarginate ± undulate, valves equally compressed, X 8.

(o) A. crenulatum (Pinard), orbicular, emarginate, valves equally compressed with a wide crenulate margin, pedicel slender and deflexed, X 8.

(p) A. floribundum (Dudley, D. 36151), broadly elliptic to obovate, ± undulate, valves equally compressed, pedicel slender, deflexed and sigmoid, X 8.

Fig. 2.



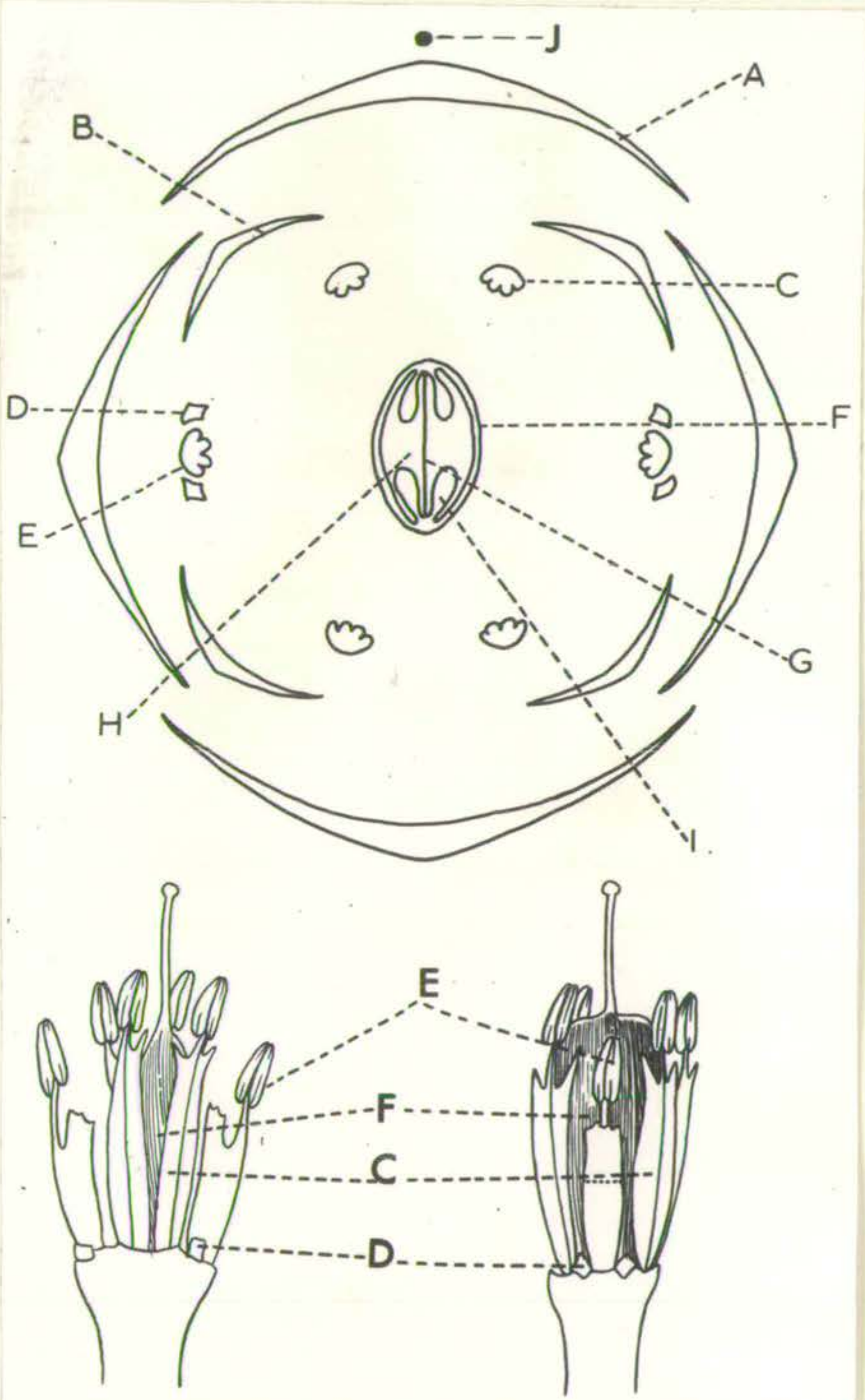


Fig. 3. Floral diagram, lateral and face views (without perianth) of the flower of A. fulvescens var. fulvescens; A- sepal. B- petal. C- long filaments. D- nectaries. D- short filaments. F- silicules. G- replum. H- locule. I- ovule. J- main axis. X 20.

VIII. BIOLOGY

(1) Pollination

Very little information is available about the pollinators or breeding systems of *Alyssum* and time has not allowed a first-hand analysis of these subjects. There are, however, two papers which deal directly with the floral biology and pollination mechanisms of *A. montanum*, a perennial in Sect. *Alyssum*. Günthart (1902) investigated the pollination mechanisms of *Alyssum wulfenianum* (possibly *A. ovirense*) and *Aurinia saxatilis*, as well as that of *Alyssum montanum*. Bergdolt's (1930) very difficult paper deals with questions of phylogenetic interpretation of the floral parts of *Alyssum montanum* and the role that some of them play in pollination. Günthart claims that the taxa he investigated may be insect pollinated when their flowers are open during warm and bright weather, or may be automatically self-pollinated when the flowers are closed during dark and damp weather. He also maintains that the styles and stigmas of these species are always situated below the anthers at the beginning of anthesis, and that this feature facilitates self-pollination, in that the force of gravity causes the pollen to fall directly on to the receptive stigmas. Bergdolt accepts most of Günthart's conclusions with a few exceptions, and indicates that the flowers of *Alyssum montanum* may be pollinated in several other special methods, additional to those detailed by Günthart.

Bergdolt rejects rather pointedly Günthart's claim that the appendages and teeth on the filaments (forming what Günthart calls the "*Insektrüssel*", or insect channel) have a function in guiding an insect's /

insect's proboscis to the nectaries. Bergdolt maintains, on the other hand, that these structures have no function in the process of pollination, but merely represent vestiges of petaloid structures from which the filaments presumably evolved (sic!). Whether this view is correct or not cannot be debated here, but the fact that all species in Sect. Psilonema have wingless unappendaged and toothless filaments, and that many perennial representatives in Sect. Alyssum and all species in Sect. Gamosepalum have a minimum development of long filament appendages and teeth - but yet are fully fertile in nature - seems to support the view that the appendages and teeth of filaments do not play an active role in the mechanical process of pollination. Bergdolt also contradicts Güthart's statement that at the beginning of anthesis the styles and stigmas are lower than the anthers; he claims that the styles and stigmas of A. montanum elongate equally and at the time of anthesis are more or less at an equal level. It is worth noting that the styles and stigmas from flowers of the representative annual and perennial species in Sect. Alyssum and Sect. Gamosepalum which the present author has dissected, are always exserted beyond the anthers at the time of anthesis, but that those of most of the annuals in Sect. Meniocus & Sect. Psilonema, and the perennials from Sect. Odontarrhena are either at the same level as the anthers, or very frequently are situated below them. This would appear to indicate that the taxa in Sect. Alyssum and Sect. Gamosepalum may be cross-pollinated, and that outbreeding is a general occurrence, as well as the possibility of being self-pollinated and inbred. It follows then, that Sect.

Psilonema /

Psilonema, Sect. Meniocus and Sect. Odontarrhena as a general rule are self-fertile, self-pollinated and inbreeding. However, it must be understood that in the absence of any conclusive data on breeding patterns, the above statements are conjectural.

Bateman (1955) indicates that 5 out of the 9 species of Alyssum which he investigated carefully were self-sterile, thereby implying that they are outbreeding, and that 4 were self-fertile, implying that they were inbreeding and self-compatible. It is most unfortunate that Bateman gives us no clue as to what species or sections of Alyssum he investigated, nor whether they are annuals or perennials; accordingly the value of his conclusions is considerably reduced, at least for a picture of the breeding systems in Alyssum. The only tentative conclusion that can be reached from Bateman's small sampling of the genus is that both outbreeding and inbreeding are present in the genus, and that the balance of these two processes has been an advantage for the survival, perpetuation and evolution of the genus as a whole. The outbreeding species presumably provide a store of variation which is the source of new genotypes for adaption to new environments, and the inbreeding species are significant for the survival of "pure" taxa or populations in a particular present set of environmental conditions. What is very important is the extrapolation that the larger flowers (presumably more attractive to pollinators) have a direct correlation with an increasing amount of outbreeding and self-sterility. The flowers in Alyssum are found among the species of Sect. Alyssum and Sect. Gamosepalum; this being associated with the fact (see above) that /

that in these species the styles and stigmas are exserted beyond the anthers at the time of anthesis. These facts, coupled with the observation that the nectaries (which have the sole function of pollinator attraction) in these groups are larger than in any other group of species in the genus, and are often lobed (as in Sect. _Gamosepalum_), would make it credible that Sect. _Alyssum_ and Sect. _Gamosepalum_ are pollinated by insects and have probably a long history of outbreeding. It is not known, however, if these groups are self-incompatible as well, but the sparse data which Bateman provides appears to indicate that this is probably the case.

On the other hand, the smallest flowered section in the genus, Sect. _Odontarrhena_ (also highly specialized morphologically), has styles and stigmas which at anthesis are hardly ever exserted beyond the anthers, and have considerably smaller and more reduced nectaries than those found in Sect. _Alyssum_ and Sect. _Gamosepalum_. Further evidence for self-pollination and self-compatability within Sect. _Odontarrhena_ is found in a particular group of species (whose fruits are very asymmetrically inflated and are sigmoid in cross-section), including _A. borzaeanum_, _A. sibiricum_, _A. corymbosoides_, etc. In these species, the upper free portion of the filaments terminated by the anthers is always incurved over the stigma or is often touching the stigma at anthesis. After anthesis and presumably after self-pollination, the filaments straighten until they are in an erect position. Only after this process has been completed do the styles elongate, the stigmas being at the same level as or higher than the anthers /

anthers. Presuming that these species are inbreeding, an assumption supported by their floral morphology, it must, however, be pointed out that they may not always necessarily be self-fertilized, because as they do have functional nectaries - though small - the possibility for cross-pollination exists, no matter how limited. Section Odontarrhena appears, then, to show a strong correlation between the perennial habit and self-fertility and inbreeding; but the perennials in Sect. Alyssum and Sect. Gamosepalum exibit a reverse trend in the breeding system by being strongly correlated with outbreeding and probably self-sterility.

Bergdolt suggests that failing cross-pollination by insects, the flowers of A. montanum will automatically become self-pollinated by a movement of the stamens to a position which facilitates the easy transfer of pollen to the receptive stigmas of the same flower, or by the closing of the flowers at night. He claims that self-pollination in this species is the direct result of the lack of cross-pollination, and also that the flowers will automatically close if cross-pollination has not proceeded within a certain length of time (not given). This phenomenon implies complete self-compatibility. Geitonogamy (pollination with pollen from other flowers of the same plant), Bergdolt also maintains, can result by the elongation of the individual flower pedicels, so that the flowers in the same or different inflorescences come into contact, and the pollen from these adjacent flowers falls indescriminately on the receptive stigmas of the also elongating styles. The action of rain-drops, he thinks, may also bring about self-pollination, by the water washing the pollen from the anthers to the stigmas in the same flower; geitonogamy /

geitonogamy may occur by the same method. It is not known how widespread these various mechanisms are in <u>Alyssum</u>, but it certainly appears that in the absence of insects which would bring about cross-pollination, many species will be self-pollinated (and self-compatible) by their intrinsic morphology.

All the annual and perennial species in Sect. <u>Alyssum</u> grown in cultivation produced fruits and viable seeds. It was noted that around the flowers of these cultivated plants and wild populations of many species, there was an abundance of insects (primarily <u>Diptera</u>) at the time of anthesis; however, it was never observed if these insects were the direct agents of pollination. Very few perennials in Sect. <u>Odontarrhena</u> were cultivated, because of the length of time needed to bring them into the flowering stage and the unavailability of viable seeds; however, <u>A. elatum</u> (Sect. <u>Odontarrhena</u> Subsect. <u>Compressa</u> Series <u>Crenulata</u>) was successfully cultivated and set seed. The insect activity around the flowers of this species at the time of anthesis was negligible. The numerous species of Sect. <u>Odontarrhena</u> which were observed in Anatolia, likewise, do not appear to be associated with a large insect congregation at the time of anthesis. This was particularly true of <u>A. corsicum</u>, which exists in very large populations in Caria and Lycia. The author could find no evidence that insects played a very active role in pollination, in any of the populations visited of this species, for though flies were present in limited quantity, they did not appear to show a particular interest in the flowers. <u>A. linifolium</u> in Sect. <u>Meniocus</u> and <u>A. dasycarpum</u> in Sect. <u>Psilonema</u> (both annuals) were /

were cultivated and observed in the field. They flowered and produced fruits without the observed agency of external pollinators, though these plants were cultivated alongside species in Sect. Alyssum (A. diffusum, A. repens, etc.) whose flowers were frequently visited by insects.

Several putative hybrids have been recognized within the genus, but as they are thought to be the result of crossing between very dissimilar and only remotely related species (often in different sections), their hybrid origin is unlikely. Before proceeding further, it is necessary to explain that the term "hybrid" is understood here to be the result of crossing between taxa (species, subspecies or varieties); in other words, hybridization is the exchange of genetic material between individuals belonging to normally reproductively isolated populations, which within their respective variation ranges are morphologically separable. A. hybridum Huter from Spain is said to be a cross between A. atlanticum Desf. in Sect. Alyssum and A. serpyllifolium Desf. in Sect. Odontarrhena Subsect. Odontarrhena. From the description of A. hybridum and material which is morphologically similar, it is evident that this taxon cannot be equated with its proported parents - though closer in fact to A. atlanticum by being in Sect. Alyssum - but is possibly equivalent to A. fastigiatum Heywood. Haussknecht (1897) claimed that his A. fallacinum was a hybrid between A. heldreichii and A. chlorocarpum (a minor variant of A. murale) - see discussion under A. fallacinum, p.215. Examination of the type material /

material and additional gatherings of _A. fallacinum_ reveals that it cannot be regarded as a hybrid, but should be treated as a distinct species in Sect. _Odontarrhena_ Subsect. _Odontarrhena_ (characterized by asymmetrically inflated fruit valves). Though _A. heldreichii_ and _A. murale_ are both in Sect. _Odontarrhena_ Subsect. _Compressa_ (characterized by compressed fruit valves) and are found together in the Pindus of N. Greece, there is no evidence of hybridization between them; in fact, the crenulate fruit wing of _A. heldreichii_ clearly establishes it as a component of the natural series in Subsect. _Compressa_, namely Series _Crenulata_. _A. pannulosum_ was described initially as closely allied to _A. condensatum_ to which it is now equated as a synonym; however, Nyárády (1938) thought of _A. pannulosum_ as an inter-sectional hybrid between _A. bornmuelleri_ in Sect. _Alyssum_ and _A. gehamense_ (his _A. obtusifolium_ subsp. _typicum_ var. _alpinum_) in Sect. _Odontarrhena_ Subsect. _Odontarrhena_. Morphologically _A. pannulosum_ has very little in common with either of these proposed parents, but fits satisfactorily within the normal range of variation of _A. condensatum_. Another putative hybrid is _A. decipiens_ Nyár. (1927) which is described as being a cross between _A. smolikanum_, a distinct usually glabrous-fruited species in Sect. _Odontarrhena_ Subsect. _Odontarrhena_ and _A. murale_, the pubescent-fruited and type species of Sect. _Odontarrhena_ Subsect. _Compressa_. The reasons for Nyárády's claim of hybrid origin are: 1) that the two supposed parents of _A. decipiens_ are known to occur in the same geographical area (Mt. Smolika in N. Greece), 2) an intermediate type of stellate hair is found on the leaves of _A. decipiens_ /

A. decipiens, 3) the habit of A. decipiens resembles superficially that of A. smolikanum (fruticose), and 4) the leaves of A. decipiens are of a similar shape and size as those of A. murale. A. decipiens is known by only 2 fragments of the same plant mounted on the same sheets as the type gathering of A. smolikanum; and as far as the present author is aware has never been found again in its type locality - though A. murale has been frequently collected. Examination of the material of A. decipiens reveals that it in no observable character deviates from the range of variation expressed by the widespread A. murale. Furthermore, though A. murale and A. smolikanum grow in the same geographical area in N. Greece, A. smolikanum is a localized high altitude and serpentine endemic whose population never comes into physical contact with the always lower altitude populations of A. murale; accordingly the chances for hybridization and genetic exchange seem remote. What is more probable, is that Baldacci, who made the original collections of A. smolikanum and A. decipiens, collected A. murale (A. decipiens) in an area near the base of Mt. Smolika, and unwittingly included these plants in the same gathering as those of A. smolikanum which he collected at a higher altitude. Most of the Nyárády proposed intermediate taxa, such as A. rechingeri - A. vranjanum "sp. trans. nov." can be precluded as representing the result of hybridization between specific (or infra-specific) taxa, as most often the proposed parental species are taxonomically and nomenclaturally synonymous. For example, A. rechingeri and A. vranjanum are clearly synonyms of A. corymbosoides (A. rhodopense), and A. rechingeri - A. vranjanum easily fits into the /

the range of variation present in <u>A. corymbosoides</u>.

In the absence of any clear evidence of hybridization between populations of sympatric species (closely allied or not), it seems likely that hybridization as an evolutionary force has played a very minor role (if any) in species differentiation in <u>Alyssum</u>. It follows that the development of species has proceeded along the lines of <u>gradual</u> speciation, that is, that the processes of divergence have advanced without the influences of any basic cytological alterations, such as polyploidy (cf. Valentine & Löve, 1958). This conclusion appears to be a safe one when the known chromosome counts (see Section VIII, part 3) are compared. Of the 21 counts for species of <u>Alyssum</u> (out of the currently recognized 161), only two, <u>A. alyssoides</u> and <u>A. wulfenianum</u> yield a tetraploid count of 2n - 32. It can be presumed then, on the basis of our present karyological information, that <u>abrupt</u> speciation is very rare in <u>Alyssum</u> as a whole, and that the infrequent infra-specific polyploidy (i.e. <u>A. thessalum</u>, a synonym of <u>A. montanum</u> var. <u>hymettium</u> and <u>A. repens</u> - probably subsp. <u>trichostachyum</u>) are examples of abrupt differentiation which has been superimposed on the fundamental gradual pattern. From the distinctive distribution patterns of allied species and endemic distributions - geographical and ecological - it appears safe to assume that geographical and/or ecological isolation have been the major factors in the differentiation of species and infra-specific groups. These factors, as well as the accumulation of some internal barriers at present imperfectly known (possibly self-compatibility, especially probable for Sect. <u>Meniocus</u> /

Meniocus, Sect. Psilonema and Sect. Odontarrhena) have prevented any large amount of gene flow, with the result that there is little evidence of hybridization between more or less "pure" species populations, though these may be morphologically variable depending on the environmental influences on the genotype and the stability of the genotype. However, it must not be assumed that the morphological variation within any given taxon is always and invariably environmentally induced. The type and range of variation in many species is certainly genetically controlled. For example, A. murale in the Pindus of N. Greece and Euboea is made up of a number of geographically intergrading micro-populations which when examined individually can be identified as A. chlorocarpum, A. chalcidicum, A. orphanides, etc. because of the stability of the genotypes and phenotypic expressions within these presumed inbreeding populations. There is, however, sufficient outbreeding and re-combination to break down the micro-populations as distinct entities, and allow the various genotypes and resulting phenotypes to fit into a pattern of wide but relatively stable variability.

(2.) Fruit and Seed Dispersal

(a) Methods.

Seed dispersal in most species of Alyssum is of the anemochorous type (Zohary, 1949), that is, the valves of the fruits (which are brought into a median position at an early stage of development) are detached from the replum after maturing (late fall or spring) by the formation of a separation tissue. The valves and seeds are then scattered by wind action. It is probable that this method prevails in most species of Aurinia and Alyssum (Sect. Meniocus, Sect. Psilonema - except A. damascenum, Sect. Gamosepalum and Sect. Odontarrhena - except Subsect. Samarifera). Many of the species that are dispersed in this manner have winged flattened seeds which facilitate wind dispersal (i.e. Aurinia saxatilis, Alyssum murale, etc.). The anemochorous method can be conveniently detected on herbarium specimens (if mature fruit is present) because the valves have either fallen away from the replum or are easily detached.

A specialized form of wind dispersal is peculiar to Sect. Odontarrhena Subsect. Samarifera. The compressed, indehiscent and thin-textured fruits of the components of this natural group are large, samaroid, usually undulate and pendulous on brittle, sigmoid and deflexed pedicels. As the largest type of fruit in the genus, the samaroid indehiscent ones found in Subsect. Samarifera catch the local wind currents like a sail. As the author has observed, the action of the wind knocks the fruits together (in a compound corymb) and detaches them from their easily broken pedicels. Because of their increased surface area and light weight, the fruits tumble in the wind currents float to the ground at least several feet from the parent plant. Once on /

on the ground, the soil moisture, dew or rain seeps into the thin valves and causes the seeds to swell and exude mucilage (at least for _A. caricum_ and _A. floribundum_) prior to germination. The swelling of the seeds, mucilage production and a gradual decomposition of the valves assist in loosening the valves from the replum. The samaroid indehiscent fruits of the cliff-inhabiting and saxatile _A. floribundum_ were observed (once on the ground) by the author to be dragged into soil and rock crevices by large black ants. A few fruits of _A. floribundum_ and _A. peltarioides,_ while still attached to the plants, were noticed to contain seeds which had started to germinate _in situ_. This phenomenon was probably due to the absorption of moisture into the locules before the fruits had been detached.

Within the _Cruciferae,_ samaroid, indehiscent and wind-dispersed fruits that are pendulous on deflexed or reflexed and fragile pedicels, are not unique to Subsect. _Samarifera_. A similar method of dispersal is observed for _Peltaria angustifolia_ DC., _Degenia velebitica_ (Degen) Hayek and _Fibigia pendula_ (Boiss.) Boiss., _Isatis_ Sect. _Samararia,_ etc.

Obviosuly the indehiscent nature of the fruits represents a secondary specialization (Zohary, 1948) which is presumably of value for added protection of the seeds during their after-ripening period (1-2 months) necessary after fruits have matured. Wind dispersal of these indehiscent fruits probably ensures a wider distribution, especially when more often than not only one viable seed is present in each fruit (though two ovules are present). Zohary's claim (1948) that reduction in ovule number in Cruciferous fruits is often accompanied by a decrease /

decrease in fruit size does not hold for Subsect. Samarifera, the species of which have the largest fruits in the genus; but his hypothesis that the lack of dehiscence through abortion or inhibition of separation tissues (to detach the valves from the replum) is a specialization is well illustrated by the species of Alyssum with indehiscent samaroid fruits. The enlargement of the fruits in these species is evidently a further specialization for wind-dispersal.

Within the annual species of Sect. Alyssum, some of the components of the A. minus ("A. campestre") complex possess yet another method of fruit dehiscence and seed dispersal, ombrochory, which is more specialized than the simple anemochorous (or wind dispersed) type. The fruits and pedicels of the early maturing and annual A. minus, A. strigosum and A. stapfii (observed in cultivated plants, and the former two also in the field) are brought into a median and spreading, more or less horizontal position at an early stage of development. The separation tissue which forces the valves away from the replum in the anemochorous species is poorly developed or lacking in the ombrochorous species. The upper valves of the fruits are usually more concave than the lower valves, and often only one seed develops in the upper locule, while two seeds are always found in the lower locule. During the rainy periods, usually in the fall or spring, the mechanical effect of the rain drops loosens the valves from the replum and moisture penetrates into the locules. The more or less concave surfaces of the upper valves seem to magnify the shock action of the rain drops, thereby increasing the efficiency of the rain in loosening and washing the valves and seeds to the ground. This feature is especially important if the rain is of short /

short duration. The moisture which has penetrated into the locules causes the seeds to swell and exude a large amount of mucilage (produced by a special layer of cells). The mucilage and swollen seeds push the valves away from the replum to the extent that further impact of rain drops wash the loosened valves and mucilaginous seeds to the ground. Because of their envelope of mucilage, the seeds adhere strongly to the soil particles that they have dropped upon, and germination occurs. The ombrochorous method of dehiscence and dispersal was observed to be accomplished in approximately ½ hour or less from the time that water was first applied. Often, annual species, which possess this method of dispersal, produce two generations in the same growing season if rains have occurred during the summer months.

Only further study will elucidate how widespread the phenomenon of ombrochory is in Alyssum; however, it was definitely observed in conjunction with hygrochasty (Zohary and Fahn, 1941; Zohary, 1949) for two species in Sect. Alyssum, namely A. szowitsianum (as A. pyramidatulum), A. marginatum, and in A. damascenum of Sect. Psilonema. Zohary and Fahn (1941) suggested that hygrochasty might also be present in A. umbellatum and A. strictum of Sect. Alyssum. The present author has confirmed (from cultivated plants) the occurrence of the ombrochorous-hygrochastic method of dehiscence and dispersal for A. umbellatum, A. strictum and A. contemptum.

Among the annual species of Sect. Alyssum, A. szowitsianum, A. marginatum, A. umbellatum, A. strictum and A. contemptum appear to form a natural morphological group, characterized by hygrochasty. The mature fruits and pedicels (the lowermost pedicels being usually 2-3 times /

times longer than the upper ones) of these species are appressed to the fruiting axis, and are often overlapping and imbricated. They remain in this position throughout the dry periods following maturity until the first rains (usually in the fall and spring). In the presence of moisture the pedicels spread horizontally bringing the fruits (with strongly concave upper valves) into a median, more or less horizontal position where the impact of rain drops loosens and washes the valves and mucilaginous seeds to the ground in a manner identical to the process described for the strictly ombrochorous species. The processes of pedicel movement and ombrochory, from the time water is applied, take approximately one hour or less.

The anatomical reasons for the movement of the pedicels of the hygrochastic species are described and illustrated by Zohary and Fahn (1941); however, a brief summary follows. It is as easily seen on herbarium material as on living plants that the pedicels of the hygrochastic species are swollen at their bases and are oval or broadly elliptic in cross-section. The swollen pedicel bases are due to a thick layer, in the upper surface of the pedicels (the surface which is appressed to the raceme axis when in the dry state), of thick walled sclerenchyma fiber cells which have a dense pattern of transverse pitting. In the lower surface of the pedicels, the layer of elongate sclerenchyma cells is thinner, and the component fibers are thin walled and are furnished with only a few, scattered, diagonally disposed pits. Zohary and Fahn (1941) point out that the thick upper layer of transversely pitted fibers is the "active" element leading to the hygrochastic movement of the pedicel, and that the lower /

lower and thinner layer of fibers with sparser and diagonally oriented pits constitutes the actual strengthening element which counter-balances the hygrochastic movement. The absorption of water by the thick layer of fibers in the upper surface of the pedicels causes the whole pedicel to move in a purely mechanical manner.

The significance of hygrochasty is directly related to the arid or semi-arid environments in which the plants grow. Zohary (1949) regards hygrochasty as a means of exposing the fruit for the maximum extent to a single and limited dispersal factor, namely rain. Seed dispersal accordingly is limited to the rainy periods, for during the dry months the fruits by being appressed to the raceme axis are not subjected to the dispersal factor of wind. Furthermore, the extent of dispersal for ombrochorous and hygrochastic species is limited to the "chosen and favourable" habitats in which the parent plants grow. This is what Zohary (1937) terms an antitechorous phenomenon, that is, seed dispersal is limited to the rainy periods during which long distance dispersal is generally impossible.

Zohary (1941:129 & 161) suggests that the hygrochastic and ombrochorous method of dehiscence and dispersal is unique to those species of Alyssum in Sect. Alyssum and Sect. Psilonema which he examined, and that it might be possible to recognize a special subsection (Subsect. "Hygrochastica") within Sect. Alyssum which contains the species characterized by a unique pedicel anatomy and a hygrochastic form of dispersal. This is a feasible suggestion for the species in Sect. Alyssum exibiting hygrochasty: this feature can be detected on herbarium specimens as well as on living plants by the fruits and basally /

basally swollen pedicels being imbricated (when dry) on pyramidal, spicate or cylindrical racemes. In addition, if fragments of the racemes are soaked or sprayed with water, the movement of the pedicels can be observed. However, the inclusion of A. damascenum (in Sect. Psilonema) in a new taxonomic group of Sect. Alyssum is untenable. Though A. damascenum possesses a hygrochastic means of dispersal, its filaments are always edentate, unwinged and unappendaged - the diagnostics of Sect. Psilonema - and this species cannot be regarded as a component of Sect. Alyssum, whose species always have winged and/or dentate and/or appendaged filaments. It is not denied that Sect. Psilonema and Sect. Alyssum are closely related, even to the extent that upon occasion some species of the latter section, i.e. A. desertorum, have been referred to the former section; but the fact remains that the filament characters are always constant and diagnostic.

The occurrence of hygrochasty in A. damascenum can be thought of as an example of convergence with the dispersal and dehiscence mechanisms prevailing in the hygrochastic species of Sect. Alyssum. In addition to the fact that the fruits and pedicels of A. damascenum are not markedly imbricated and appressed to the raceme axis, the pedicels (not strikingly swollen at their bases) have a different anatomical structure (Zohary and Fahn, 1941) to the pedicels of A. szowitsianum and allied species. The thick walled fiber cells which constitute the "active" element of hygrochasty are, in A. damascenum, not confined to the upper (appressed) surface, but are distributed in a more or less uniform circular ring round the terete pedicels. The strengthening element of thin walled fiber cells is enclosed within the ring /

the ring of thick walled ones, and is always located in the outer surface of the pedicels. It must be mentioned that the pedicel anatomy of A. szowitsianum and allied species in Sect. Alyssum might have been derived from the A. damascenum type merely by concentrating all the thick walled "active" fibers to the inner surface of the pedicel, and increasing the amount of thin walled strengthening cells in the outer surface; however, this is a matter of conjecture. Apart from any consideration of hygrochasty or pedicel anatomy, the overall resemblances and external morphological characters clearly indicate that A. damascenum should be referred to Sect. Psilonema.

The question of recognizing a subsection within Sect. Alyssum, whose diagnostic is a hygrochastic-ombrochorous method of dehiscence and dispersal, must be left in abeyance until many more annual and perennial taxa can be studied as critically as Zohary and Fahn (1941) and Zohary (1949) examined A. szowitsianum, A. marginatum and A. damascenum. Furthermore, only to recognise a "Subsect. Hygrochastica" would not solve the problem of what to do with the rest of the large Sect. Alyssum, whose subdivision presents numerous difficulties.

(b) Seed Mucilage.

The production of a mucilaginous sheath around the seeds of the ombrochorous and hygrochastic species of Alyssum, in the presence of moisture, is important in fruit dehiscence, dispersal of disseminules, and the retention of the seeds in a favourable environment for germination (Zohary and Fahn, 1941; Zohary, 1949), but this phenomenon is by no means limited to the strictly hygrochastic species as suggested by Zohary (1937). The production of mucilage is a relatively stable feature in many anemochorous dispersed species, i.e. Sect. Meniocus, Sect. Psilonema, Sect. Alyssum and Sect. Gamosepalum, and is in fact widespread in the family, including the supposedly primitive Tribe Sysymbreae.

Seeds from recent collections of about 70 representative species of Alyssum and Aurinia were soaked in likewarm water for about three hours, and were then removed to a 50% aqueous-alcoholic solution of Toluidine blue and left overnight. If mucilage was produced, a dark blue gelatinous sheath was observed enveloping the seeds on the following day. It must be commented that the seeds investigated were usually not more than two or three years old; older seeds produced no mucilage though seeds from recent collections of the same species yielded a definite mucilage layer. The use of old seeds accounts for errors similar to that of Schulz (1927) who claimed that the seeds of A. bornmuelleri did not exude mucilage.

In the following table the results of the present author's studies of mucilage production are summarized. The formation of a mucilaginous sheath is graded into three categories: 0 = no production; + = a slight sheath /

sheath, measuring c. 0.1 mm. wide or less; and ++ = a thick sheath, measuring 0.3 mm. wide or more. The method of dehiscence and dispersal, when known, is given for each species studied.

Genus	Species	Mucilage	Dispersal and Dehiscence
AURINIA	saxatilis	0	anemochory
	rupestris	0	anemochory
ALYSSUM			
Sect. Meniocus	linifolium	++	anemochory
	meniocoides	++	anemochory
	stylare	++	anemochory
	blepharocarpum	++	anemochory
Sect. Psilonema	damascenum	++	ombrochory and hygrochasty
	dasycarpum	++	anemochory
	homalocarpum	+	anemochory
Sect. Alyssum	desertorum	++	anemochory
	turkestanicum	++	anemochory
	foliosum	++	?
	minutum	++	anemochory
	fulvescens	++	anemochory
	strictum	++	ombrochory and hygrochasty
	contemptum	++	ombrochory and hygrochasty
	umbellatum	++	ombrochory and hygrochasty
	szowitsianum	++	ombrochory and hygrochasty
	marginatum	++	ombrochory and hygrochasty
	rostratum	++	anemochory
	macropodum	++	?
	minus	++	ombrochory
	stapfii	++	ombrochory
	strigosum	++	ombrochory
	xanthocarpum	++	?
	hirsutum /		

	hirsutum	++	?
	trichocarpum	++	?
	repens	++	anemochory
	pseudo-mouradicum	++	anemochory
	erosulum	++	anemochory
	idaeum	0	anemochory
	mouradicum	+	?
	handelii	0	?
	aurantiacum	0	anemochory
	argyrophyllum	0	anemochory
	praecox	++	anemochory
	lepidotum	++	anemochory
	lanceolatum	++	anemochory
	muelleri	++	anemochory
	aizoides	+	anemochory
	bornmuelleri	++	anemochory
	caespitosum	+	anemochory
Sect. Gamosepalum	lepidoto-stellatum	++	anemochory
	paphlagonicum	++	anemochory
	baumgartnerianum	++	anemochory
	corningii	++	anemochory
	sulphureum	++	anemochory
Sect. Odontarrhena			
Subsect. Odontarrhena	corsicum	+	anemochory
	troodi	0	anemochory
	discolor	+	anemochory
	oxycarpum	0	anemochory
	davisianum	0	anemochory
	callichroum	0	anemochory
	cypricum	0	anemochory
	huber-morathii	0	anemochory
	lanigerum	0	anemochory
	pateri	0	anemochory
	borzaeanum	0	anemochory
	sibiricum /		

	sibiricum	0	anemochory
	condensatum	0	anemochory
	anatolicum	0	anemochory
	haussknechtii	0	anemochory
Subsect. Compressa	murale	0	anemochory
	akamasicum	+	anemochory
	cassium	0	anemochory
	giosnanum	0	anemochory
	elatum	0	anemochory
Subsect. Samarifera	floribundum	++	anemochory of the
	trapeziforme	0	dissemiule, which
	peltarioides	+	in this subsection
	caricum	++	is the whole
	samariferum	0	fruit

From the above table it can be seen that mucilage is not produced by any species of Aurinia examined, but is well developed in Alyssum Sect. Alyssum, Sect. Psilonema, Sect. Meniocus and Sect. Gamosepalum. The inhibition of mucilage in A. idaeum, A. handelii, A. aurantiacum and A. argyrophyllum - closely allied species in Sect. Alyssum - is corrleated with the very specialized type of trichome, the large lepidote scales which these species have in common, but the physiological and phylogenetic reasons for the inhibition of mucilage in this group of plants are still a matter for conjecture. It is thought that the general lack of mucilage production in Subsect. Odontarrhena and Subsect. Compressa of Sect. Odontarrhena is an advanced state correlated with the reduction in ovule number (to one in each locule - diagnostic for Sect. Odontarrhena) in conjunction with a general decrease in the size of the fruits (Zohary, 1948). On the other hand, it could be argued that /

that the sporadic occurrence of mucilage in Sect. Odontarrhena represents a reversal of trend or the retention of a primitive feature, if the mucilage gives the plant a special and particular dispersal advantage. Such is the case in the species of Subsect. Samarifera whose seeds are always enclosed in samaroid indehiscent fruits which act as the dissemimules and are dispersed by wind action.

The anatomical basis of mucilage production (or its inhibition) needs to be studied in detail; however, Abraham (1885:617-621 and Pl. 26, fig. 65-81) investigated mucilage production in the seeds of A. alyssoides (A. calycinum). From his work and the present author's own observations, it appears that the outermost layer of cells (of the 5 cell layers) in the testa is the active components in mucilage production. It is these epidermal cells which give the seed surface of all Alyssum species a minutely papillose appearance. As these cells increase in size during elongation, their contents become viscous, and two types of walls are differentiated. The top wall of the epidermal cells is thin and fragile, but the lateral and basal walls are thick and rigid. When the seeds are mature and are brought into contact with moisture, the osmotic movement of water into the cells and the internal force exerted by the now distended cell contents rupture the thin outer (or upper surface) walls, and allow their viscid contents to escape. When this process is multiplied by the number of epidermal cells, it can be easily visualized how the individual cell contents can coalesce into a sheathing envelope of mucilage. Abraham (1885) observed that the gelatinous sheath was not uniform, and after staining it with eosin, noticed /

noticed that definite "rays" which took the stain heavily were embedded in a lighter coloured amorphous matrix. Under suitable light conditions this feature can be observed, superficially ciliate, macroscopically without staining; the present author noticed it in the mucilage of the seeds of A. blepharocarpum in Sect. Meniocus. The observation of "ciliate seeds" account for Formanek's description of A. corymbosoides f. ciliata. The membranous wings (if present) of seeds do not possess the layer of mucilage-releasing cells. It is possible that the amount and exact composition of the mucilage would constitute additional differences which could be used in a classificatory manner, but a study such as this would require comparative biochemistry.

(3.) Karyology

Enumerations of chromosome numbers of Alyssum species may be found in Jaretsky (1928 and 1932), Manton (1932), Darlington and Wylie (1955), Löve and Löve (1961) and in the Index to Plant Chromosome Numbers, 1 (1-4), 1958-1960; 2 (5-6), 1961. It is difficult to assess many of the Alyssum counts because of the taxonomic confusion within the genus, and consequent risk of misidentification. It was not possible to verify the identifications of material used for counts of taxa attributed to Alyssum in the following table.

Genus	Species	2n	Authorities
AURINIA	saxatilis subsp. saxatilis (as Alyssum saxatile or Alyssum arduinii or Alyssum saxatile subsp. arduinii)	16	Laiback (1907), Jaretzky (1928), Manton (1932), Baksay (1961)*
	saxatilis subsp. orientalis (as Alyssum orientale)	16	Jaretzky (1932), Manton (1932)
	corymbosa (as Alyssum corymbosum)	16	Jaretzky (1928)
	petraea (as Alyssum petraeum or Alyssum edentulum	16	Jaretzky (1928 & 1932)
HORMATHOPHYLLA	pyrenaica (as Alyssum pyrenaicum)	32	Jaretzky (1932), Manton (1932)
ALYSSUM			
Sect. Meniocus	linifolium	14-16	Manton (1932)
Sect. Psilonema	dasycarpum	16	Jaretzky (1932), Manton (1932)
	alyssoides (often as A. calycinum)	32	Jaretzky (1928), Manton (1932), Böcher & Larson (1958)

Genus	Species	2n	Authorities
ALYSSUM			
Sect. Alyssum	minus (as "A. campestre"	16	Jaretzky (1932), Manton (1932), Böcher & Larson (1958), Gardé & Gardé (1953), Ball, University of Liverpool (unpublished)
	umbellatum	16	Ball, University of Liverpool (unpublished)
	rostratum	16	Manton (1932)
	wierzbickii	16	Laibach (1907)
	repens	32	Manton (1932)
	transsilvanicum	16	Manton (1932),* Mattick in Tischler (1950)
	ovirense	16	Manton (1932)
	wulfenianum	32	Manton (1932)
	moellendorfianum	16	Manton (1932)
	doerfleri	16	Manton (1932)
	cuneifolium	16	Manton (1932)
	montanum subsp. montanum	16	Jaretsky (1932), Manton (1932), Quézel (1957), Böcher & Larson (1958)
	thessalum	32	Manton (1932)
Sect. Odontarrhena	tortuosum	16	Jaretsky (1932), ? Manton (1932)
	murale	16	Jaretsky (1928 & 1932)
	borzaeanum	16	Manton (1932)
	argenteum	16	Liabach (1907), Contandriopoulos (1962)
	corsicum	16	Contandriopoulos (1957)
	robertianum	16	Contandriopoulos (1957)
	alpestre	16	Contandriopoulos (1962)
Sect. Tetradenia	spinosum	32	Manton (1932)

* after the date of the authority indicates counts from material of known wild origin.

The difficulty in placing much reliance on the chromosome counts of Alyssum is exemplified in Darlington and Wylie (1955) who record 2n = 32 for A. alyssoides. Their count was taken from a horticultural cultivar of Lobularia maritima called "Small Alison". Manton's record of A. tortuosum, 2n = 16, cannot be relied on because she cites the authority of that species as Ruprecht, rather than Willdenow or Waldstein & Kitaibel as it had been previously known erroneously. The count of A. murale (2n = 16) attributed to Laibach (1907) by Jaretzky (1928) and Löve and Löve (1961) is erroneous. Nowhere does Laibach mention having examined A. murale, but he did count A. argenteum, a species very distinct from A. murale. It is obvious that the workers who are attributing the record of A. murale to Laibach are confusing that species with A. argenteum.

It can be seen from the above table of chromosome numbers that though very little cytological work has been done on Alyssum or Aurinia, and the counts that have been made are very unrepresentative, the general pattern appears to be relatively stable with few sporadic deviations from n = 8 and 2n = 16. Jaretzky (1932) indicated that the structure of the chromosomes was very similar for all of the 27 species he investigated (he did not, however, enumerate them all!); of those, 21 were 2 n = 16 and only 5 were tetraploides with 2n = 32. Manton (1932) comments that because of the uniformity in number and morphology of the Alyssum chromosomes she examined (c. 1.8-3 μ long at metaphase), it was doubtful if a cytological study of Alyssum would be of much aid in overcoming taxonomic difficulties.

It is impossible to evaluate the occurrence of the tetraploid (2n = 32) /

(2n = 32) number in A. repens and 2n = 16 in A. transsilvanicum (the latter is regarded in the following study because of morphological continuities as a synonym of A. repens subsp. repens) as recorded by Manton (1932). The count of A. transsilvanicum is the only Manton record based on material of known wild origin; it was, however, been verified by an additional count by Mattick in Tischler (1950). There are no known counts of A. repens subsp. trichostachyum. The diploid number of 14 from A. linifolium, the only species in Sect. Meniocus which has been examined, is probably due to an error in counting.

The tetraploid count for A. thessalum (treated in the following study as synonymous with A. montanum var. hymettium because of morphological continuities) is interesting because it illustrates a chromosomal difference between infra-specific taxa. This difference helps to confirm the taxonomic recognition of var. hymettium. In a similar manner, apart from morphological characters, different chromosome numbers serve to distinguish A. ovirense (2n = 16) and A. wulfenianum (2n = 32). These species are very closely allied, to the extent that Baumgartner (1908) entertained the possibility that the latter could be treated as an alpine variety of the former.

Some of the polyploidy recorded in Alyssum may be due to what Manton (1932) terms local vegetative polyploidy, such as occurs occasionally in the genus Crambe, but only more extensive cytological studies within a sound taxonomic framework will clarify the significance of polyploidy. It would be especially valuable to compare the chromosome number and morphology of the taxa which compose the A. minus ("A. campestre") complex, i.e. A. minus, A. stapfii, A. strigosum and A. hirsutum /

A. hirsutum. No chromosome counts are known for any of the known 49 species of _Alyssum_ endemic in Turkey.

Most of the counts of _Alyssum_ and _Aurinia_ have been made on mitotic root material or meiotic pollen mother cells. Laibach (1907) used an unusual method and counted the mitotic chromosomes from young trichome cells of _Aurinia saxatilis_, _Alyssum wierzbickii_ and _Alyssum argenteum_. A cytological investigation of the primordial trichome cells of _Alyssum_ could be combined advantageously with an ontogenetic study of the types of trichomes.

(4.) Morphological Abnormalities

On this subject Nyárády (1927) has much to say about a special type of stem formation in Sect. Odontarrhena for which he invented a new term ("caulomania"). In place of an inflorescence bearing flowers, more and more stems are produced with densely leafy short shoots ("phyllomania") occurring in the leaf exils. He interprets this form of growth as a hypertrophy of the stems. The present author has not seen any material illustrating this abnormality, and Nyárády did not give any details for the gatherings which he observed.

The undulation of fruits, which Nyárády treats as an abnormal expression, is diagnostic for a number of species of Sect. Odontarrhena whose fruit valves are equally compressed. Many species in Subsect. Compressa, i.e. A. murale, A. akamasicum, A. cassium, A. heldreichii, A. elatum, etc., and all components of Subsect. Samarifera consistently have more or less undulate fruits.

Nyárády (1927) reports cleistogamy occurring in flowers of A. markgrafii Schulz, but does not indicate if viable seeds are produced from these flowers. He comments that normal chasmogamous flowers develop on the same inflorescence as the cleistogamous ones. The floral parts of these "cleistogamous" flowers are considerably different from those of normal flowers, namely that the petals and sepals of the former are larger, their stamens are very reduced and frequently aborted, and the styles on their seemingly aborted and reduced ovaries are very short. The stimuli triggering the production of these "cleistogamous" flowers (if in fact they are truly cleistogamous and not just an abnormal development) are not known. The present author has not observed /

observed cleistogamous flowers on any specimens of A. markgrafii or any other species.

Nyárády (1927) points out that occasionally the usually many-flowered and many-fruited racemes of A. argenteum All. produce only 1-3 mature fruits; the other flowers maintain an immature stage of development, dry up and fall away. This abnormality or stasimorphy (arrested development) he continues, is not attributable to the absence of pollination, but rather to an unequal distribution or lack of "nutrients" within the plant. A similar example of an usually many-fruited raceme producing very few fruits was observed in Anatolia, rarely, in large populations of A. strigosum.

The development of sterile shoots in the axils of the inflorescence branches of A. borzaeanum is thought by Nyárády to be an example of recrudescense. This is not an uncommon phenomenon for sand-dune or steppe inhabiting plants which normally produce densely conferted and basal sterile shoots, i.e. A. sibiricum, A. caliacrae, A. stribrnyi, etc. A specimen of A. eriophyllum from Anatolia (Stainton et. al. 5478) whose basal sterile shoots had been annihilated in the field by insect damage, showed a strong development of sterile shoots in the axils or the inflorescence branches, or from the axils of the subtending leaves.

Occasionally A. murale (in Romania) will have teratologically formed hairs sparingly mixed with the more abundant normal ones. This is a very rare condition and has been seen by the present author only once; however, Nyárády (1927) illustrates 12 types of abnormal hairs from A. murale. The major process in the formation of these hairs seems to /

be the elongation and thickening of the supporting stalk or stipe, and the reduction in the number of rays, so that infrequently the hair appears simple or only once or twice branched. Nyárády found on the leaves of A. heldreichii and the fruits of A. borzaeanum and A. sibiricum (as A. halacsyi) a type of abnormally developed hair which he calls the "Surrogatum" hair (substituting hair). These are developed in matted indumentums and lie underneath the normal long-rayed hairs, and are furnished with short, thick and few rays. Nyárády hypothesises that these "Surrogatum" hairs have developed from the need of additional water conservation in extreme xerophytic environments, and that if the outer and larger hairs are lost due to wind action or other reasons, there will still be an inner layer of much smaller and appressed hairs.

The occurrence of teeth or appendages on the petals is quite a constant feature, though not diagnostic for a number of species in Sect. Odontarrhena. In A. borzaeanum, teeth may occur on 2-3 petals out of 4 in individual flowers. Other species in which the petals are sporadically toothed are A. caliacrae, A. sibiricum, A. murale, A. obtusifolium, A. condensatum and A. virgatum. Nyárády (1927) claims that the toothing of the petals of A. borzaeanum, etc. is a formation homologous to the toothing and appendages of the filaments, and is an atavism (1925) or the beginning of a progressional sequence (1929). The petals of A. pinifolium (Triplopetalum) and A. lesbiacum are always appendaged. Nyárády (1925) claimed that the diagnostic petal appendages of Triplopetalum were not homologous with the teeth or appendages that occurred sporadically with other species, or to the toothed structures of the filaments, but were rather derived in a totally /

totally different manner (see discussion under A. pinifolium, p.649). It is interesting that in addition to diagnostic appendages occurring on the petals of A. lesbiacum, a close ally of A. pinifolium in Subsect. Samarifera, appendages or teeth are also known to occur on the petals of A. virgatum, yet another ally in Subsect. Samarifera.

Another teratology of floral parts is pointed out by Nyárády for a collection of A. murale (Richter, Romania). The petals in many flowers (but not all) approach the morphology of the stamens to the extent that often some of them have rudimentary anthers and toothed appendages. A gathering of A. szowitsianum (Sect. Alyssum (Lace, Baluchistan) was observed by the present author to have consistently very unusually developed flowers. The petals and ovaries of these flowers appeared normally developed, but the stamens (or what should have been stamens) had no anthers and were large, flat, greenish and covered with a dense indumentum. The cause of the malformation of the stamens in the case of this collection appeared to be presence of insect galls on the stems and inflorescence. A study of teratologically formed petals and filaments might be very rewarding in elucidating the origin, structure and function (and morphogenesis) of the filament and petal appendages.

Galls caused by insects have been observed by Nyárády on A. murale and A. markgrafii - in the latter case possibly causing the "cleistogamous" flowers. Examples of galls have been seen by the present author on A. szowitsianum and A. eriophyllum. Houard (1908) records that A. alyssoides (A. calycinum) from Central Europe and A. hirsutum from Russia and Caucasia form abnormal greenish or whitish flowers, the parts of /

of which are covered with a dense indumentum due to the formation of galls caused by the mite, Eriophyes drabae Nal. Galls caused by the beetle, Ceuthorrhynchus constrictus Marsh. are formed on the roots of A. alyssoides (Houard, 1913). Houard (1908) also records large, swollen, fusiform galls (the size of a mittet head) with a central cavity as forming on the stems of A. alyssoides. These stem galls are caused by the fly, Perrisia alyssi Kieff. Large galls (10-15 x 6-8 mm.) are formed on the stems and inflorescence branches of A. montanum subsp. gmelinii (as A. arenarium Gmelin), from Germany, by the fly Janetiella fallax Kieff. (Houard, 1908). The large, hollow and fusiform galls recorded by Houard (1908) forming occasionally at the apices of the inflorescence branches of A. bertolonii Desv. and A. argenteum All. were noticed by the present author on Anatolian collections of A. murale. These galls are said by Houard to be formed by beetles.

Albugo candida (Pers.) Ktze. is reported by Nyárády to occur on A. murale in Romania. Erysiphe communis (Wallr.) Link has been seen on plants of A. contemptum from Anatolia. Nyárády reports Cuscuta europaea L. growing on an Alyssum in Romania, but does not say on which species.

The teratological formations caused by insects or other reasons have not caused any taxonomic confusion within the genus: however, the interpretation of the ontogeny of petal appendages of A. pinifolium (Triplopetalum) is subject to some controversy - which in the case of Nyárády (1925) lead to the description of Triplopetalum, a genus supposedly distinct from Alyssum.

IX. SYNOPSIS OF THE GENUS AURINIA

AURINIA (L.) Desv. Journ. Bot. Appl., 3, 162 (1814); Schulz in Nat. Pflanzenfam., 17b, 491, f. 298 (1936).

Syn.: Alyssum Sect. Anodontea DC., Syst. Nat., 2, 317 (1821) - lectotype: Au. petraea (Syn.: Alyssum edentulum Waldst. & Kit.)!

Anodontea (DC.) Don, Gen. Hist. Dichl. Pl., 1, 180 (1831)!

Alyssum Sect. Aurinia (Desv.) Koch, Synop. Fl. Germ. & Helv., 1, 58 (1836)!

Aurinia Sect. Corioceratium Griseb., Spic. Fl. Rum. & Bith., 1, 272 (1843)!

Alyssum Subgen. Aurinia (Desv.) Le Maout & Decaisne, Fl. Élém. Jard. Champ., 1, (1855).

Lepidotrichum Vel. & Bornm. in Öst. Bot. Zeit., 34, 324 (1889)!

Plants perennial or biennial. Lower cauline and sterile shoot leaves distinctly rosulate at apices of thick stem stocks, often repand-dentate or pinnatifid, up to 100 mm. long, bases swollen and persistent. Indumentum of stellate or lepidote stellate hairs. Inflorescence racemose or corymbose or paniculate. Pedicels divergent and spreading. Calyx cup-shaped with 4, free and spreading sepals, not saccate. Petals yellow or white, spathulate and clawed, bifid or entire. Long filaments 4, always free, bilaterally winged and dilated to base, often with small basal tooth. Short filaments 2, winged with small basal tooth. Anthers short, obtuse. Nectaries 4, globose or triangular, 1 at each side of short filaments. Styles of varying lengths, often widely dilated to base, persistent. Silicules dehiscent, latiseptate, bilocular /

bilocular with prominent replum, locules 2-4-ovulate, valves glabrous or rarely pubescent, compressed or inflated at centre, or equally inflated and ± globose. Seeds winged or rarely wingless, not mucilaginous. Embryo notorrhizal.

Type species: Au. saxatilis (L.) Desv. (Alyssum saxatile L.).

Component species:

Au. saxatilis (L.) Desv. (E,B,T,O).

Au. leucadaea (Guss.) Koch (E,B).

Au. uechtritziana (Bornm.) Cullen & Dudley, comb. nov. (B,T).

Au. petraea (Ard.) Schur (E,B).

Au. corymbosa Griseb. (B).

Au. rupestris (Ten.) Cullen & Dudley, comb. nov., (E,B,T).

A. halimifolia (Boiss.) Cullen & Dudley, comb. nov., non L. (E).

(1) Key to Turkish Representatives

1. Inflorescense compound, corymbose; margins of basal leaves dentate or sinuate-repandate; stellate hairs on leaves with ± few or many rays, never lepidote; silicule valves membranous, margins smooth.
   2. Flowers yellow; seeds widely winged; silicules (3-) 4-8 (-10) x (2-) 3-8 (-15) mm., valves compressed or only slightly inflated at centre; inflorescense 5-15 (-20) cm. long; fertile stems greenish with sparse indumentum 1. saxatilis (E,B,T)
   2. Flowers white; seeds wingless; silicules 2-4 x 2-2.5 mm., valves strongly and equally inflated; inflorescence 20-40 cm. long; fertile stems whitish with dense indumentum, especially towards base /

base 2. <u>uechtritziana</u> (B,T)

1. Inflorescense simple, racemose; margins of basal leaves entire and smooth; stellate hairs on leaves strongly lepidote; silicule valves cartilaginous, margins prominently ridged at apex

3. <u>rupestris</u> (E,B,T)

(2) Systematics and Enumeration of Turkish Taxa

1. A. saxatilis (L.) Desv., Journ. Bot. Appl. 3, 162 (1814).

Key to subspecies

1. Silicules elliptic or obovate, obtuse or acute, rarely emarginate, (3-) 4-5 (-6) x (2-) 3-4 (-5) mm., always longer than broad; styles 0.5-1 mm. long, not significantly dilated at base; margins of basal leaves sinuate or sparsely dentate, teeth c. 0.5 mm. deep saxatilis (E)

1. Silicules orbicular or transversely elliptic, emarginate or truncate, (3.5) 4-8 (-10) x (4-) 5-8 (-10-15) mm., usually wider than long, or if apex obtuse or acute then silicules c. 8-10 (-15) mm. long and wide and styles 2-2.5 mm. long; styles (1-) 1.5-2 (-2.5) mm. long, strongly dilated at base (base 0.5-0.8 mm. diam., apex 0.1-0.2 mm. diam.); margins of basal leaves dentate, often appearing pinnatified, teeth (0.5-) 1-3 (-5) mm. deep, or if smooth then plants very reduced, 5-10 cm. tall

2. Silicules (6-) 7-10 (-12) x 8-12 (-15) mm.; pedicels (7-) 10-15 (-20) mm. long; styles (1.5-) 2-2.5 mm. long; petals (4.5-) 6-7 x (2-) 2.5-3.5 mm.; seed wings (0.5-) 0.7-1 mm. wide megalocarpa (B,T)

2. Silicules (3.5-) 4-5 (-6) x 4-6 (-7) mm.; pedicels 4-10 mm. long; styles 1-1.5 mm. long; petals 3-4 (-4.5) x 1.5-2 mm.; seed wings 0.4-0.5 mm. wide orientalis (E,B,T)

subsp. saxatilis Reichenb., Icon. Bot., 3, t. 232 (1825); Reichenb., Ic. Fl. Germ. & Helv., 2, t.20, f. 4280 (1837-1838); Fritsch in Kerner, Sched. Fl. Aust.-Hung., 9, 24 (1902); Jav. & Csap., Ic. Magy. /

Magy. Fl., pl. 213, f. 1600 as A. arduini (1934); Gauckler in Ber. Beyer. Bot. Gesell., 23, 121 (1938); Mansfeld in Fedde Rep. Sp. Nov., 46, 115 (1939); Fl. Ukr. 5, 329, pl. 75 (1953); Fl. Rep. Pop. Rom., 3, 327, pl. 56, f. 2 (1955); Preslia, 32, 360 (1960).

Syn.: Alyssum saxatile L., Sp. Pl. 2, 650 (1753)!

Aurinia media Schur, Enum. Pl. Transs., 61 (1866)!

Alyssum saxatile var. subsinuatum Borbas in Math. Term. Közl., 15, 178 (1878)!

Alyssum arduini Fritsch, Exc. Fl. Öst., 253 & 628 (1897)!

Alyssum saxatile var. typicum Beck in Glasn. Zem. Muz. Bosn. Herceg., 28, 129 (1916).

Alyssum saxatile var. arduini (Frit.) Hayek, Prod. Fl. Pen. Balc. 1, 430 (1925)!

Alyssum saxatile subsp. arduini (Frit.) Pawl., Fl. Tatrorum, 1, 325 (1956)!

Type: L-herb. Royen, Herb. Lugb. Bat., No. 901050 (901.212-211 & 901.212-215); 2 specimens collected by Royen in the Leiden Botanic Gardens.

Distribution: Widespread in Central and S.E. Europe, extending E. into the Ukraine and the upper Caucasus, and N. into Poland. Map 1.

subsp. orientalis (Ard.) Dudley, comb. nov.; Sibth. & Smith, Fl. Gr., 7, 21, t. 624 as Alyssum saxatile (1830); Boiss., Fl. Or. 1, 266 pro /

pro species (1867); Velen., Fl. Bulg., 37 (1891); Hal., Consp. Fl. Gr. 1, 90 as Alyssum saxatile (1900); Bornm. in Mitt. Thür. Bot. Ver., 24, 11, f. 2 (1909); Hayek, Prod. Fl. Pen. Balc. 1, 430 pro species (1925).

Syn.: Alyssum orientale Ard., Animad. Spec. Alt. 2, 32, t. 15, f. 1 (1764)!

Clypeola tomentosa L., Mantissa, 92 (1767)!

Alyssum affine Ten., Syll., 315 (1831)!

Aurinia orientalis (Ard.) Griseb., Sp. Fl. Rum. & Bith., 1, 272 (1843)!

Alyssum orientale var. majus Hausskn. in Mitt. Thür. Bot. Ver., 3-4, 112 (1893)!

Alyssum saxatile var. alpinum Hal. in Denks. Akad. Naturwissen. Wien, 61, 499 (1894)!

Alyssum saxatile var. planifolium Heldr., Chlor. Parn., 13 (1899)!

Alyssum denticulatum Form. in Verh. Natur. Ver. Brünn., 37, 177 (1899).

Alyssum saxatile var. majus (Hausskn.) Hal., Consp. Fl. Gr., 1, 91 (1900)!

Alyssum saxatile var. albidum Tuzs. in Bot. Közl., 8, 266 (1909).

Alyssum saxatile var. orientale (Ard.) Beck in Glasn. Zem. Muz. Bosn. Herceg., 28, 129 (1916).

Alyssum saxatile var. orientale f. maiis (Hausskn.) Hayek, loc. cit.!

Alyssum saxatile subsp. orientale (Ard.) Rech. fil. in Ann. Nat. /

Nat. Hofmus. Wien, 43, 300 (1929)!

Alyssum orientale f. humilis Vierh. in Öst. Bot. Zeit., 84, 137 (1935)!

Alyssum orientale f. elata Hal. ex Vierh., op. cit., 138, pro syn.!

Alyssum saxatile var. canum f. linneanum Tuss. ex Vierh., op. cit., 137, pro syn.!

Type: "Oriente". Seeds given to Arduino by Dr. Leonardo Seslerio were cultivated at the Padova Botanic Gardens, and Arduino states that his description and figure is based on two cultivated examples in his herbarium. The authentic specimens seen are in the herb. LINN and G-DC. The specimen sent to Linnaeus by Arduino in 1761 (No. 828:3) may be regarded as a duplicate from Arduino's herbarium. It is designated by Linseaus as "Ard.", indicating its origin, and is determined as Alyssum saxatile. This specimen, together with Arduino's description and figure of Alyssum orientale formed the basis of Clypeola tomentosa L., a later synonym. The specimen in the G-DC. herbarium is also presumably a duplicate from Arduino's herbarium. Other cultivated Arduino specimens representing this taxon are probably extant in the harbaria of C,FI, and PAD).

Distribution: S. Italy, Greece, Aegean Islands, Crete, Turkey-in-Europe and the W. coast of Anatolia. Maps 1 and 2.

TURKEY. A2(E): Prov. Istanbul, Bosporous, nr. Fanar (?), Sibthorp (fide Fenzl in Tchih., Asie Min. Bot. 1 (3), 296:1860). B1: Prov. Çanakkale, Gisow Hissar, valley of Rhodius (nr. Çanakkale), Apr. 1856, Kirk /

Kirk; Prov. Izmir, nr. Izmir, 27 Apr. 1870, Pernin; ibid., 3 Apr. 3 Jun. 1854, Balansa 62; ibid, Whittall 414; ibid.,Mt. Sipylo (Manisa dağ), 250 m., 19 May 1906, Bornmüller 9084. C2: Prov. Denizli, Denizli-Acipayam, 25 km. from Denizli, 860 m., 2 Jun. 1962, Dudley (D.35340). Numerous intermediate specimens between ssp. saxatilis and ssp. orientalis occur in Romania and Hungary. Habitat: Saxatile on calcareous substrates; alt. 250-1000 m. Fl. Apr.-May.

Three well developed subspecies are present in this polymorphic species. As seen on Map 1, subsp. orientalis is partially sympatric with subsp. saxatilis, and in the areas of overlap (Romania and Hungary) populations of intermediates occur. The density of the indumentum, amount of leaf dentation or lobation and stem length of subsp. orientalis are subject to considerable variation; these minor variations account for the numerous varieties listed in the synonymy under that subspecies. Often the indumentum is denser, stem length is diminished and leaf dentations lessened at higher altitudes, but this is not a constant pattern.

Fritsch recognized that under Alyssum saxatile, Linnaeus in Species Plantarum ed. 1 (1753) cited the Tournefort polynomial "Alyssum creticum saxatile, foliis undulatis incanis" (from Tournefort, Corollarium institutionum, 15 : 1703), which is synonymous with Arduino's Alyssum orientale. Fritsch applied a nomen novum, Alyssum arduini, to refer to Linnaeus's Alyssum saxatile based on Royen's polynomial "Alyssum caulibus frutescentibus paniculatis, foliis lanceolatis undulatis integris" (from Royen, Florae Leydensis, 331 : 1740).

subsp. megalocarpa (Hausskn.) Dudley, comb. nov.; Bornm. in Engl. Bot. Jahrb., 59, 449 (1925); Rech. fil., Fl. Aegeae, 223 (1943). Pl. 1.

Syn.: Alyssum orientale var. megalocarpum Hausskn., loc. cit.! *

Alyssum ephesium Bornm. in Mitt. Thür. Bot. Ver., 24, 11, f. 1 (1909)!

Alyssum saxatile subsp. megalocarpum (Hausskn.) Rech. in Beih. Bot. Centralb., 54, 611 (1936)!

Type: (Aegean Islands: B1: Chios): in saxosis ins. Chios, 1853, Pauli (holo. ? JE n.v.)

Distribution: Cyclades, Sporades, W. Aegean Islands, W. coast of Anatolia. Maps 1 and 2.

TURKEY. C1: Prov. Aydin, Ruins of Priene, 150 m., 25 May 1962, Dudley (D.34972a); ibid., Epheseus, 1 Jun. 1906, Bornmüller 9083 (holo. A. ephesium JE n.v., iso. OXF).

AEGEAN ISLANDS. B1: Chios, Tal nr. Livadi, 500 m., Rechinger 5311; Lesbos, Malea nr. Philia, Candargy (fide Rech. fil., Fl. Aegeae, loc. cit.). C1: Kos, Asphendiu nr Pyli, Forsyth-Major 642; ibid., Mt. Dikios, 800 m., Rechinger 8023 & 7981; Samos, Mt. Kakis, 610-1219 m., 1 May 1940, Davis 1672K; ibid., Ambelos, 700 m., Rechinger 3913; ibid. Mt. Kerki, 1000 m., Rechinger 1966 & 4125; ibid., Zoodochus Rigi, Rechinger 3715.

Habitat: Saxatile on calcareous substrates; alt. 150-610 (-1219) m. Fl. Apr.-May.

* in Mitt. Thür. Bot. Ver., 3-4, 112 (1893)!

This subspecies is distinguished from subsp. orientalis, with which it is sympatric, entirely by quantitative characters. The range of distribution of subsp. megalocarpa is very limited, confined to a few Aegean Islands and the Mediterranean coast of Anatolia. Some gatherings of subsp. orientalis (Alyssum affine) from Calabria in Italy (e.g. Rigo 312) have fruits which approach in size some of the smaller fruited gatherings of subsp. megalocarpa from the Aegean Islands (e.g. Forsyth-Major 642 from Kos). A gathering from Prov. Aydin (Davis 25231) in W. Anatolia is not determinable as subsp. megalocarpa due to its smaller fruits; however, this may be a reflection of immaturity as the other differential characters of subsp. megalocarpa are present. Dudley D. 34972a was collected near the area of the Davis gathering, and is easily distinguished as subsp. megalocarpa.

2. Au. uechtritziana (Bornm.) Cullen & Dudley, comb. nov.; Velen., Fl. Bulg., 42 (1891); Azn. in Bull. Soc. Bot. Fr., 64, 165 (1897); Velen., Suppl. Fl. Bulg. 1, 27 (1898); Schulz in Natur. Pflanzenfam., 17b, 495, f. 271, m-o (1936); Hayek, Prod. Fl. Pen. Balc., 1, 428 (1925); Stoj. & Steff., Fl. Bulg., 532, pl. 585 (1948).

Syn.: Ptilotrichum (Koniga) uechtritzianum Bornm. in Øst. Bot. Zeit., 38, 10 (1888)!

Lepidotrichum uechtritzianum (Bornm.) Velen. & Bornm. in Øst. Bot. Zeit., 39, 324 (1889)!

Type: (Bulgaria): Ost-Bulgarien, massenhaft under Bucht von Varna zwischen Pontus und Devno-See, bei Galata, Bornmüller 1885 (holo. JE n.v., iso. W, K).

Distribution: Black sea coast in Bulgaria, and one coastal record from Asiatic Turkey. (Thrace ? fide Hayek, loc. cit.). Map 2.

TURKEY. A2: Istanbul, Bournov (Jum Burnu nr. Kartal), 8 Sept. 1895, Nemetz 178 (G-B.V.D. Post).

Habitat: Maritime sands; fl. Jul.-Aug. (-Sept.).

The reasons for treating this rare and distinctive taxon as a component of the genus Aurinia, rather than as the monotypic genus Lepidotrichum, are stated on p. 19 . The Turkish record has previously been considered as coming from Turkey-in-Europe; however, in the original publication of this record, Aznavour (1897) clearly states that Nematz collected this plant from near Kartal, a village on the Marmara Sea on the Asian side of the Bosphorus. Unfortunately this specimen is merely a portion of an inflorescence, but its floral structure and indumentum leave no doubt that it is correctly referred to Aurinia uechtritziana.

3. Au. rupestris (Ten.) Cullen & Dudley, comb. nov.

Key to subspecies

Silicules pubescent, at least when young — rupestris (E,B)

Silicules always glabrous — cyclocarpa (T)

subsp. rupestris. Ten., Fl. Nap., 2, 72, t. 60 (1820); DC., Syst. Nat., 2, 320 (1821); Ten., Syll. Fl. Neap., 316 (1831); Bertol., Fl. Ital., 6, 498 (1844); Fiori & Paol., Ic. Fl. Ital., 1, 166, f. 1451 (1899); Hal., Consp. Fl. Gr., 1, 87 (1900); Hayek, Prod. Fl. Pen. Balc., 1, 442 (1925).

Syn.: Alyssum rupestre Ten., Fl. Nap., 1, 37 (1811-1815)!
Koniga rupestris (Ten.) Heynh., Nom. Bot. Hort., 1, 439 (1840)!
Lobularia rupestris (Ten.) Steud., Nom. Bot., ed. 2, 64 (1841)!
Koniga scardica Griseb., Spic. Fl. Rum. & Bith., 1, 278 (1843)!
Ptilotrichum rupestre (Ten.) Boiss., Fl. Or., 1, 288 (1867)!
Ptilotrichum rupestre var. scardicum (Griseb.) Hal., loc. cit.!

Syntypes: (Italy): in rupibus editioribus Aprutii, Morrone, Gussone (orig. NAP n.v., iso. G-DC); Majella a Sarimarsvallo, Tenore (orig. NAP n.v., iso. G-DC); Monte Armaro, Schouw (orig. C n.v., iso. G-DC).

Distribution: Italy, Yugoslavia, Albania & Greece.

Habitat: Alpine of calcareous screes; alt. 1850-2700 m. Fl. Jun.-Aug.

subsp. cyclocarpa (Boiss.) Cullen & Dudley, comb. & stat. nov.; Boiss. Fl. Or., 1, 288 (1867); Grossh., Fl. Kavk., ed. 2, 4, 211 (1950).

Syn.: Ptilotrichum cyclocarpum Boiss. in Ann. Sc. Nat., ser. 2, 17, 159 (1842)!

Type: (Turkey, B7: Prov. Tunceli): Kurdistan, (Mounzur Dagh), Aucher (holo. G-B n.v., iso. K).

Distribution: Endemic in Turkey, known from the Armenian Highlands, the Anti-Taurus and the Cilician Taurus. Map 2.

TURKEY. A7: Prov. Gümüşane, Karahissartasch (nr. Elias dağ), 19 May 10 Jun. 1894, Sintenis 5505; ibid., Gümüşane, Bourgeau 33; ibid., Ardas (Torut) - Besklise, Sintenis 92; A8: Prov. Gümüşane/Erzurum, Bayburt-Erzurum, 1500 m., Huet. B5: Prov. Kayseri, Bakir dağ, nr. Akoluk Yayla, 2500-2700 m., 29 Jun. 1952, Davis 19346. B6: Prov. Kayseri, Pinarbasi, 2000 m., 26 May 1960, Stainton et. al. 5167.; Prov. Maras, Berit dağ, 2800 m., 14 May 1934, Balls 1087; ibid., distr. Göksun, Binboga dağ, above Yalak, 2000 m., 14 Jul. 1952, Davis 19977; ibid., 2200-2300 m., 17 Jul. 1952, Davis 20155; ibid., on Isik dağ, above Karli yayla, 2800 m., 15 Jul. 1952, Davis 20021B; B7: Prov. Tunceli, Munzur dağ, above Ovacik, 2800 m., 17 Jul. 1957, Davis 31241. C5: Prov. Icel/Niğde, Kysil depe above Bulghar Maaden, 2800 m., Siehe 457; ibid., Bulghar Magara, 2600 m., 1895, Siehe 573 ibid., Bulghar Maaden, Aug. 1855, Balansa 418; ibid., Gysil depe- Ketsiebele, 2580 m., Kotschy 126c.

Habitat: Alpine of dry limestone ridges and scree; alt. 2000-2800 m. Fl. May-Aug.

It was obvious that following the rejection of _Ptilotrichum_ as a valid taxonomic category (p. 18), its components had to be re-assigned to other genera (Table 2). The correlated characters in Table 3 (p. 31) show that _Alyssum_ (or _Ptilotrichum_) _rupestre_, _Koniga scardica_ and _Ptilotrichum cyclocarpum_ all share the generic diagnostics of _Aurinia_, in particular, the very long, linear, often repand and dentate basal cauline and sterile shoot leaves whose bases are swollen and persistent on indurated stem stocks, and the cup-shaped calyces.

The only consistent difference between the Italian and Balkan _rupestris_ and the Anatolian _cyclocarpa_ is that the fruits of the latter, even when immature, are always glabrous; the fruits of the European taxon are always pubescent, at least when young. This constant character coupled with the completely allopatric distribution justifies the retention of the Anatolian _cyclocarpa_ at subspecific rank. Many specimens from Albania and Greece morphologically link the two subspecies. The mature fruits of these intermediate plants (often known as _Ptilotrichum ruprestre_ var. _scardicum_) are glabrous, resembling the mature fruits of subsp. _cyclocarpa_; but their young fruits by being pubescent resemble the persistent pubescence characteristic of typical subsp. _rupestris_. The variation pattern might be interpreted as an interupted cline.

X. SYNOPSIS OF THE GENUS ALYSSUM

ALYSSUM L. Gen. Pl., ed. 5, 293 (1754); Schulz in Nat. Pflanzenfam., 17b, 490 (1936).

Syn.: Meniocus Desv., Journ. Bot. Appl., 3, 173 (1814).

Ptilotrichum Meyer in Ledeb., Fl. Alt., 3, 50 (1831)!

Psilonema Meyer, loc. cit.!

Odontarrhena Meyer, op. cit., 58.

Gamosepalum Hausskn. in Mitt. Thür. Bot. Ver., n.f., 11, 70 (1897)!

Triplopetalum Nyár. in Mag. Bot. Lap., 24, 97 (1925)!

Plants annual, biennial, or if perennial then always with sterile shoots or rosettes. Indumentum of stellate hairs with branched or unbranched rays, often sublepidote or lepidote scales, simple setae or simple tuberculate hairs rarely present. Leaves simple undivided, entire, maximum c. 20 mm. long. Inflorescence racemose or corymbose or paniculate or umbellate or candelabra-form. Pedicels straight or flexuose, ascending or divergent and spreading or deflexed, arcuate recurved or sigmoid. Calyx elongate, with 4 free (or appearing connate due to interlocking hairs) and erect sepals, monomorphic or rarely dimorphic, never truly saccate but often persistent or inflated in fruit. Petals 4, yellow or white or rarely reddish, obovate or spathulate, entire or emarginate or retuse or bilobed, clawed, gradually or abruptly attenuate into claw, rarely with basal appendages or teeth. Long filaments 4, winged or rarely unwinged, free or rarely connate along wing, usually variously toothed and/or appendaged. Short filaments 2, winged or unwinged, usually /

usually with appendages or teeth. Anthers elliptic or triangular, introse, medifixed, obtuse or acute at apex. Nectaries 4, one at each side of short filaments, erect and peg-like or globose or triangular, infrequently lobed. Pistils sessile on receptacle or rarely stipitate, bilocular with prominent replum, locules 1-6 (-8) ovulate, placentation from the near the top or distinctly marginal. Styles of various lengths, slender or stout, often widely dilated to base, persistent. Silicules latisptate, dehiscent or rarely indehiscent, glabrous or pubescent, rarely papillose, held in the same or opposite direction as the pedicels, or pendulous, valves compressed or equally or unequally inflated. Seeds winged or wingless, often mucilaginous. Embryo notorrhizal or pleurorhizal.

Lectotype species: A. montanum L.

(1).

Sect. MENIOCUS (Desv.) Hook. in Benth. & Hook., Gen. Pl., 1, 74 (1862); Schulz in Nat. Pflanzenfam. 17b, 492 (1936).

Syn.: Meniocus Desv., Journ. Bot. Appl., 3, 173 (1814).

Alyssum Subgen. Meniocus (Desv.) LeMaout & Decaisne, Fl., Élém. Jard. Champ., 1 (1855).

Plants annual. Long filaments unilaterally winged and toothed. Short filaments with free appendages. Nectaries globose. Silicules dehiscent, always compressed, glabrous and smooth, or pubescent with simple setae, or papillose, held in same direction as pedicels, 2-4 (-8) ovules per locule, placentation distinctly marginal. Seeds winged or unwinged, mucilaginous.

Type /

Type species: A. linifolium Steph. ex Willd.

Component species:

A. linifolium Steph. ex Willd. (E,B,N,T,O).

A. meniocoides Boiss. (T,O).

A. aureum (Fenzl.) Boiss. (T,O).

A. huetii Boiss. (T).

A. stylare (Boiss. & Bal.) Boiss. (T).

A. heterotrichum Boiss. (O).

A. blepharocarpum Dudley & Huber-Morath (T).

(2).
Sect. PSILONEMA (Meyer) Hook. in Benth. & Hook., Gen. Pl., 1, 74 (1862); Schulz in Nat. Pflanzenfam., 17b, 491 (1936).

Syn.: Psilonema Meyer in Ledeb., Fl. Alt., 3, 50 (1831)!

Alyssum Subgen. Tetratrichia Gay in Cosson, Fl. Atlant., 2, 236 (1885).

Plants annual. All filaments unwinged, edentate and unappendaged. Nectaries peg-like or globose. Silicules dehiscent, equally inflated, glabrous and smooth, or pubescent, held in same direction as pedicels, always 2 ovules per locule, placentation from near the top. Seeds winged or unwinged, mucilaginous.

Type species: A. dasycarpum Steph. ex Willd.

Component species:

A. alyssoides (L.) L. (E,B,T?,O).

A. damascenum Boiss. & Gaill. (O).

A. dasycarpum Steph. ex Willd. (E,B,T,O).

A. /

A. granatense Boiss. & Reut. (E,N).

A. homalocarpum (Fisch. & Meyer) Boiss. (O).

(3).

Sect. ALYSSUM. Schulz in Nat. Pflanzenfam., 17b, 491 (1936).

Syn.: Moenchia Roth., Tent. Fl. Germ., 1, 273 (1788).

Alyssum Sect. Adyseton DC., Syst. Nat., 2, 302 (1821) - lectotype: A. montanum L.!

Adyseton (DC.) Don, Gen. Hist. Dichl. Pl., 1, 177 (1831).

Adyseton Sect. Disodontea Don, loc. cit. - lectotype: A. montanum L.

Ptilotrichum Meyer in Ledeb., Fl. Alt., 3, (1831)!

Alyssum Sect. Eualyssum Griseb., Spic. Fl. Rum. & Bith., 1, 274 (1843).

Koniga R. Br. Sect. Ptilotrichum (Meyer) Griseb., op. cit., 278.

Alyssum Sect. Ptilotrichum (Meyer) Hook. in Benth. & Hook., Gen. Pl., 1, 74 (1862).

Plants annual, biennial, or if perennial then with sterile shoots or rosettes. Sepals monomorphic, free, but often persistent in fruit, ventral surface glabrous. Petals always yellow, often pale. All filaments free, unilaterally or bilaterally winged and/or dentate and/or appendaged. Silicules dehiscent, equally or unequally inflated, glabrous or pubescent, held in the same direction as pedicels, 2 ovules per locule, placentation from near the top. Seeds winged or wingless, mucilaginous.

Lectotype /

Lectotype species: A. montanum L.

Component species:

A. desertorum Stapf. (E,B,N,T,O).

A. turkestanicum Regel & Schmalh. (O).

A. scutigerum Durieu (N).

A. macrocalyx Cosson & Bur. (N).

A. foliosum Bory & Chaub. (B,T,O).

A. minutum Schlect.ex DC. (E,B,N,T,O).

A. smyrnaeum Meyer (B,T).

A. fulvescens Sibth. & Sm. (B,T).

A. strictum Willd. (T,O).

A. contemptum Schott & Ky. (T,O).

A. umbellatum Desv. (E,B,T,O).

A. szowitsianum Fisch. & Meyer (T,O).

A. marginatum Steud. ex Boiss. (O).

A. rostratum Stev. (E,B).

A. macropodum Boiss. & Bal. (T).

A. minus (L.) Rothm. (E,B,N,T,O).

A. stapfii Vierh. (T,O).

A. strigosum Banks & Sol. (E,B,N,T,O).

A. xanthocarpum Boiss. (T,O).

A. hirsutum Marsch.-Bieb. (E,B,T).

A. bulbotrichum Hausskn. & Born. (T).

A. trichocarpum Dudley & Huber-Morath (T).

A. cephalotes Boiss. (T).

A. /

A. canescens DC. (O)-lectotype species: Ptilotrichum Meyer.

A. tenuifolium Willd. (O).

A. purpureum Lag. & Rodr. (E).

A. fischerianum (DC.) (E,O).

A. lenense Adams (E,O).

A. repens Baumg. (E,B,T,O).

A. scardicum Wetts. (B).

A. wulfenianum Bernh. in Willd. (E,B).

A. ovirense Kern. (E,B).

A. wierzbickii Heuff. (B).

A. calycocarpum Rupr. (E,T,O).

A. pulvinare Velen. (B).

A. pseudo-mouradicum Hausskn. & Bornm. ex Baumg. (T).

A. erosulum Gennar & Pestal. (T).

A. montanum L.(E,B).

A. nevadense Wilmott ex Ball (E).

A. fastigiatum Heywood (E).

A. diffusum Ten. (E,B?).

A. armenum Boiss. (T,O).

A. ochroleucum Boiss. & Huet. (T).

A. artwinense Busch (T).

A. cuneifolium Ten..(E,B).

A. arenarium Loisel. (E).

A. atlanticum Desf. (E,N).

A. moellendorfianum Aschers. (B).

A. /

A. stribrnyi Velen. (B,T,O).

A. idaeum Boiss. & Heldr. (B).

A. mouradicum Boiss. & Bal. (T,O).

A. handelii Hayek (B).

A. aurantiacum Boiss. (T).

A. argyrophyllum Schott & Ky. (T).

A. praecox Boiss. & Bal. (T).

A. densistellatum Dudley (B).

A. lepidotum Boiss. (T).

A. lassiticum Hal. (B).

A. sphaciotícum Boiss. & Heldr. (B).

A. propinquum Baumg. (T).

A. lanceolatum Baumg. (O).

A. persicum Boiss. (O).

A. muelleri Boiss. & Buhse (O).

A. iranicum Hausskn. ex Baumg. (O).

A. aizoides Boiss. (T).

A. bornmuelleri Hausskn. ex Degen (T).

A. taygeteum Heldr. (B).

A. doerfleri Degen (B).

A. caespitosum Baumg. (T).

(4).

Sect. GAMOSEPALUM (Hausskn.) Dudley, <u>comb</u>. & <u>stat. nov.</u>; Schulz in Nat. Pflanzenfam., <u>17b</u>, 494, (1936). Map 22.

Syn.: <u>Gamosepalum</u> Hausskn. in Mitt. Thür. Bot. Ver., n.f. <u>11</u>, 73 (1897)!

<u>Plants</u> always perennial with sterile shoots. <u>Sepals</u> distinctly dimorphic, always persistent and often inflated in fruit, appearing connate due to interlocking indumentum, ventral surface pubescent. <u>Petals</u> whitish with purple veining at base of limb or yellow. <u>Long filaments</u> bilaterally winged, edentate, and unappendaged, coherent or contiguous but free. <u>Short filaments</u> with basal connate tooth. <u>Silicules</u> dehiscent, equally or unequally inflated, always pubescent, held in same direction as pedicels, 2 ovules per locule, placentation from near the top. <u>Seeds</u> narrowly winged or wingless, mucilaginous.

(a) Series GAMOSEPALUM

Filamenta longa conniventia. Indumentum e pilis stellatis pauci-radiatis (radiis ramosis) compositum. Petala albida vel pallide flava, limbo basi saepe purpureo-venoso.

Lectotype species: <u>A. lepidoto-stellatum</u> (Hausskn. & Bornm.) Dudley.

Component species:

<u>A. tetrastemon</u> Boiss. (T).

<u>A. lepidoto-stellatum</u> (Hausskn. & Bornm.) Dudley (T).

<u>A. paphlagonicum</u> (Hausskn.) Dudley (T).

<u>A. thymops</u> (Huber-Morath & Reese) Dudley (T).

(b)
Series LIBRA Dudley, <u>series nov.</u>

A serie <u>Gamosepalo</u> filamentis longis contiguis libris (non conniventibus), indumento pilis lepidotis multo-radiatis, petalis sulphureis haud purpureo-venosis recedit.

Type species: <u>A. baumgartnerianum</u> Bornm. ex Baumg.

Component species:

<u>A. baumgartnerianum</u> Bornm. ex Baumg. (T,O).

<u>A. corningii</u> Dudley (T).

<u>A. sulphureum</u> Dudley & Huber-Morath (T,O).

<u>A. harputicum</u> Dudley (T).

<u>A. niveum</u> Dudley (T).

<u>A. lycaonicum</u> (Schulz) Dudley (T).

(5).

Sect. TETRADENIA (Spach) Dudley, comb. nov.; Schulz in Nat. Pflanzenfam., 17b, 493, f. 300 as Ptilotrichum spinosum (1936).

Syn.: Konig Adans. Sect. Tetradenia Spach, Hist. Nat. Vég. Phan., 6, 492 (1838).

Plants perennial, often spinose, with sterile shoots. Fruiting racemes candelabra-form. Pedicels arcuate and recurved. Petals whitish or reddish. Long filaments free, narrowly bilaterally winged, edentate or with a small basal tooth. Short filaments with small basal tooth. Nectaries distinctly bilobed. Silicules always glabrous, conspicuously boat-shaped, held erect or horizontally in opposite direction of pedicels, valves strongly and unequally inflated, 2 ovules per locule, placentation from near the top. Seeds wingless, not mucileaginous.

Lectotype species: A. spinosum L.

Component species:

A. lapeyrousianum Jord. (E).

A. cochleatum Cosson & Dr. (N).

A. spinosum L. (E,N).

(6).

Sect. ODONTARRHENA (Meyer) Koch, Synop, Fl. Germ. Helv., 59 (1836); Hook. in Benth. & Hook., Gen. Pl., 1, 74 (1862); Nyár. in Bul. Grăd. Bot. Cluj, 7, (1927); 8 (1928); 9 (1929), Schulz in Nat. Pflanzenfam., 17b, 491 (1936). Nyár. in Bul. Grăd. Bot. Cluj, 18 (1938); Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Stiinţe Geol. Geog. Şi. Biol., ser. A, mem. 3, 1 (1949).

Syn.: Odontarrhena Meyer in Ledeb., Fl. Alt., 3, 58 (1831). Plants perennial with sterile shoots and rosettes, rarely biennial. Pedicels divergent and spreading or sigmoid and deflexed. Petals usually obovate, rarely with basal appendages. Long filaments unilaterally or bilaterally winged and variously dentate. Short filaments with free or connate appendates or teeth. Silicules dehiscent or indehiscent, glabrous or pubescent, held in same direction as pedicels or pendulous, valves compressed or unequally or equally inflated; or samaroid, often undulated, 1 ovule per locule with placentation from near the top. Seeds winged or wingless, rarely mucilaginous.

(i)Subsect. ODONTARRHENA

Pedicels divergent and spreading. Silicules dehiscent, valves unequally or equally inflated, not undulated, veination inconspicuous.

Lectotype species: A. tortuosum Willd.

Component species:

A. /

A. corsicum Duby (E,T).

A. bertolonii Desv. (E,P).

A. markgrafii Schulz (B)

A. masmenaeum Boiss. (T).

A. syriacum Nyár. (T,O?).

A. troodi Boiss. (O).

A. discolor Dudley & Huber-Morath (T).

A. libanoticum Nyár (O).

A. robertianum Bern. ex Gren. & Godr. (E).

A. tavolare Briq. (E).

A. smolikanum Nyár. (B).

A. nebrodense Tin (E).

A. fragillimum (Bald.) Rech. fil. (B).

A. chondrogynum Burtt (O).

A. oxycarpum Boiss. & Bal. (T).

A. davisianum Dudley (T).

A. fallacinum Hausskn. (B).

A. penjwinensis Dudley (O).

A. constellatum Boiss. (T,O).

A. callichroum Boiss. & Bal. (T).

A. cypricum Nyár. (T,O).

A. huber-morathii Dudley (T).

A. eriophyllum Boiss. & Hausskn. (T).

A. tortuosum Willd. (E,B,O).

A. longistylum (Somm. & Lev.) Gross. & Schishk. (E,T,O).

A. serpyllifolium Desf. (E,N)

A /

<u>A. alpestre</u> L. (E).

<u>A. lanigerum</u> DC. (O).

<u>A. inflatum</u> Nyár. (O).

<u>A. pateri</u> Nyár. (T).

<u>A. obtusifolium</u> Stev. ex DC. (E,B,O).

<u>A. obovatum</u> (Meyer) Turcz. (E,O).

<u>A. szarabiacum</u> Nyár. (O).

<u>A. baicalicum</u> Nyár. (O).

<u>A. gehamense</u> Federov (T,O).

<u>A. bracteatum</u> Boiss. & Buhse (O).

<u>A. corymbosoides</u> Form. (B).

<u>A. borzaeanum</u> Nyár. (B,T).

<u>A. sibiricum</u> Willd. (E,B,T,O).

<u>A. caliacrae</u> Nyár. (E,B).

<u>A. euboeum</u> <u>Hal</u>. (B).

<u>A. condensatum</u> Boiss. & Hausskn. (T,O).

<u>A. filiforme</u> Nyár. (T)

<u>A. singarense</u> Boiss. & Hausskn. (O).

<u>A. anatolicum</u> Hausskn. ex Nyár (T).

<u>A. haussknechtii</u> Boiss. (T).

<u>A. fedtschenkoanum</u> Busch (O).

(ii) Subsect. COMPRESSA Dudley, subsect. nov.

A subsect. Odontarrhena siliculis compressis vel subinflatis ± undulatis semper conspicue nervosis differt.

(a) Series COMPRESSA Dudley, series nov.

Silicula marginibus apteris integris pedicellis rigidis patulis suffulta.

Type species: A. murale Waldst. & Kit.

Component species:

A. murale Walst. & Kit. (E,B,T,O).

A. argenteum All. (E).

A. tenium Hal. (B).

A. subspinosum Dudley (O).

A. akamasicum Burtt (O).

A. cassium Boiss (T,O).

(b) Series CRENULATA Dudley, series nov.

A serie Compressa siliculis marginibus alatis crenulatis pedicello capillari flexuoso deflexo suffultis differt.

Type species: A. crenulatum Boiss.

Component species:

A. ciliicicum Boiss. & Bal. (T).

A. giosnanum Nyár. (T).

A. heldreichii Hausskn. (B).

A. alatum Boiss. & Heldr. (T).

A. crenulatum Boiss. (T,O).

(iii)
Subsect. SAMARIFERA Dudley, <u>subsect. nov.</u>

A subsect. <u>Odontarrhena</u> siliculis indescentibus samaroideis undulatis pendulis papyraceis semper compressis pedicello capillari flexuoso deflexo suffultis differt.

Type species: <u>A. samariferum</u> Boiss. & Hausskn.

Component species:

<u>A. floribundum</u> Boiss. & Bal. (T).

<u>A. trapeziforme</u> Bornm. ex Nyár. (T).

<u>A. peltarioides</u> Boiss. (T).

<u>A. virgatum</u> Nyar. (T).

<u>A. caricum</u> Dudley & Huber-Morath (T).

<u>A. pinifolium</u> (Nyár.) Dudley (T).

<u>A. samariferum</u> Boiss. & Hausskn. (T,O).

<u>A. dubertretii</u> Gom. (T).

<u>A. lesbiacum</u> (Cand.) Rech. fil. (T).

(7.) Binomials Known only from Literature and of Uncertain Status

(Names in parenthesis indicate the possible disposition of the binomial).

A. algeriensis Pomel, Nouv. Mat. Fl. Atl., 232 (1875) - N. Africa.

(? A. atlanticum)

A. americanum Greene in Pittonia, 2, 224 (1892) - N. America.

(? Lesquerella)

A. amoris Coincy in Bull. Herb. Boiss., 3, 168 (1895) - Spain.

(? A. minus)

A. antiatlanticum Emb. & Maire in Bull. Soc. His. Nat. Afr. Nord., 23, 165 (1932) - N. Africa.

A. arcticum Wormsk. ex Hornem. in Oeder, Fl. Dan., 9, 5, t. 1520 (1820) - Greenland.

(? Lesquerella)

A. argenteoides Nyár. in Bul. Grad. Bot. Cluj, 7, 77 (1927) - Siberia.

A. atlanticum Emg. & Maire ex Pau in Cavanillesia, 4, 156 (1931) - non Desf. - N. Africa.

A. bilimekii Willk. in Willk. & Lang, Prod., 3, 832 (1880) - Spain.

(? Hormathophylla)

A. boliviense Muschler in Engl. Bot. Jahrb. 40, 275 (1908) - Bolivia.

(? Lesquerella or Eudema)

A. brasi Loret ex Rouy & Fouc., Fl. Fr., 2, 192 (1895) - France.

(? A. petraeum)

A. brughieri Brein & Colla, Herb. Pedem., 1, 142 (1833) - ? Italy.

A. costei Sennen & Pau in Bull. Acad. Geog. Bot., 18, 452 (1908) - Spain.

A. /

A. decoloratum Pomel, Nouv. Mat. Fl. Atl., 236 (1875) - N. Africa.

(? A. atlanticum)

A. djurdjurae Chod. in Bull. Soc. Bot. Fr., 36, 19 (1889) - N. Africa.

(? A. atlanticum)

A. emarginatum Zahl. ex Vis., Fl. Dalm., 3, 117 (1852) - Yugoslavia.

A. embergeri Guézel in Bull. Soc. Sc. Nat. Maroc, 31, 254 (1953) - N. Africa.

(Sect. Odontarrhena)

A. filifolius Wahlb. in Isis, 21, 998 (1840) - Asia Minor.

A. flahaultianum Emb. in Bull. Soc. Sc. Nat. Maroc., 15, 199 (1935) - N. Africa.

(Sect. Odontarrhena)

A. fontqueri Sennen in Nann. Soc. Linn. Lyon, n.s., 71, 12 (1925) - Spain.

A. gintlii Beck in Glazn. Zem. Mus. Bosn. i Hercegov., 28, 132 (1916) - Yugoslavia.

(? Berteroa)

A. globosum Grossh. in Izv. Azerbaidzh. Fil. Ak. Nauk. S.S.S.R., 5, 74 (1934) - Caucasus.

A. hakaszkii Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol. ser. A, mem. 3, 1, 32 (1949) - Altai.

(Sect. Odontarrhena)

A. heideri Kroch., Suppl. Fl. Siles., 2, 169 (1823) - Poland.

A. heinzi Ullep in Øst. Boţ. Zeit., 35, 307 (1885) - Yugoslavia.

(? A. ovirense)

A. hieronymi Sennen in Bol. Soc. Arag., 15, 259 (1916).

A. hybridum Hut. in Øst. Bot. Zeit., 54 (1904) - Spain.

(described as an inter-sectional hyrid between A. atlanticum (Sect. Alyssum) and A. serpyllifolium (Sect. Odontarrhena)= ? A. fastigiatum)

A. /

A. jonasianum Cost. & Sennen in Bull. Soc. Bot. Fr. 47, 426 (1900)

- France.

(? Lobularia maritima)

A. latifolium Vis., Fl. Dalm., 3, 118 (1852) - Yugoslavia.

(? A. minus)

A. leiocarpum Pomel, Nov. M at. Fl. Atl., 235 (1875) - N. Africa.

(? A. atlanticum)

A. loiseleuri Fourn., Quatre Fl. Fr., 425 (1932) - France.

(? A. arenarium)

A. luteolum Pomel, Nouv. Mat. Fl. Atl., 234 (1875) - N. Africa.

(? A. atlanticum)

A. marizii Cout. in Bol. Soc. Broter., 25, 189 (1910) - Portugal.

A. micropetalum Kit. in Linnaea, 32, 497 (1863)-non Fischer ex DC.

- Hungary.

A. muricatum Kit., op. cit., 498. - Hungary.

A. mutabile Vent., Jard. Cels, 85 (1800) - Italy.

(? Berteroa)

A. myriophyllum Lojoc in Malphigia, 20, 113 (1906) - Sicily.

(? A. arenarium)

A. nanum Pomel, Nouv. Mat. Fl. Atl., 236 (1875) - N. Africa.

A. numidicum Pomel, op. cit., 377 - N. Africa.

A. obcordatum (Desv.) DC., Syst. Nat., 2, 324 (1821) - ? Habitat.

(? Aurinia saxatilis)

A. orbiculatum Urv. in Mem. Soc. Linn. Paris, 1, 335 (1822) - Greece.

A. parvulum Schrad. in Linnaea, 10, Literb., 69 (1836) - ? Habitat.

A. patulum Pomel, Nouv. Mat. Fl. Atl., 238 (1875) - N. Africa.

(? A. alyssoides)

A. /

A. pflanzii Muschler in Engl. Bot. Jahrb., 49, 210 (1913) - Bolivia.

(? Lesquerella or Eudema)

A. saxigenum Timb. in Lucante Rev. de Bot., 10, 54 (1892) - France.

(? A. montanum)

A. scabrum Weinm., Cat. Hort. Dorpat., 215 (1810) - Hungary.

(? A. umbellatum)

A. semidodecandra Schrank, Baier Fl., 11 (1789) - Czechoslovakia.

A. simplex Rud. in Schrad., Journ., 2, 290 (1790) - ? Habitat.

(? A. minus)

A. spathulaefolium Form. in Verh. Nat. Ver. Brünn, 22, 176 (1893) - Bulgaria.

(? A. stribrnyi)

A. speciosum Pomel, Nouv. Mat. Fl. Atl., 237 (1875) - N. Africa.

(? A. atlanticum)

A. subbaicalicum Nyár. in. Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A., mem. 3, 1, 18(1949) - Siberia.

A. tuberculatum Kit. in Linnaea, 32, 498 (1863) - Hungary.

A. urbanianum Muschler in Engl. Bot. Jahrb., 40, 275 (1908) - Bolivia.

(? Lesquerella or Eudema)

A. wilkommii De Roem. ex Willk. in Linnaea, 25, 8 (1852) - Spain.

(? A. granatense)

XI. THE TAXONOMIC POSITION OF SECT. GAMOSEPALUM

The genus _Gamosepalum_ (Haussknecht, 1897) when originally described contained four species (_G. lepidoto-stellatum_, _G. paphlagonicum_, _G. confine_ and _G. alyssoides_). Schulz (1927) when describing _G. lycaonicum_, correctly asserted that _G. alyssoides_ and _G. confine_ were synonymous with other species. The present author, after examining the classical collections and recent material, concludes that four new species are necessary to encompass the higherto unrecognized distinct discontinuities found in the group, and that _A. tetrastemon_, _A. corningii_ (originally as _A. tetrastemon_ var. _cappadocicum sensu_ 1867) and _A. baumgartnerianum_ should be transferred to _Gamosepalum_.

Haussknecht pointed out the bewildering similarity of _Gamosepalum_ to _Alyssum_, and accepted that a close relationship existed between the species he described. He thought that these species comprised a natural group held together by the gamosepalous (_sic_) dimorphic sepals and the whitish petals. He further indicated that though this natural complex might be included as an anomolous section of _Alyssum_, recognition at generic level was recommendable. This conclusion was satisfactory to him, for the consistent characters illustrated by the _Gamosepalum_ material at his disposal combined with the almost entirely Anatolian distribution were not shared by any _Alyssa_.

Schulz cast doubt on the validity of the whitish petals being used as a diagnostic generic character, as his _G. lycaonicum_ possessed /

possessed yellow flowers. After examining several species of Alyssum (A. bornmuelleri : Siehe 423, among others) Schulz claimed a close relationship to Gamosepalum. However, for him, the adhering dimorphic sepals constituted the major generic diagnostic, and accordingly maintained the generic rank, but with some reservation.

Neither Hausskneht or Schulz considered the characters or taxonomic position of A. caespitosum (Baumgartner, 1909). This species shares some important characters with the species of Gamosepalum. This character correlation, when evaluated in terms of a sequence of specializations, indicates a closer affinity of Gamosepalum to Alyssum than was previously realized. The discussion of A. caespitosum, accompanying the description, correctly assures an affinity of this species to A. bornmuelleri, and also points out a definite similarity in habit and leaf shape with A. corningii (A. tetrastemon sensu Baumgartner). The inference that a very close relationship exists between all of the cushion-forming species is shared by the present author, but it is regrettable that Baumgartner did not consider the species of Gamosepalum as forming a natural group having a direct relationship with Alyssum Sect. Alyssum.

The question of rank for Gamosepalum, which troubled the earlier workers, is no less of a problem now, but it is safely established from the following survey, that the species of Gamosepalum have a closer relationship to a species complex within Alyssum Sect. Alyssum (cf. Table No. 5) than to any other group of species. To grant Gamosepalum generic status would divorce these species, without justification /

justification, from those Alyssa which they most closely resemble by virtue of important character correlations (Table No. 5) and to which they are undeniably allied. Sectional rank for Gamosepalum within Alyssum relates not only to the fact that the species of Gamosepalum have a number of constant character expressions in common, but also that a trend towards some of the gamosepaloid expressions is found in some species of Sect. Alyssum (i.e. A. caespitosum).

A method suggested by Wagner in Hardin (1957) and Stern (1961), utilizing specialization indices calculated from correlations of significant characters, produces a plausible evaluation of the relative positioning of the natural series within Sect. Gamosepalum to one another and to the closely related species complex in Sect. Alyssum. The characters were chosen to establish them as correlated differential or diagnostic specific expressions - such as may be used in a key to define one species from another. In addition, the consistent character expressions furnished similarities, due either to convergence or homologous variation, which when judiciously correlated elucidate the relative systematic placement of the taxa.

In Table No. 5 and as indicated in the following explanation of characters, each character is graded into a sequence of increasing complexity and specialization; from the less advanced (respective to the other states) or primitive (0) to the intermediate or rare morphological expression (1) to the highly specialized (2). A specialization value of 0 or 1 or 2 was given for each character accordingly; the character values when totalled giving a combined sum /

sum of specialization (the specialization index) for every species considered. A graphic presentation (Table No. 6) of these specialization indices, combined with an interpretation of the significance of correlated characters, indicates a presumed affinity among the species of Sect. Gamosepalum and a possible relationship of these species as a whole to Sect. Alyssum.

Tables No. 6 and No. 7 show that A. caespitosum of Sect. Alyssum has a remarkable resemblance to Series Libra of Sect. Gamosepalum, in particular to A. sulphureum (cf. p.478). The argument for maintaining A. caespitosum in Sect. Alyssum rather than for transfering it to Sect. Gamosepalum rests primarily on the stress and taxonomic weighting of the differential characters and an interpretation of similarities. Lacking the correlation of the important filament character (G) in its advanced or intermediate states with the other advanced Gamosepalum expressions of A, D and H (see below), A. caespitosum should be accepted as a specialized species within Sect. Alyssum. It offers an example of what a Gamosepaloid precursor in Sect. Alyssum might have looked alike. It is not to be presumed that any integral part of Sect. Gamosepalum arose in an evolutionary manner from A. caespitosum or from any other now existing species. Table No. 6, synthesized from present knowledge, merely illustrates a logical association which, when viewed phylogenetically, may help to explain some of the processes leading to a morphological advancement along a particular line or series of taxa, in this case a similar pattern of variation and morphological continuity.

The dendroid appearance of Table No. 6 is the result of the diagrammatic /

(1).

TABLE No. 5: SPECIALIZATION VALUES FOR THE TEN SPECIES OF SECT. GAMOSEPALUM AND FOR SIX OF THE MOST CLOSELY ALLIED SPECIES IN SECT. ALYSSUM *

	Character Expressions										Specialization Indices
SECT. ALYSSUM	A	B	C	D	E	F	G	H	I	J	TOTAL
1. A. aizoides	0	0	0	0	0	0	0	1	0	1	2
2. A. iranicum	0	0	0	0	2	0	0	0	0	1	3
3. A. bornmuelleri	0	0	0	0	0	0	1	1	0	1	3
4. A. doerfleri	0	0	0	0	0	0	0	2	1	1	4
5. A. taygeteum	0	0	0	0	0	0	1	2	1	1	5
6. A. caespitosum	1	1	2	1	0	0	1	2	1	1	10
SECT. GAMOSEPALUM											
Series Gamosepalum											
7. A. tetrastemon	2	0	2	2	2	2	2	0	0	1	13
8. A. lepidoto-stellatum	2	0	2	2	2	2	2	0	0	1	13
9. A. paphlagonicum	2	1	2	2	2	2	2	0	0	1	14
10. A. thymops	2	1	2	2	1	2	2	0	1	2	15
Series Libra											
11. A. baumgartnerianum	2	1	2	2	0	1	2	2	0	0	12
12. A. sulphureum	2	1	2	2	0	1	2	2	0	1	13
13. A. niveum	2	0	2	2	0	1	2	2	2	1	14
14. A. corningii	2	1	2	2	1	1	2	2	1	1	15
15. A. harputicum	2	0	2	2	0	1	2	2	2	2	15
16. A. lycaonicum	2	2	2	2	0	1	2	2	2	1	16

* Explanation of character expressions in text; specialization indices of each species is plotted in Table No. 6.

diagrammatic construction used to indicate possible specific interrelationships. No claim is made for the direct evolution of any individual species from any other, or any natural complex from any other complex. An explanation of the transformation of one species into another, if this in fact does occur, is not thin the realm of a correlation of morphological expressions. The best that can be accomplished here is a fair picture and extrapolatory appraisal of the relationships and affinities in the present, rather than an inference of past, evolutionary developments.

As a means of checking the conclusions implicit in Table No.5 and No.6, an additional pictorial interpretation (Table No.7) was constructed utilising selected correlated character expressions. This table gives supporting evidence for the validity of the species and group relationships established when the specialisation indices were used, and further permits a clear diagrammatic representation of the natural groups of species based on morphological continuities.

The danger of misinterpreting trends of evolution must be borne when morphological specialisations are judged for the purpose of assessing supposed affinities or relationships. Every character expression that is to be graded in a specialisation sequence should be subjected to a critical evaluation in the light of the established "Principles of Evolution" (Bessey, 1915). These principles are: that evolution does not always occur in an upward direction, i.e. it may involved "degradation and degeneration" (simplification and reduction); does not proceed at an equal rate for all organs or characters, i.e. some /

some characters may be static or advancing by simplification or reduction, while others may be progressing in a very specialized and elaborate manner; and according to selection pressures, the direction of advancement may be reversed during the development of or after the fulfilment of any given morphological trend. For example, the "primitive" hair type contrasted to synstemony in Series Gamosepalum; the free (intermediate) filaments contrasted with the very specialized hair type in Series Libra; and the specialized inflated calyx contrasted with the less specialized petal colour of A. lycaonicum.

As seen from Table No. 5, the specialized morphological expressions in Series Gamosepalum of sepal dimorphism and coherence, filament fusion, entire filament wings and whitish petals are correlated together; also correlated are the advanced sepal dimorphism, coherence and inflation (at least in some species), entire filament wings and lepidote scales in Series Libra. It would appear that because of the differences in their specialization correlations, the two natural series of Sect. Gamosepalum did not arise from one another, but rather diverged independently from a basic stock in Sect. Alyssum (see Table No. 6). A caespitosum in Sect. Alyssum, with a specialization index of 10, is the most highly specialized of all the species allied to the Gamosepala and has the greatest number of characters approaching those which are diagnostic for Sect. Gamosepalum Series Libra - in particular to A. baumgartnerianum, the type species of the series, which has a specialization index of 12.

In conclusion, the graphic presentations (Tables No. 5, 6 and 7) based /

based on morphological continuities, trends of specialization and over-all resemblances sharply show that Gamosepalum is a natural group of allied species which is further divisible into two smaller groups or series. The occurrence of a species (A. caespitosum) intermediate in some character expressions, between Alyssum and Gamosepalum stresses the consanguinity of the two groups and the advisability of recognizing Gamosepalum at the sectional level.

Explanation of the character expressions.

A. Sepal dimorphism. The presence of two outer sepals of different size and shape than the two inner ones is characteristic of all species in Sect. Gamosepalum, and is directly correlated with the advanced specialization values of characters C, D and H. Sepal dimorphism, interpreted as an expression of asymmetrical growth, is a specialized condition arising from homomorphic or symmetrical sepals (Bessey, 1915: Dictum 18).

Table No. 5

uniform in size and shape - 0

intermediate - 1

dimorphic - 2

Table No. 7

8

8

8

B. Calyx inflation. Inflation of the sepals may be presumed to assist, by some means, fruit dispersal and protection of the floral parts, and is a specialization from the subinflated or uninflated type. The full expression of inflated calyces is attained only in A. lycaonicum and is correlated with the largest and most highly evolved type of indumentum.

Table No. 5 not inflated - 0 : subinflated (intermediate)- 1: strongly /

strongly inflated - 2.

C. Sepal connation. The generic name, Gamosepalum, owes its origin to the interlocking indumentum of the sepals causing them to appear fused. The earlier workers who maintained Gamosepalum as a genus distinct from Alyssum (Hausskne cht, 1897; Schulz, 1927; Bornmüller, 1936) did not appreciate the true cause of the sepal coherence, but rather attributed it to a true fusion of the sepal margins. In any case, the pseudo-connation (as well as true fusion had it occurred) of the sepals represents a specialized departure from free sepals. As indicated on Table No. 5, the interdigitating hairs on the sepals prevails in all species of Sect. Gamosepalum, and is directly correlated with sepal dimorphism (A) and the presence of indumentum on the inner surface of the sepals (D). In A. caespitosum of Sect. Alyssum the occurence of pseudo-connate sepals is correlated only with the intermediate expressions of characters D and H.

Table 5

free - 0: intermediate - 1: connate - 2:

In Table No. 7 this characters is applied as the horizontal axis.

D. Sepal indumentum. The occurrence of indumentum on the inner surface of the sepals is common in all species of Sect. Gamosepalum, and is only rarely observed in A. caespitosum of Sect. Alyssum. It would be difficult to interpret the lack of indumentum in this position of all other species of Sect. Alyssum as a repression or retrogression. Accordingly, the presence of indumentum represents a special development of some unknown adaptive value.

Table No. 5

absent /

Table No. 5

absent - 0: rarely present - 1: always present - 2.

E. Petal colour. Yellow is the predominating colour in the less advanced species, while white, pinkish or purplish tones are usually of more recent origin (Payson, 1921). The whitish petals with reddish-purple veining especially prominent at the throats of the corollas, are found in Sect. Alyssum only in A. iranicum and all members of Series Gamosepalum but one (that being A. thymops which has intermediate coloured petals.). Most of the components of Series Libra have yellow petals.

Table No. 5	Table No. 7
always yellow - 0	●
intermediate (pale cream) - 1	◐
whitish with reddish-purple veining - 2	○

F. Fusion of the long filaments. Three states are observed in the species examined. First, the completely free and distant filaments, a state present in all species of Sect. Alyssum. Secondly, closely adjacent and often overlapping or touching filaments which infrequently (A. corningii) may cohere at the very base. Thirdly, closely adjacent filaments which always cohere to one another by fusion of the filament wings. The third state is of diagnostic value for all taxa comprising Series Gamosepalum: the second state being characteristic of all components of Series Libra. Any synstemonous condition is a specialization from the normally free filaments (Bessey, 1915: Dictum 25).

Table No. 5	Table No. 7
free /	

Table No. 5	Table No. 7
free and distant - 0	▲
closely adjacent, overlapping or touching rarely basally coherent - 1	Δ
always coherent - 2	△

G. Dentation of the wings of the long filaments. The presence of edentate, uniformly winged filaments in Sect. *Gamosepalum* is directly correlated with the high specialization values of characters A, C, D and G. This filament state may be considered as a suppression of the normal expression of toothing or abrupt constriction of the wings present in most of the other *Alyssum* species (Fig. 1B, l and m).

Table No. 5

always toothed - 0

occasionally edentate, but always abruptly narrowed - 1

always edentate and uniform - 2

H. Hair type. Payson's conclusion (1921) that the most highly evolved trichome is that with many rays is accepted. The sequence of elaboration from the few-rayed stellate hair (Fig. 1A, c) to the lepidote hair (Fig. 1A, l and m) through the sublepidote hair (Fig. 1A, k) is well developed in Sect. *Gamosepalum* and the allied species in Sect. *Alyssum*. The lepidote scale of all species of Series *Libra* is correlated with the specialization value of 1 for character G. On the other hand, the presence of the simpler type of trichome with few, often furcate and divergent rays in Series *Gamosepalum* is directly correlated with the fusion of the long filaments. These correlations /

correlations support the natural ordering of the series within the section. The indumentum character is evaluated in terms of the predominant type of hair. Two species in Sect. Alyssum considered in this survey, A. aizoides and A. bornmuelleri have roughly an equal amount of both basic types; the simpler form more prevalent on the upper portions of the plant, while the lepidote scales are commoner on the lower cauline and sterile shoot leaves.

Table No. 5

few-rayed but often branched stellate hairs - 0

equal quantities of both types - 1

many-rayed lepidote or sublepidote hairs - 2

In Table No. 7 this character is expressed as the vertical axis.

I. Indumentum Disposition. Only three species in Sect. Gamosepalum (Series Libra: A. harputicum, A. niveum and A. lycaonicum) have a completely homomorphic indumentum made up entirely of lepidote scales. The homomorphic condition is thought to be an advancement from a mixed indumentum because the homomorphic condition is expressed with the most specialized type of trichome, the large lepidote and peltate scale. Furthermore, in A. harputicum the advanced type and disposition of the hair type is correlated with the most specialized leaf form; in A. lycaonicum it is correlated with the very specialized inflated calyces. All the other taxa treated in this comparison have a development of tuberculate hairs with divergent and furcate rays (this conditions itself being an expression of elaboration) on the upper parts of the plant mixed with short-rayed stellate or lepidote hairs. This /

This dimorphism of indumentum disposition may be expressed strongly or weakly and are given specialization values of 0 or 1 respectively.

Table No. 5

strongly dimorphic with prominently tuberculate and long-rayed stellate hairs on the upper cauline leaves, pedicels and sepals - 0

weakly dimorphic on the upper parts of the plant with short rayed and only slightly tuberculate hairs - 1

always homomorphic of lepidote scales - 2

J. Leaf shape. Among the species of Sect. Gamosepalum and the allied members of Sect. Alyssum, the more or less oblanceolate or lanceolate leaf is commonest. The very narrow, linear-oblanceolate leaf of A. thymops and A. harputicum (involute and almost cylindrical in the latter) may be derived from the commoner shape by some process of surface area reduction related to the conservation of moisture in arid habitats. The intermediate shape presumable stems from the larger, spathulate or broadly obovate type illustrated by A. baumgartnerianum. It must be stressed, however, that the leaf shape while of some value in determining specialization values and establishing inter-relationships of Sect. Gamosepalum, it may be of no use in other species complexes (Babcock, 1947).

Table No. 5

broadly obovate or spathulate - 0

more or less oblanceolate or lanceolate (intermediate) - 1

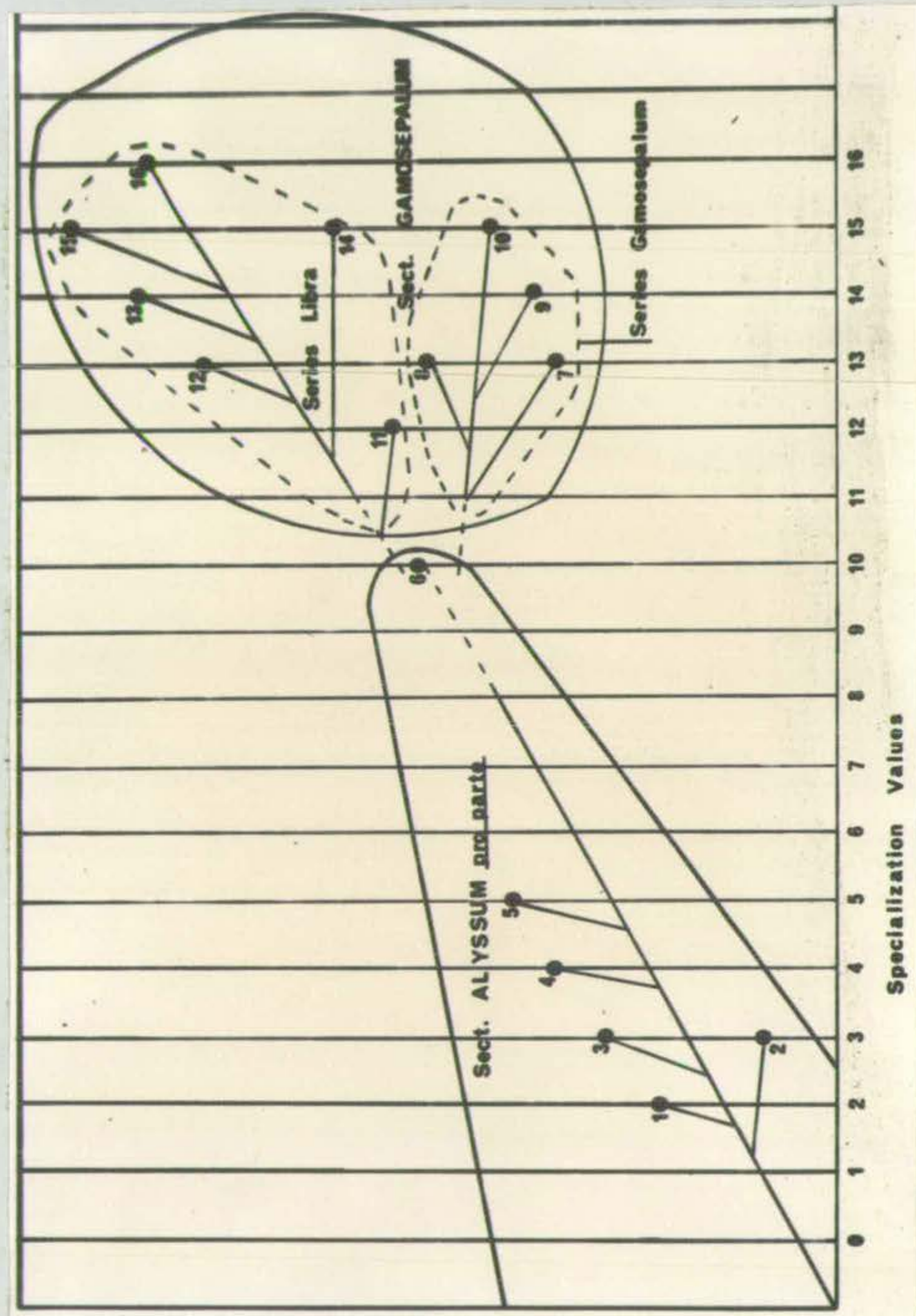
narrowly linear-oblanceolate, rarely involute and cylindrical - 2

Several other characters might be considered in this study. For example, it could be interpreted that the broadly spathulate petals /

petals which are constricted at their middle and are furnished with conspicuously dilated and denticulate claw wings (Fig. 1B, f) of species numbers, 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12 and 14 (see Table No. 5) constitute a departure from the obovate and gradually attenuate ones which are gradually attentate and are furnished with entire and narrowing claw wings (Fig. 1B, a and b) towards an increase in complexity. The example of sepal fimbriation (Stern, 1961) sets a precedent for this conclusion. It is, however, difficult to visualize the relatively simple, obovate petals of A. lycaonicum, the most specialized representative of Sect. Gamosepalum, having evolved in any manner except as the result of a reduction process from a more elaborate type of petal; especially in A. lycaonicum where the simpler petal shape is directly associated with the most specialized inflated calyx. Unfortunately, the petal shape throughout the whole genus, though of value in distinguishing species, is not a satisfactory character to judge evolutionary trends. Most of the components of Sect. Odontarrhena have the obovate simple form of petal. This fact implies that the development of petal shape at least in that section - a relatively advanced section with the number of ovules in each locule reduced to one - follows a trend of reduction and simplification, rather than elaboration. But it must always be kept in mind that what is applicable to one group of plants, in this case an entire section, may not be at all applicable to other groups or sections.

It is also interesting to point out that most of the Gamosepalum and related Alyssum species have cauline leaves which increase in size upwards /

upwards and are often involucrate. This is not the case with A. lycaonicum, whose cauline leaves decrease significantly in size upwards and are never involucrate. It can be safely assumed that the involucrate condition has a particular value for the protection of the floral parts and developing fruits. The diminishing size of the leaves of A. lycaonicum may well represent a reduction process associated with the development of the strongly inflated calyces which obviously have a protective and dispersal function.

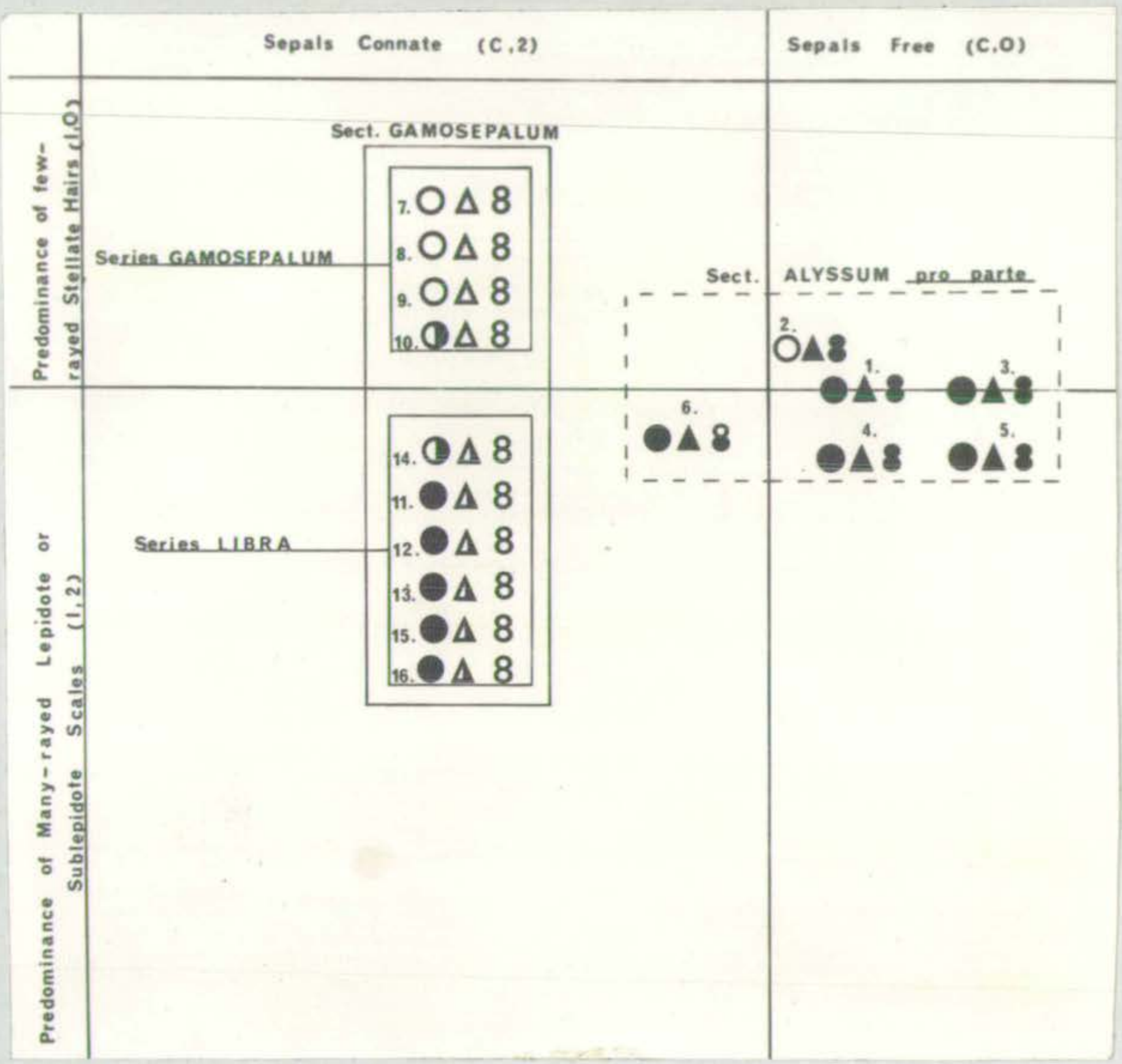


(2).

TABLE 6 : BASED ON SPECIALIZATION INDICES ILLUSTRATING THE PROBABLE RELATIONSHIP WITHIN SECT. GAMOSEPALUM AND TO SOME SPECIES OF SECT. ALYSSUM

(3).

TABLE No. 7: BASED ON CORRELATION OF SELECTED CHARACTERS SHOWING THE INTERRELATIONSHIP OF THE SPECIES IN SECT. GAMOSEPALUM AND SOME ALLIED SPECIES IN SECT. ALYSSUM



XII. KEYS TO ALYSSUM IN TURKEY AND SOME ALLIED EUROPEAN AND ASIATIC SPECIES.

The first key encountered is to the natural sections of the genus. Any difficulty which may arise in placing any given specimen in the correct section (or into the correct subsections of Sect. Odontarrhena) can be resolved by referring to the sectional or subsectional descriptions or diagnoses given in the Synopsis of the Genus Alyssum, p.181 . Reference to Figures 1A, 1B, 2 and 3 with their accompanying legends, and to the morphological criteria in the Introduction (p.68) will clarify any misconception of the morphological details which are used in the keys.

Some of the terminology requires explanation. The state of being pubescent (or having pubescence) is to be understood in the broad sense, implying any state or type of indumentum. The term "plicate" refers to any kind of leaf folding which in the case of Alyssum is conduplicate. "Homomorphic" is used to indicate that the indumentum is composed of only one type of trichome; "heteromorphic" or "dimorphic" indicates that two types of trichomes are present. "Bicolored" refers to the state of the indumentum on the leaves; the lower surfaces being densely pubescent and silvery or whitish, and the upper surfaces usually greenish with a sparse indumentum. "Concolorous" indicates that the indumentum on both leaf surfaces is more or less uniform and of the same colour. "Homophyllous" versus "heterophyllous" are convenient descriptive terms; the former denotes the state of having leaves of essentially one /

one shape and evenly distributed on the fertile stems or sterile shoots, while the latter refers to the occurence of leaves of different shape and size, conferted below on the fertile stems and sterile shoots. The condition of fruits being undulate, especially in Sect. Odontarrhena Subsect. Compressa and Subsect. Samarifera, should not be confused with the state of asymmetry caused by the unequally inflated valves of most species in Subsect. Odontarrhena and many species of Sect. Alyssum. The valves of the species of Subsect. Odontarrhena and Subsect. Samarifera are equally compressed, but are often wavy, a situation best expressed as undulate. Wherever possible, characters of filament wings, teeth and appendages have been assiduously avoided, because they are difficult to observe and are not conducive to convenient identification although important in classification. It should be pointed out that a number of characters, such as fruit indumentum, ovule number and even fruit shape and inflation, are often as easily observed when only flowers with immature pistils are available, as when mature fruits are present.

The taxa distinguished in the following keys are numbered systematically, and this numbering is followed in the formal enumeration of each species. As a guide to correct identification the epithets in the key are accompanied by an abbreviated summary of the broad geographical areas (in parenthesis) where the taxa are known to occur. E represents Europe, T- Turkey, O- anywhere in the Orient excluding Anatolia but including Cyprus. But for one species (A. macropodum var. macropodum and var. heterotrichum) all infra-specific categories are keyed out in the enumeration of their respective species.

(1) Key to Sections

1. Plant annual
    2. Silicules always compressed, glabrous and smooth, or pubescent with simple seta or papillae; placentation marginal, 2-4 (-8) ovules per locule — Meniocus
    2. Silicules always inflated, glabrous and smooth, or pubescent with stellate hairs; placentation near the top of locules, always with 2 ovules per locule
        3. Filaments unwinged, edentate and unappendaged — Psilonema
        3. Filaments always winged and/or dentate and/or appendaged — Alyssum pro parte
1. Plant perennial or biennial
    4. Locules always uni-ovulate — Odontarrhena
    4. Locules 2-4-ovulate
        5. Pedicels arcuate, recurved; silicules boat-shaped, valves strongly and unequally inflated (one valve strongly convex, the other strongly concave); silicules not held in the same direction as the pedicels, horizontal or erect; fruiting racemes candelabra-form — Tetradenia
        5. Pedicels straight, spreading or horizontal; silicules never boat-shaped, valves variously inflated; silicules held in the same direction as the pedicels
            6. Sepals dimorphic, appearing connate due to interlocking hairs, always persistent, ventral surfaces pubescent; long filaments edentate, unappendaged, always closely adjacent /

adjacent, free or coherent

<u>Gamosepalum</u>

6. Sepals monomorphic, always free, but often persistent; ventral surfaces glabrous, long filaments always dentate and/or appendaged, always free <u>Alyssum pro parte</u>

without setae

(2) Key to Sect. MENIOCUS

1. Silicules glabrous, smooth, without papillae
   2. Seeds wingless; styles 0.1-0.5 mm. long; petals 1.2-2(-2.4) x 0.5 mm.; sepals 0.7-1.7 mm. long 1. linifolium (E,T,O)
   2. Seed wings 0.1-0.4 mm. wide; styles 0.5-1.8 mm. long; petals (1.5-)2-6 x 1.5-2 mm.; sepals 2-3 mm. long
      3. Styles 0.5-1 mm. long; petals entire (1.5-) 2-3.5 mm. long; leaves usually 0.5-1.5 (-2.5) mm. wide 2. meniocoides (T,O)
      3. Styles 1-1.8 mm. long; petals retuse or bilobed, 4-6.5 mm. long; leaves usually 2-4 mm. wide 3. aureum (T,O)
1. Silicules pubescent with setae, often with minute papillae, or if setae absent on valves then always present on silicule margins
   4. Styles filiform, 1.5-2.5 mm. long; petals deeply bilobed (lobe 0.5-0.8 mm. deep), or retuse to subretuse; sepals 2-3.5 mm. long
      5. Silicules elliptic, or broadly elliptic, (4.5-) 5.5-7 mm. long, obtuse, densely pubescent with setae 0.5-1 mm. long, papillae not present; seeds wingless; petals deeply bilobed 5. stylare (T)
      5. Silicules orbicular, 3.5-5.5 mm. long, emerginate or subemarginate (rarely obtuse), sparsely pubescent with setae 0.2-0.5 mm. long, or if only on margins papillae often present; seed wings 0.2-0.3 mm. wide; petals retuse or subretuse 7. blepharocarpum (T)

4. /

4. Styles stout, 0.5-1 mm. long; petals shallowly bilobed (lobe 0.3-0.5 mm. deep), or emarginate; sepals 1-2 mm. long

6. Petals shallowly bilobed, 2.5-4 mm. long; seed wings 0.1-0.2 mm. wide; sepals deciduous in fruit; plants ascending or erect

4. <u>huetii</u> (T)

6. Petals emarginate, (0.7-) 1-1.5 mm. long; seeds wingless; sepals ± persistent in fruit; plants procumbent or decumbent

6. <u>heterotrichum</u> (O)

(3) Key to Sect. PSILONEMA

1. Silicules orbicular or rotund, emarginate or obtuse, pubescent, margins entire and smooth; sepals persistent in fruit; leaves always entire

2. Indumentum on silicules homomorphic of appressed stellate hairs; seeds winged; styles 0.5-1 mm. long, slender

3. Stellate hairs on silicules short-rayed, not overlapping; styles glabrous; petals retuse 8. alyssoides (E,O)

3. Stellate hairs on silicules long-rayed, overlapping; styles pubescent at base; petals deeply bifid 9. damascenum (O)

2. Indumentum on silicules heteromorphic of appressed stellate hairs, and long, unequal-rayed stellate hairs, appearing strigose; seeds wingless; styles (1-) 1.5-2 mm. long, stout, strongly dilated at base

10. dasycarpum (E,T,O)

1. Silicules broadly obovate, truncate, glabrous, margins papillose; sepals early deciduous; leaves often denticulate

11. homalocarpum (O)

(4) Key to Sect. ALYSSUM

1a Plant annual

2a Siliculés glabrous or rarely with sparse indumentum

3a Sepals early deciduous; indumentum of sublepidote, ± short many-rayed stellate hairs, 0.2-0.3 mm. diam.; leaves linear, oblanceolate, gradually attenuate into petiole

4a Uppermost leaves not involucrate; silicules orbicular, emarginate, (2-) 3-3.5 (-4) x (2-) 2.5-3 (-4) mm., inflated only at centre, flat margins 0.5-1 mm. wide

5a Glands erect, subulate, conspicuous at base of filaments; petals retuse or emarginate, 0.5-1 mm. wide; hyaline margins of sepals 0.2-0.4 mm. wide; silicules glabrous or rarely with few stellate hairs only on margins 12. <u>desertorum</u> (E,T,O)

5b Glands reduced, inconspicuous at base of filaments; petals deeply emarginate, 0.2-0.4 mm. wide; hyaline margins of sepals not more than 0.1 mm. wide or absent; silicules always with sparse but uniform indumentum 13. <u>turkestanicum</u> (O)

4b Uppermost leaves involucrate; silicules rotund or ovate, truncate, 3.5-6 (-7.5) x 4.5-5 (-6) mm., uniformly inflated, flat margins 0.2-0.3 mm. wide 14. <u>foliosum</u> (E,T,O)

3b Sepals long persistent; indumentum of ± long, few-rayed rarely branched stellate hairs (0.4-) 0.5-0.8 (-1) mm. diam./

diam.; leaves obovate-spathulate, abruptly constricted into petiole

6a Styles 0.5-1 (-1.5) mm. long, strongly dilated at base, 2 X wider at base than apex; petals densely pubescent with long-rayed, strigose, stellate hairs emarginate 0.5-0.6 mm. wide at apex, claws dilated, 2-3 X wider than apex, pale yellow 15. <u>minutum</u> (E,T,O)

6b Styles (1-) 1.5-3.5 (-4) mm. long, slender, often rostrate, not dilated at base or only slightly so; petals glabrous or sparsely pubescent with short-rayed appressed stellate hairs, bilobed, (1-) 1.5-4 mm. wide at apex, gradually attenuate into claws, deep yellow

7a Styles 1-1.5 mm. long; petals 3-3.5 x 1-1.5 mm.; hyaline margins of sepals 0.1-0.2 mm. wide; long filaments edentate 16. <u>smyrnaeum</u> (T)

7b Styles 2-3.5 (-4) mm. long; petals (4-) 4.5-7 x 2.5-4 mm.; hyaline margins of sepals 0.3-0.5 mm. wide; long filaments always dentate

17. <u>fulvescens</u> (E,T)

2b Silicules always pubescent with dense, homomorphic or heteromorphic indumentum

8a Indumentum on silicules homomorphic, only of stellate hairs

9a Uppermost leaves involucrate, 2-4 X larger than lower leaves; pedicels swollen at base, appressed to main axis /

axis when mature

10a Silicules greenish, with stellate hairs of ± unequal, few and divergent rays; fruiting racemes umbellate or long spicate or widely cylindrical

11a Fruiting racemes long spicate; petals entire, 1.5-2 mm. long, glabrous 18. <u>strictum</u> (T,O)

11b Fruiting racemes strictly umbellate or widely cylindrical; petals retuse, 2.5-3.5 mm. long, sparsely pubescent

12a Fruiting racemes widely cylindrical; styles 0.5-0.8 mm. long silicule valves ± equally inflated 19. <u>contemptum</u> (T,O)

12b Fruiting racemes strictly umbellate; styles 1-1.5 mm. long; silicule valves strongly unequally inflated 20. <u>umbellatum</u> (E,T,O)

10b Silicules whitish with stellate hairs of equal and many rays, appressed; fruiting racemes short or elongate, pyramidal or conical, or narrowly cylindrical

13a Styles pubescent, (0.3-) 0.4-1 (-1.5) mm. long; silicules obtuse or truncate; fruiting racemes pyramidal or narrowly cylindrical, (2-) 4-10 cm. tall 21. <u>szowitsianum</u> (T,O)

13b Styles glabrous, 0.2-0.3 (-0.4) mm. long; silicules emarginate; fruiting racemes short conical /

conical or pyramidal, 1-2.5 cm. tall 22. marginatum (O)

9b Uppermost leaves not involucrate, less than 2 X larger than lower leaves; pedicels slender to base spreading, or horizontal to deflexed

14a Styles strongly dilated at base, 2 X wider at base than apex, rostrate, (1.4-) 2-3.5 mm. long; petals strongly or weakly constricted at middle, (2.5-) 3.5-5 x (1-) 1.5-2.5 mm.

15a Sepals early deciduous; petals emarginate or retuse, lateral margins denticulate; silicules elliptic or ovate, truncate or obtuse; stellate hairs on silicules minute and many-rayed, or if few-rayed then rays unequal

16a Seed wings 0.3-0.5 mm. diam., petals densely pubescent; silicules 4-4.5 x 3.5-4 mm.; pedicels 9-12 mm. long, strictly ascending; fruiting racemes up to 20 cm. long, branches if present ½ or less the length of primary axis 23. rostratum (E)

16b Seed wings absent or rarely rudimentary; petals glabrous; silicules 2.5-3 x 1.8-2.5 mm.; pedicels 3.5 mm. long, divergent or horizontal; fruiting corymbs (3-) 5-10 cm. long, branches as long or longer than primary axis

24. macropodum var. macropodum (T)

15b Sepals persistent in fruit; petals bilobed, lateral margins /

margins entire; silicules orbicular or broadly ovate, emarginate or retuse or truncate; stellate hairs on silicules coarse, with few, equal and long rays

26. stapfii (T,O)

14b Styles not dilated at base nor rostrate, 0.5-1 (-1.6) mm. long; petals gradually attenuate to base, 2-2.5 (-3.5) x 0.4-0.9 mm.

17a Leaves greenish with indumentum of long and few-rayed stellate hairs; styles pubescent at least at base, 0.7-1.6 mm. long; silicule valves ± unequally inflated 25. minus (E,T,O)

17b Leaves cinereus with indumentum of minute, sublepidote, many-rayed stellate hairs; styles glabrous, 0.5 mm. long; silicule valves equally inflated 13. turkestanicum (O)

8b Indumentum on silicules always heteromorphic with simple tuberculate and/or bifurcate hairs intermixed with stellate hairs

18a Tuberculate hairs on silicules always bifurcate, with equal coarse, rarely sericeous rays, (0.2-) 0.5-1 (-1.5) mm. long; tuberculate base of hairs on silicules, sepals and pedicels 0.5 mm. long or less, (rarely more)

19a Styles densely pubescent with heteromorphic indumentum similar to that on silicules; silicules elliptic /

elliptic, truncate, 2.5-3.5 x 1.6-2.3 mm.

24. macropodum var. heterotrichum (T)

19b Styles glabrous or sparsely pubescent at base with minute stellate hairs; silicules orbicular or broadly elliptic or ovate, retuse or obtuse or acute, 4-7 x 3-6 mm.

20a Styles 0.5-1.5 mm. long, slender but rigid; silicules orbicular, retuse or subretuse; petals 2-3 (-3.5) x 0.4-0.9 (-1.4) mm.; pedicels 3-5 mm. long; fruiting racemes corymbose

27. strigosum (E,T,O)

20b Styles (2-) 2.5-3.5 (-4.5) mm. long, strongly dilated at base, rostrate; silicules broadly elliptic or ovate, obtuse or acute; petals (4.5-) 6-7 x (1-) 2.5-3.5 mm.; pedicels 5-8 (-12) mm. long; fruiting racemes simple

28. xanthocarpum (T,O)

18b Tuberculate hairs on silicules simple, slender, sericeous, 1-3 mm. long, or if bifurcate then rays unequal; tuberculate base of hairs on silicules, sepals, and pedicels 0.7-2.5 (-3) mm. high, (rarely less)

21a Styles 1.2-2.2 mm. long, not dilated at base, or only slightly so, glabrous; sepals early deciduous; fruiting corymbs usually compound; silicules (4.5-) /

(4.5-) 5-6 mm. wide; pedicels spreading or horizontal
29. hirsutum (E,T)

21b Styles 3-4 mm. long, strongly dilated at base, pubescent; sepals persistent in fruit; fruiting racemes simple and cylindrical or globuliform; silicules 3.5-4.5 mm. wide; pedicels strictly erect, or arcuate and deflexed

22a Fruiting racemes elongate and cylindrical; petals bifid or retuse, densely pubescent; leaves decreasing in size upwards; styles pubescent with only minute appressed stellate hairs

23a Silicules ovate or broadly elliptic; petals 5-6 mm. long; seeds wingless 30. bulbotrichum (T)

23b Silicules orbicular; petals 6-8 mm. long; seeds winged 31. trichocarpum (T)

22b Fruiting racemes congested and globuliform; petals entire, glabrous or rarely sparsely pubescent; leaves increasing in size upwards, uppermost involucrate; styles pubescent with heteromorphic indumentum similar to that on silicules
32. cephalotes (T)

1b Plants perennial or biennial

24a Indumentum of few-rayed, ± branched, sparse or copious stellate hairs, appearing ± strigose and greenish-grayish (rarely whitish), overall upper cauline leaves never bracteate-involucrate; fertile stems arcuate ascending or /

or erect, never cushion-forming, (10-) 20-60 (-100) cm. long (rarely less); sterile shoots arcuate ascending or erect, never conferted, $\frac{1}{2}$-$\frac{3}{4}$ the length of fertile stems, or absent

25a Stellate hairs on pedicels appearing hirsute or strigose (especially in the upper half), with divergent unequal rays, 1-2 mm. long (rarely less)

26a Sepals persistent in fruit

27a Plant biennial; cauline leaves acute and long attenuate, lowermost greenish; pedicels 10-20 mm. long; silicules emarginate 34. wierzbickii (E)

27b Plant perennial; cauline leaves obtuse or subacute, lowermost whitish; pedicels 5-10 mm. long; silicules obtuse or truncate 35. calycocarpum (E,T,O)

26b Sepals early deciduous

28a Petals spathulate, bilobed or retuse, 2-3.5 mm. wide; fruiting racemes elongate, 10-20 (-30) cm. long; cauline leaves decreasing in size upwards

29a Silicule valves densely pubescent, grayish or whitish, membranous wing absent; styles pubescent below 33. repens (E,T,O)

29b Silicule valves glabrous, greenish, but with sparse minute, stellate hairs on margins, membranous wing (c.0.3 mm. wide) with sparse minute stellate hairs; styles glabrous 37. pseudo-mouradicum (T)

28b /

28b Petals obovate, entire, 1-1.5 mm. wide; fruiting racemes condensed, not more than 4 (-6) cm. long; cauline leaves increasing in size upwards

30a Fertile stems lax, sparingly leafy; pedicels ascending or spreading; cauling leaves 15-20 x 2-3 mm.; indumentum of all parts of long and few-rayed, rarely branched stellate hairs, grayish-green and strigose

31a Silicules orbicular, emarginate, 4.5-5 x 3-4 (-5) mm. long; styles 2-3 mm. long, glabrous or rarely sparsely pubescent at base

36. <u>pulvinare</u> (E)

31b Silicules broadly elliptic or ovate, deeply retuse, 6-6.6 x 4 mm.; styles (3-) 3.5-4 mm. long; always densely pubescent up to half their length 38. <u>erosulum</u> (T)

30b Fertile stems erect or ascending, ± densely leafy; pedicels horizontal or deflexed; cauline leaves 3-10 (-15) x 1-1.5 (-2) mm.; indumentum of upper cauline leaves of short and few-rayed, (branched appearing many-rayed), appressed stellate hairs, grayish-green, that of lower cauline and sterile shoot leaves whitish 40. <u>armenum</u> (T,O)

25b Stellate hairs on pedicels appressed, or if with divergent rays, then rays less than 0.5 mm. long, and /

and equal

32a Silicules broadly elliptic or rotund or ovate or obovate, 4.5-5 x 4-5 mm. (rarely less); styles 2-4 mm. long; petals golden-yellow

33a Sepals persistent in fruit; petals retuse; cauline leaves decreasing in size upwards

34a Fertile stems 10-20 cm. long, decumbent to erect; cauline leaves all narrowly oblanceolate, acute; petals densely pubescent; hyaline margins of sepals 0.1-0.2 mm. wide 39. <u>montanum</u> (E)

34b Fertile stems 20-30 (-40) cm. long, sprawling to arcuate; lower cauline leaves obovate to spathulate, ± obtuse; upper cauline leaves oblanceolate-obovate, ± acute, longer and narrower than lower ones; petals glabrous; hyaline margins of sepals 0.3-0.5 mm. wide 44. <u>stribrnyi</u> (E,T,O)

33b Sepals early deciduous; petals entire or subemarginate; cauline leaves increasing in size upwards

35a Silicule valves ± equally inflated; cauline leaves broadly oblanceolate or obovate, those of sterile shoots about twice as large 40. <u>armenum</u> (T,O)

35b /

35b Silicule valves strongly unequally inflated; cauline leaves linear-oblanceolate, those of sterile shoots about ½ the size

41. <u>ochroleucum</u> (T)

32b Silicules orbicular, 2.5-3 mm long and wide; styles 1.5-2 mm. long; petals pale lemon yellow

42. <u>artwinense</u> (T)

24b Indumentum of many-rayed, strongly branched, lepidote or sublepidote, dense stellate hairs, appearing silvery-white, or ashy (rarely greenish), that of cauline and sterile shoot leaves ± dissimilar; upper cauline leaves bracteate-involucrate; fertile stems cushion-forming or procumbent or decumbent or laxly sprawling, or if erect and ascending never more than 15 (-20) cm. long; sterile shoots conferted, never more than ¼ the length of fertile stems

36a Sepals early deciduous; indumentum on all leaves of equal-rayed, appressed, and lepidote or sublepidote stellate hairs

37a Silicules glabrous

38a Fruiting racemes condensed, few-fruited, subumbellate; petals obovate, entire, gradually attenuate into claws, 1-1.5 mm. wide; fertile stems procumbent or decumbent, slender, fragile,

5 /

5-7 cm. long 45. <u>idaeum</u> (E)

38b Fruiting racemes elongate, many-fruited; petals spathulate, retuse, or subretuse, abruptly constricted into claws, (1.5-) 2-2.5 mm. wide; fertile stems stout, erect or ascending, 10-15 cm. long 46. <u>mouradicum</u> (T,O)

37b Silicules always pubescent

39a Cauline and sterile shoot leaves broadly ovate or obovate or spathulate or orbicular, ± obtuse

40a Silicules broadly elliptic or rotund, obtuse or truncate, 7-10 x 5-6 mm.; styles 1.5-2 mm. long; seed wings 0.5-1 mm. wide; silicule valves equally inflated at centre, compressed at margins 47. <u>handelii</u> (E)

40b Silicules ovate or obovate or orbicular, emarginate or rarely acute, 4-6 x 3-4 (-4.5) mm.; styles 2.5-3 mm. long; seed wings absent or 0.1-0.3 mm.; silicule valves strongly unequally inflated

41a Fruiting racemes elongate, 4-6 (-10) cm. long; cauline leaves increasing in size upwards; fertile stems stout, indurated, ascending or erect; petals retuse

42a Stellate hairs on silicules sparse with sparingly /

sparingly branched or unbranched rays; seeds winged; stellate hairs on leaves of sterile shoots 0.7-1 mm. diam., not lepidote 50. praecox (T)

42b Stellate hairs on silicules dense, with prominently branched rays; seeds wingless; stellate hairs on leaves of sterile shoots lepidote or sublepidote, 0.3-0.4 mm. diam. 51. densistellatum (E)

41b Fruiting racemes condensed, subumbellate, 2-3 cm. long; cauline leaves decreasing in size upwards; fertile stems slender, fragile, arcuate or procumbent or decumbent; petals entire or subemarginate 49. argyrophyllum (T)

39b Cauline and sterile shoot leaves linear-oblanceolate, or lanceolate, or narrowly ovate

43a Styles stout, 0.5-1 (-1.5) mm. long; margins of petal claws denticulate; leaves of sterile shoots lanceolate or narrowly elliptic, closely imbricated 52. lepidotum (T)

43b Styles slender and rostrate, (2-) 2.5-4 (-5) mm. long; margins of petal claws entire; leaves of sterile shoots linear-oblanceolate, lax /

lax

44a Fertile stems depressed and decumbent, slender; sterile shoots conferted, 1 cm. long or less; cauline leaves 3-6 (-10) x 0.5-1 (-2) mm.

45a Petals spathulate, retuse, abruptly constricted into claws, 2.5-3 mm. wide; styles 2.5-3 mm. long; stellate hairs on silicules few-rayed, not lepidote 48. <u>aurantiacum</u> (T)

45b Petals obovate, entire or subemarginate, gradually attenuate into claws, 1-2 mm. wide; styles 4.5-5 mm. long; stellate hairs on silicules many-rayed and lepidote 55. <u>propinquum</u> (T)

44b Fertile stems arcuate-ascending or erect, stout; sterile shoots laxly ascending or decumbent, 2 cm. long, or more; cauline leaves 8-20 x 3-7 mm.

46a Fruiting racemes condensed, umbellate, few-fruited; silicules obtuse or truncate, 6-7 x 5-7 mm. 53. <u>lassiticum</u> (E)

46b Fruiting racemes elongated, often reduced but never umbellate, always many-fruited; silicules emarginate, (3-) 4-5 mm. long and /

and wide 58. _muelleri_ (O)

36b Sepals persistent in fruit; indumentum on upper cauline leaves (upper surfaces and margins) appearing strigose with unequal-rayed stellate hairs, that of lower cauline and sterile shoot leaves with only equal-rayed appressed lepidote or sublepidote stellate hairs

47a Cauline leaves imbricated, strongly appressed to stems; styles densely pubescent their entire length; pedicels 10-15 (-20) mm. long, always horizontal or deflexed; silicules obcordate or transversely elliptic 54. _sphacioticum_ (E)

47b Cauline leaves lax or spreading; styles glabrous or sparsely pubescent to no more than ½ their length; pedicels (3-) 5-10 (-15) mm. long, divergent and spreading or ascending or appressed to main axes; silicules orbicular or elliptic or ovate or rotund

48a Fruiting racemes elongate, (10-) 15-20 fruited or more, may be reduced, but never umbellate

49a Silicules emarginate; petals bilobed or /

or retuse

50a Pedicels 4-6 mm. long; petals pale yellow, deeply bilobed; plant small, individual, few-stemmed, not more than 10 cm. diam.; fertile stems 5-10 cm. long

43. moellendorfianum (E)

50b Pedicels 10-15 mm. long; petals golden-yellow, retuse; plant large, many-stemmed, up to 70 cm. diam.; fertile stems 20-30 (-40) cm. long

44. stribrnyi (E,T,O)

49b Silicules obtuse or truncate; petals entire or rarely subretuse

51a Silicules elliptic or rotund, 4-5 x 3-3.8 mm.; pedicels strongly ascending or appressed to stems; petals spathulate, whitish, tinged pink-purple at throat, abruptly constricted into claws, margins of claws denticulate 59. iranicum (O)

51b Silicules orbicular (4-) 5-6 mm. long and wide; pedicels spreading and divergent; petals obovate, yellow, gradually attenuate into claws /

claws, margins of claws entire

52a Fruiting racemes basally branched; petals 1.5 mm. wide; plant erect (10-) 15-30 cm. tall; sterile shoots few, erect 57. persicum (0)

52b Fruiting racemes simple, unbranched; petals 2.5-3 mm. wide; plant sprawling and decumbent to ascending, (3-) 5-10 (-15) cm. tall; sterile shoots numerous, cushion-forming 56. lanceolatum (0)

48b Fruiting racemes conferted, umbellate or subumbellate, 5-10 (-15) fruited

53a Petals glabrous or sparsely pubescent on limbs, not on claws; indumentum on sepals heteromorphic, appearing strigose or hirsute, or if homomorphic with only lepidote stellate hairs, then sepals never appearing connate; lepidote hairs on leaves with long peripheral rays

54a Petals broadly spathulate, bilobed or retuse (rarely entire), abruptly constricted into claws, margins /

margins of claw denticulate;
styles (2.5-) 4-6 mm. long

55a Petals 5-7 mm. long; styles 2.5-4 (-4.5) mm. long; upper cauline leaves 6-8 x 0.5-1 mm.; indumentum on upper vegetative parts strigose with long and unequal-rayed stellate hairs; silicules elliptic to broadly elliptic, (rarely obovate), obtuse or truncate

56a Styles ½ X shorter than silicules; length and width of silicules ± equivalent; fertile stems conferted, not more than 5 cm. above cushion-forming sterile shoots

60. aizoides (T)

56b Styles 2-3 X shorter than silicules; silicules at least 2 X longer than broad; fertile stems erect, up to 10 cm. above sterile shoots

61. bornmuelleri (T)

55b Petals 8-10 mm. long; styles 5-6 /

5-6 mm. long; upper cauline leaves 10-20 x 1-2 mm.; indumentum on upper vegetative parts lepidote with equal and short rayed stellate hairs; silicules ovate or broadly elliptic, emarginate

63. <u>doerfleri</u> (E)

54b Petals obovate, entire, gradually attenuate into claws, margins of claw entire; styles 1-2 mm. long

62. <u>taygeteum</u> (E)

53b Petals always densely pubescent on claws, never on limbs; indumentum on sepals homomorphic, of dense lepidote stellate hairs, sepals appearing strongly connate (rarely with divergent rays at apex); lepidote hairs on leaves with short peripheral rays 64. <u>caespitosum</u> (T)

(5) Key to Sect. GAMOSEPALUM

1. Indumentum of few-rayed, branched stellate hairs; long filaments coherent; petals whitish, often purple-veined at throat (or pale cream in A. thymops)(Series Gamosepalum)

2. Indumentum on sepals of strongly tuberculate, interlocking, long, undulating, sericeous, rayed (rays 1-1.5 mm. long), densely tomentose, stellate hairs, and dense subappressed stellate hairs; petals broadly spathulate, retuse or bilobed, sparsely or densely pubescent; leaves obovate or oblanceolate, abruptly constricted into petiole, 10-20 x 2-4 mm.

3. Long filaments coherent for their entire length; ventral surface of sepals with long sericeous rays and appressed equal-rayed stellate hairs; petals 2.5-3.5 mm. wide
65. tetrastemon (T)

3. Long filaments coherent for only ½-¾ their length; ventral surface of sepals with long sericeous rays only; petals 1.2-2 mm. wide

4. Petals retuse, sparsely pubescent; styles 1.5-2 mm. long; fruiting racemes condensed; pedicels ± horizontal
66. lepidoto-stellatum (T)

4. Petals bilobed, densely pubescent; styles c. 3 mm. long; fruiting racemes elongated; pedicels ascending or spreading
67. paphlagonicum (T)

2. Indumentum on sepals of sparse, only slightly tuberculate, stiff, ± short-rayed (rays 0.5-0.6 mm. long) stellate hairs /

hairs, and sparse appressed stellate hairs; petals obovate, entire or rarely subretuse, glabrous; leaves linear, narrowly oblanceolate, gradually attenuate into petiole, 5-10 x 0.5-1 mm. 68. thymops (T)

1. Indumentum of many-rayed, lepidote or sublepidote stellate hairs; long filaments closely adjacent, but never coherent; petals deep or pale yellow (Series Libra)

5. Indumentum on sepals, pedicels, and cauline leaves heteromorphic with appressed lepidote or sublepidote stellate hairs, and divergent or erect, long-rayed stellate hairs; hyaline margins of sepals obvious, not obscured by stellate hairs

6. Petals entire or subretuse; hyaline margins of sepals 0.3-0.4 mm. wide; styles densely pubescent; upper cauline leaves involucrate 69. baumgartnerianum (T,O)

6. Petals bilobed; hyaline margins of sepals 0.1-0.2 mm. wide; styles glabrous or only sparsely pubescent, upper cauline leaves not involucrate

7. Petals pale yellow, 5-5.5 x 1.5 mm.; styles always sparsely pubescent for $\frac{3}{4}$ their length; sepals greenish with sparse indumentum; ventral surface of sepals with sparse, short-rayed stellate hairs 70. corningii (T)

7. Petals deep yellow, 6-7.5 x 2.5-3 mm.; styles glabrous or rarely sparsely pubescent at base; sepals grayish-white with dense indumentum; ventral surface of sepals /

sepals with long sericeous rays of unequal lengths, and few-rayed stellate hairs 71. sulphureum (T,O)

5. Indumentum of sepals, pedicels, and cauline leaves homomorphic with only lepidote stellate hairs; hyaline margins of sepals obscured by interlocking hairs

8. Sepals not inflated in fruit, 2.5-4.5 mm. long; petals 5-7 mm. long, sparsely or densely pubescent on claw, not on limb, constricted at middle, or if gradually attenuate margins of claw denticulate; cauline leaves increasing in size upwards; plants cushion-forming or decumbent, 3-11 cm. tall

9. Cauline leaves very narrowly linear-oblanceolate, 0.5-1.5 mm. wide; petals 5-5.5 x 2 mm., entire 72. harputicum (T)

9. Cauline leaves oblanceolate or spathulate, 2-3 mm. wide; petals 6.5-7 x 3-3.5 mm., retuse to subretuse 73. niveum (T)

8. Sepals greatly inflated in fruit, 6-8 mm. long; petals 8-9 (-10) mm. long, densely pubescent on limb, not on claw, gradually attenuate, margins of claw entire; cauline leaves decreasing in size upwards; plants ascending, 10-20 cm. tall 74. lycaonicum (T)

Sect. ODONTARRHENA

(6)

Key to Subsections

1. Silicules dehiscent, not samaroid; pedicels divergent and spreading or sigmoid-deflexed

  2. Silicule valves unequally inflated and S-shaped in cross section at base, or equally inflated and cross section at base orbicular, or quadrangular or transversely and narrowly elliptic, veination inconspicuous <u>Odontarrhena</u>

  2. Silicule valves compressed or slightly and equally inflated, $\pm$ straight in cross section at base, veination $\pm$ prominent <u>Compressa</u>

1. Silicules indehiscent, samaroid; pedicels always sigmoid-deflexed <u>Samarifera</u>

(a) Key to Subsect. Odontarrhena

1a Silicules glabrous or papillose

2a Valves of silicules thick, glaucous, or papillose; plants usually fruticose; fertile stems arcuate-ascending or erect, (10-) 25-50 (-60) cm. high, rarely less; sterile shoots arising above the long, aphyllous, and lignose base, erect or ascending (seldom absent), 10-20 cm. long, rarely less

3a Fruiting corymbs many-branched and widely spreading, never with subtending involucrate leaves; silicules rotund, or elliptic, or obovate, or orbicular

4a Cauline leaves broadly obovate or spathulate, obtuse, rarely subacute, abruptly constricted into petiole, decreasing in size upwards; plant perennial, many-branched; fertile stems stout, arcuate-ascending

5a Cauline and sterile shoot leaves dissimilar in form, both concolorous; petals 2-2.5 mm. long

6a Silicules orbicular or obovate (3-) 3.5-4.5 mm. long; styles slender, 0.5-1 mm. long 75. corsicum (E,T)

6b Silicules elliptic to broadly elliptic, 5-6 mm. long; styles stout, 1.5-2 mm. long

76. masmenaeum (T)

5b Cauline and sterile shoot leaves similar in form, both bicolored; petals 3.5-4.5 mm. long

7a Styles 1.5-2 mm. long; silicules smooth, sessile; fertile stems 10-20 cm. long; cauline leaves 6-10 (-20) /

(-20) x 3-4 (-6) mm. 77. <u>syriacum</u> (T,O?)

7b Styles 2-3 mm. long; silicules prominently rugose, stipitate; fertile stems 25-40 cm. long; cauline leaves (15-) 20-35 x (4-) 6-8 mm. 79. <u>discolor</u> (T)

4b Cauline leaves oblanceolate, acute, gradually attenuate into petiole, increasing in size upwards; plant biennial, branching inconspicuous; fertile stems slender, strictly erect 80. <u>libanoticum</u> (O)

3b Fruiting corymbs condensed, subtended by broad involucrate leaves; silicules ovate or obcordate and papillose

8a Silicules smooth, ovate, acute, or attenuate; styles stout, 1-1.5 (-2) mm. long; pedicels divergent or ascending 78. <u>troodi</u> (O)

8b Silicules strongly papillose, obcordate, obtuse, or truncate; styles slender, 0.5-1 mm. long; pedicels horizontal to deflexed 82. <u>chondrogynum</u> (O)

2b Valves of silicules thin, never glaucous or papillose; plants suffrutescent; fertile stems sprawling or decumbent, never more than 15 cm. long; sterile shoots conferted at base, not longer than 8 cm.

9a Silicules orbicular, emarginate, 2-2.5 (-3) mm. long; styles 0.5-1 mm. long; leaves linear-oblanceolate, greenish with sparse indumentum of few-rayed stellate hairs 84. <u>davisianum</u> (T)

9b Silicules elliptic, acute or obtuse, 4-6 mm. long; styles 2-2.5 /

2-2.5 (-3) mm..long; leaves obovate or spathulate to rotund, silvery-white with dense indumentum of many-rayed, sublepidote stellate hairs

10a Seeds winged; leaves of sterile shoots spathulate to rotund, abruptly constricted into petiole; cauline leaves bicolored, uppermost involucrate

81. *smolikanum* (E)

10b Seeds unwinged; leaves of sterile shoots obovate, gradually attenuate into petiole; cauline leaves concolorous, uppermost not involucrate 83. *oxycarpum* (T)

1b Silicules pubescent, never papillose → 16a

11a Upper cauline leaves spathulate or broadly obovate or rotund, (rarely oblanceolate), always obtuse, prominently involucrate, persistent

12a Silicules orbicular to obcordate, emarginate, strongly S-shaped in cross section at base; styles 0.5-1 mm. long; short filament appendages connate at base; all filaments incurved 101. *borzaeanum* (E,T)

12b Silicules elliptic or ovate to rotund, obtuse or truncate, only slightly S-shaped or transversely and narrowly elliptic in cross section at base; styles 1-3 mm. long; short filament appendages free; all filaments straight

13a Fertile stems arcuate ascending to erect, (6-) 15-40 cm. long; sterile shoots few, arcuate ascending /

ascending to erect, arising from along woody caudex, (3-) 5-10 cm. long

14a Fertile stems homophyllous, leaves evenly distributed; styles 2-3 mm. long; silicules elliptic, 4-6 mm. long; stellate hairs on silicules sparse, long-rayed, easily displaced; seeds winged 81. smolikanum (E)

14b Fertile stems heterophyllous, lower cauline leaves congested, forming a distinct zone; styles 1-1.5 (-2) mm. long; silicules ovate to rotund, (2.5-) 3.5-4 mm. long; stellate hairs on silicules dense, short-rayed, persistent; seeds unwinged 97. obtusifolium (E,O)

13b Fertile stems sprawling decumbent, or procumbent, rarely ascending, 5-10 cm. long; sterile shoots densely conferted on cushion-forming crown, 1-2 cm. long (rarely longer)

15a Styles slender, always glabrous; silicules broadly ovate 2.5-3 mm. long and wide; petals abruptly constricted into claws, emarginate or retuse, rarely truncate, 1.5-2 (-2.5) x 0.5-1 mm.; involucral leaves enveloping inflorescence 99. bracteatum (O)

15b Styles dilated at base, sparsely pubescent at least when young; silicules elliptic or narrowly ovate, 3-4 x 2-3 mm.; petals gradually attenuate into /

into claws, obtuse or truncate, 3-3.5 x 1-1.5 (-2) mm.; involucral leaves not enveloping inflorescence
98. gehamense (T,O)

11b Upper cauline leaves oblanceolate or narrowly obovate (rarely spathulate), acute, never involucrate, but frequently bracteate, early deciduous

16a Plants few-stemmed, never reduced or dwarfed; fertile stems erect or arcuate ascending, (15-) 20-60 (-100) cm. long; sterile shoots conspicuous, erect or ascending from base, or borne along fertile stems

17a Indumentum on silicules dense, whitish, with many-rayed stellate hairs; styles pubescent at base
107. singarense (O)

17b Indumentum on silicules sparse, greenish or tawny, of few-rayed, (often branched appearing many-rayed), stellate hairs; styles glabrous

18a Cauline and sterile shoot leaves similar in form, both oblanceolate, acute, flat or plicate, or if spathulate, then obtuse or truncate and always plicate

19a Silicules orbicular or obcordate or broadly obovate; sepals acute; petals densely pubescent

20a Silicules orbicular or obcordate, emarginate or /

or truncate, 2-3 (-3.5) x 2-3 mm.; styles slender, not dilated at base; long filament appendages narrow, uni-bilateral, irregularly dentate, connate only for ½ - ¾ their length

100. corymbosoides (E)

20b Silicules broadly obovate, obtuse or attenuate, 3.5-4 x 2.5-3 (-4) mm.; styles stout, dilated at base; long filament appendages wide, always unilateral, minutely denticulate, connate for their entire length 85. fallacinum (E)

19b Silicules ovate or elliptic, or narrowly obovate; sepals obtuse; petals glabrous or sparsely pubescent

21a Indumentum on leaves of sterile shoots pannose-tomentose with long, sericeous, undulating, unequal, and few-rayed stellate hairs (2-4 mm. diam.); cauline leaves gradually decreasing in size upwards; stellate hairs on silicules coarse with divergent, unequal rays and branches (0.4-0.6 mm. diam.)

91. eriophyllum (T)

21b Indumentum on leaves of sterile shoots with /

with equal and ± many-rayed, appressed sublepidote stellate hairs (0.3-0.5 mm. diam.); cauline leaves gradually increasing in size upwards; stellate hairs on silicules delicate, appressed with equal rays (0.2-0.4 mm. diam.)

22a Petals 2-2.5 x (0.5-) 0.6-0.7 mm.; silicules elliptic to narrowly elliptic; leaves of sterile shoots linear, oblanceolate, acute, (4-) 10-20 (-25) mm. long; seed narrowly winged

90. <u>huber-morathii</u> (T)

22b Petals (2-) 3-3.5 x (0.8-) 1-1.5 mm.; silicules ovate or broadly elliptic; leaves of sterile shoots spathulate, obtuse or truncate, less than 10 mm. long; seed unwinged 89. <u>cypricum</u> (T,O)

18b Cauline and sterile shoot leaves dissimilar in form, cauline leaves oblanceolate, acute or obtuse, those of sterile shoots obovate or spathulate, obtuse, both always flat, never plicate

23a Silicules 2.5-3.5 mm. long; petals retuse or emarginate, rarely entire; fruiting corymbs with arcuate and flexuose /

flexuose branches, branches (5-) 8-15 (-20) cm. long 88. callichroum (T)

23b Silicules 4-4.5 (-6) mm. long, (rarely less); petals entire, rarely subretuse; fruiting corymbs with rigid, ascending or divergent or spreading branches, not flexuose or arcuate, branches 4-7 (-10) mm. long

24a Seeds unwinged; petals sparsely pubescent; pedicels 3-5 mm. apart, horizontal or deflexed; silicules ovate or broadly elliptic 86. penjwinensis (O)

24b Seeds winged; petals glabrous; pedicels 1-2 mm. apart, always divergent; silicules obovate or narrowly elliptic 87. constellatum (T)

16b Plants ± many-stemmed, reduced or dwarfed; fertiles stems lax, decumbent sprawling or procumbent, or if arcuate ascending then widely divergent or divaricate and ± tortuose, 3-20 (-30) cm. long, rarely strictly erect; sterile shoots numerous decumbent or procumbent or laxly ascending /

ascending and ± tortuose, rarely
strictly erect, arising from thick
conferted crown

25a Silicules always broadly obovate to
obcordate or orbicular, strongly
S-shaped in cross section at base

26a Plants fruticose, aphyllous at base;
stellate hairs on leaves of sterile
shoots lepidote, appressed, 0.15-
0.2 (-0.3) mm. diam.; fruiting
racemes unbranched; silicules broadly
obovate, obtuse to attenuate, 4-5 x
3-4 mm.; petals 4 x 1-1.5 mm.

104. <u>euboeum</u> (E)

26b Plants suffrutescent, leafy at base
at least when young; stellate
hairs on leaves of sterile shoots ±
many-rayed but not lepidote (0.4-)
0.5-1 mm. diam. with suberect rays;
fruiting corymbs always branched,
silicules orbicular or obcordate,
emarginate or truncate, rarely
obtuse, 3.5 (-4) mm. long and wide;
petals 1.5-2.5 (-3) x 0.5-1 mm.

27a Cauline leaves gradually
decreasing /

decreasing in size upwards; fertile stems heterophyllous, lower cauline leaves densely aggregated, forming a distinct zone; stellate hairs on silicules persistent; seeds narrowly winged

103. <u>caliacrae</u> (E)

27b Cauline leaves gradually increasing in size upwards; fertile stems homophyllous, leaves evenly distributed; stellate hairs on silicules easily displaced; seeds unwinged, or rarely with a rudimentary wing

28a Silicules 3-3.5 (-4) x 2-3.5 mm.; stellate hairs on silicules 0.4-0.7 mm. diam. with divergent unequal rays; stellate hairs on leaves of sterile shoots appearing ± tomentose with unequal sericeous rays up to 1.5 mm. long; short filament appendages free 102. <u>sibiricum</u> (E,T,O)

28b Silicules 2-3 mm. long and wide; stellate hairs on silicules 0.15 /

0.15-0.4 mm. diam. with equal rays; stellate hairs on leaves of sterile shoots subappressed with equal stiff rays 0.2-0.5 mm. long; short filament appendages connate at base 101. _borzaeanum_ (E,T)

25b Silicules ovate or elliptic, or oblong, or narrowly obovate, only slightly S-shaped or transversely and narrowly elliptic or quadrangular or orbicular in cross section at base

29a Fruiting racemes congested or pyramidal; silicules conical, acute, orbicular in cross section at base; styles strongly dilated at base, 2-3 X wider at base than apex, densely pubescent at base 109. _haussknechtii_ (T)

29b Fruiting corymbs obpyramidal, but often reduced and contracted; silicules ovate or obovate or elliptic or oblong, truncate or emarginate or obtuse, rarely acute, quadrangular or transversely and /

and narrowly elliptic or slightly S-shaped in cross section at base, styles slender or if dilated at base, only slightly so, glabrous or only sparsely pubescent at base

30a Plants forming a lax fruticose cushion, aphyllous at base; fertile stems rigid, erect or arcuate ascending; cauline and sterile shoot leaves both silvery-white, spathulate, always plicate; valves of silicules equally inflated, or one valve convex, the other concave, cross section at base transversely and narrowly elliptic or slightly S-shaped

89. <u>cypricum</u> (T,O)

30b Plants suffrutescent, sprawling, seldom forming a cushion; fertile stems spreading or divaricate or decumbent or prostrate; leaves of sterile shoots whitish-gray, cauline leaves greenish, both oblanceolate or obovate or spathulate, always flat; valves of /

of silicules unequally inflated or if ± equally inflated, cross section at base transversely and narrowly elliptic or quadrangular

31a Silicules oblong, narrowly elliptic, 2-3 X longer than broad, quadrangular in cross section at base; cauline leaves linear-oblanceolate, always acute, 15-25 (-30) x 1-2.5 (-4) mm.; long filament appendages ± broad, bilateral, deeply 2-3-many-dentate, usually connate for less than ½ their length

32a Lower cauline leaves densely aggregated, forming a distinct zone; petals gradually attenuate into claws, 0.5-0.8 mm. wide; silicules greenish with coarse, and few-rayed stellate hairs (0.4-) 0.5-0.7 (-0.8) mm. diam.

106. filiforme (T)

32b Lower cauline leaves evenly distributed, not aggregated or /

or forming a distinct zone;
petals abruptly constricted into
claws, 1-1.5 mm. wide; silicules
ashy or whitish with delicate
and many-rayed stellate hairs
0.2-0.5 (-0.6) mm. diam.

33a Fertile stems condensed,
dwarfed; sepals obtuse;
silicules obtuse or attenuate;
branches of fruiting corymbs
c. 5 cm. long, rarely more,
always spreading

105. <u>condensatum</u> (T,O)

33b Fertile stems arcuate-ascending
or divaricate; sepals acute;
silicules emarginate or
truncate; branches of fruiting
corymbs divaricate or horiz-
ontal, more than 5 cm. long

34a Sterile shoots erect, often
branched or forming separate
rosettes, 5-10 cm. long;
styles 1-1.5 (-2) mm. long;
pedicels 4-6 mm. long,
rarely less; stellate hairs
on /

on silicules with branched
and suberect rays, 0.4-0.5
(-0.6) mm. diam.

107. singarense (O)

34b Sterile shoots conferted at
base, less than 2-3 cm. long;
styles 0.5-1 mm. long;
pedicels 2-3 mm. long, rarely
more; stellate hairs on
silicules appressed, lepidote
to sublepidote with sparingly
branched rays, 0.2-0.3 mm.
diam. 108. anatolicum (T)

31b Silicules ovate or narrowly
elliptic, only slightly longer
than broad, slightly S-shaped
or transversely and narrowly
elliptic in cross section at
base; cauline leaves obovate
to oblanceolate and acute or
spathulate-orbicular and obtuse,
5-10 x 2-3(-4) mm., or if long,
then always obtuse; long
filament appendages ± narrow,
unilateral, uni-dentate or
minutely /

minutely denticulate, connate for at least ½ its length or more

35a Sepals lanceolate, acute; indumentum on sterile shoots bicolored; fruiting corymbs lax, not congested, silicules evenly distributed on branches for (2-) 3-5 (-8) cm.

36a Styles 0.5-1 mm. long; seeds narrowly winged; petals 2-2.5 (-3) x 0.5-1 mm.; silicules 2-3 (-3.5) mm. long

92. <u>tortuosum</u> (E,O)

36b Styles 1.5-2 mm. long; seeds wingless; petals (3-) 3.5-4 x 1-1.5 mm.; silicules (3-) 3.5-4.5 (-5) mm. long

93. <u>longistylum</u> (E,T,O)

35b Sepals ovate, obtuse; indumentum on sterile shoots concolorous; fruiting corymbs /

corymbs ± compact, silicules conferted at apex of branches for 1-2 (-3) cm.

37a Inflorescence simple or sparingly branched, 1-2 cm. long and wide; leaves broadly spathulate-orbicular, abruptly constricted into petiole, obtuse, 5-8 mm. long; fertile stems 5 cm. or less long, densely foliate; silicules 2.5-3 mm. long 98. _gehamense_ (T,O)

37b Inflorescence compound ± abundantly branched, 3-5 cm. long and wide, or more; leaves oblanceolate to obovate, gradually attenuate into petiole, ± acute, (5-) 8-15 mm. long; fertile stems 5-15 (-20) cm. long, ± sparsely leafy; silicules (2-) 3.5-4 (-6) mm. long

38a Silicules ovate or narrowly obovate, 2-3.5 (-4) /

(-4) x 2-3 (-3.5) mm.;
styles 0.5-1 (-1.5) mm. long;
petals 1.5-2.5 (-3) x 0.5-1
mm., truncate

39a Valves of silicules slightly and equally inflated; silicules transversely and narrowly elliptic in cross section at base, whitish with dense indumentum of many-rayed stellate hairs

95. inflatum (O)

39b Valves of silicules always unequally inflated; silicules slightly S-shaped in cross section at base, greenish with ± sparse indumentum of few-rayed stellate hairs

96. pateri (T)

38b Siliculeselliptic, (3-) 3.5-5 (-6) x 2.3 mm.; styles 1-1.5 (-2) mm. long; petals 2.5-3.5 (-4) x 1-1.5 mm., rotund, (or if all parts smaller /

smaller, then plant densely conferted - 105. A. condensatum)

40a Styles glabrous; fertile stems rigid, ascending or divergent, unbranched, arising from dense crown, not condensed; apices of long filament appendages usually uni-dentate, 1-1.5 mm. long

94. lanigerum (0)

40b Styles sparsely pubescent at base, at least when young; fertile stems lax, decumbent, often copiously branched, or condensed and dwarf; apices of long filament appendages variously multi-dentate, 0.5-(1) mm. long or less, seldom uni-dentate

105. condensatum (T,0)

(b) Key to Subsect. Compressa

1. Silicules unwinged, margins smooth and entire; pedicels stout, rigid and spreading (series Compressa)

  2. Plants perennial; silicules elliptic or orbicular or rotund, rarely obovate, emarginate, or obtuse or truncate; cauline leaves gradually increasing in size upwards, or if decreasing then plants spinose

    3. Fertile stems arcuate-ascending to erect, occasionally sprawling-decumbent, rarely deflexed or procumbent, sterile shoots arcuate-ascending or erect, always more than 1 cm. long, often ½ or occasionally as long as fertile stems; cauline leaves strongly bicolored; pedicels (2.5–) 3–8 (–10) mm. long

      4. Fertile stems (1–) 4–10 (–15) in number, (10–) 30–50 (60) cm. long; cauline leaves linear, oblanceolate (rarely obovate), gradually attenuate into petiole, ± acute, uppermost not involucrate; seed wings prominent (0.2–) 0.4–0.7 mm. wide 110. murale (E,T,O)

      4. Fertile stems always 3–6 in number, never longer than 10–30 cm.; cauline leaves broadly obovate or orbicular-spathulate, never linear-oblanceolate, abruptly constricted into petioles, ± obtuse, uppermost always conspicuously involucrate; seed wings inconspicuous, 0.1–(–0.2) mm. wide

        5. Silicules obtuse or truncate, always flat, greenish with /

with sparse few-rayed stellate hairs; styles 0.5-1 mm. long; sepals elliptic, obtuse, 1-1.3 mm. long; petals entire, pubescent, 1.5-2 x 0.5 mm.

111. tenium (E)

5. Silicules deeply emarginate, strongly undulated, silvery-white with dense many-rayed, sublepidote stellate hairs; styles 1.5-2 mm. long; sepals lanceolate, acute, 2-2.5 mm. long; petals emarginate, glabrous, 3-4 x (0.6-) 1-1.5 mm. 113. akamasicum (O)

3. Fertile stems rigid, divaricate and zig-zag, ultimate branches always spinose; sterile shoots conferted on stems, 1-4 mm. long; cauline leaves concolorous; pedicels 1-2 mm. long 112. subspinosum (O)

2. Plants biennial; silicules broadly obovate or obcordate, always deeply emarginate; cauline leaves abruptly decreasing in size upwards 114. cassium (T,O)

1. Silicules winged, margins crenulate; pedicels slender, brittle, ± sigmoid-deflexed (series Crenulata)

6. Silicules always pubescent, veination inconspicuous

7. Petals pubescent; styles pubescent at least at base, 0.7-1 (-1.5) mm. long; sterile shoots decumbent; leaves of sterile shoots obovate or spathulate, silvery, 4.5-5 (-6) mm. wide 116. giosnanum (T)

7. Petals glabrous; styles glabrous, 1.5-2 mm. long; sterile shoots absent, or if present erect or ascending; leaves of /

of sterile shoots oblanceolate, greenish, 2-3 mm. wide

8. Silicules obovate or elliptic, membranous, with narrow crenulate margins (0.1-0.3 mm. wide); stellate hairs on silicules few-rayed, unbranched; plant perennial; 115. <u>cilicicum</u> (T)

8. Silicules orbicular, cartilaginous, with wide crenulate margins (0.5-0.8 mm. wide); stellate hairs on silicules branched, appearing many-rayed; plant biennial; 119. <u>crenulatum</u> (T,O)

6. Silicules glabrous, or very rarely with few stellate hairs, veination always prominent

9. Silicules obovate, truncate or obtuse, 4.5-6 mm. long; petals 3-3.5 x 1-1.5 mm.; cauline leaves increasing in size upwards; leaves of sterile shoots oblanceolate, 5-10 x 1-3 mm., plicate or subplicate; plant 25-35 cm. tall 117. <u>heldreichii</u> (E)

9. Silicules orbicular, retuse, (2.5-) 3-4.5 mm. long; petals 2-2.5 x 0.5-0.8 (-1) mm.; cauline leaves decreasing in size upwards; leaves of sterile shoots obovate or spathulate, 15-20 x 6-8 mm., flat; plant 60-80 cm. tall 118. <u>elatum</u> (T)

(c) Key to Subsect. Samarifera

1. Silicules and ovaries glabrous and smooth, or papillose with sphaeroid crystals

2. Petals with basal denticulate lateral appendages; floral parts with sphaeroid crystals appearing as pellucid dots; ovaries minutely papillose; filaments all unwinged and with basal appendages; leaves involute 125. pinifolium (T)

2. Petals without basal lateral appendages; floral parts without crystal formations; ovaries smooth; long filaments winged and with basal appendages; short filaments with basal appendages; leaves linear-oblanceolate, or obovate to spathulate, flat or plicate, never involute

3. Silicules elliptic, subundulate, veination inconspicuous, reddish-purple when dry: 8-10 x 5-7 mm.; indumentum on leaves appearing strigose, with coarse, long-rayed stellate hairs 121. trapeziforme (T)

3. Silicules ovate or obcordate or obovate or rotund or orbicular, strongly undulate, veination conspicuous, greenish-yellow when dry, (5-) 6-10 (-17) x (3.5-) 4-10 (-16) mm.; indumentum on leaves with slender ± short-rayed, lepidote or sublepidote, appressed stellate hairs

4. Leaves of sterile shoots obovate or spathulate, obtuse or truncate, abruptly constricted into petioles, (1.5-) 3-5 (-10) mm. wide; petals (3-) 3.5-4.5 x (1-) ? 1.5-2 (-2.5) mm.

5. /

5. Cauline leaves increasing in size upwards; leaves of sterile shoots concolorous; silicules obovate or rotund, valves fragile, membranous; short filament appendages (0.1-) 0.2-0.3 mm. wide

   6. Petals glabrous or rarely sparsely pubescent; styles 1-1.5 mm. long; short filament appendages $\frac{1}{4}$-$\frac{1}{2}$ as long as filaments; lower cauline leaves evenly distributed, not congested into a distinct zone 122. peltarioides (T)

   6. Petals densely pubescent; styles 0.5-0.8 (-1) mm. long; short filament appendages as long as filaments; lower cauline leaves congested, forming a distinct zone 123. virgatum (T)

5. Cauline leaves decreasing in size upwards; leaves of sterile shoots strongly bicolored; silicules obcordate or orbicular, valves stiff, cartilaginous; short filament appendages 0.4-0.5 mm. wide 124. caricum (T)

4. Leaves of sterile shoots linear-oblanceolate, acute, gradually attenuate into petioles, (0.5-) 1-2 (-3) mm. wide; petals (1.5-) 2-2.5 x (0.5-) 1-1.5 (-2) mm.

   7. Cauline leaves increasing in size upwards, lowermost congested, forming a distinct zone; fruiting corymbs compact, not widely spreading, branches not more than 5 cm. long 123. virgatum (T)

   7. Cauline leaves decreasing in size upwards, lowermost evenly /

evenly distributed, not congested into a distinct zone; fruiting corymbs widely spreading, branches 5-10 (-15) cm. long

8. Styles 0.5 mm. long; silicules ovate, 5-8 x 4-4.5 mm.; leaves of sterile shoots strongly bicolored; pedicels 2-3 (-3.5) mm. long 120. <u>floribundum</u> (T)

8. Styles (0.5-) 0.8-1 mm. long; silicules broadly obovate to rotund, (7.5-) 12-17 x (9-) 12-16 mm.; leaves of sterile shoots concolorous; pedicels (3.5-) 5-8 mm. long 126. <u>samariferum</u> (T,0)

1. Silicules and ovaries pubescent, never papillose or with sphaeroid crystals

9. Silicules obovate, retuse or subemarginate, subundulate, 5-5.6 x 4-4.5 mm.; styles 1-1.5 mm. long; sepals early deciduous 127. <u>dubertretii</u> (T)

9. Silicules orbicular or transversely elliptic, deeply emarginate, strongly undulate, 7-8.5 mm. long and wide; styles 0.2-0.3 mm. long; sepals ± persistent in fruit 128. <u>lesbiacum</u> (T)

XIII. SYSTEMATICS OF ALYSSUM IN TURKEY AND SOME ALLIED EUROPEAN AND ASIATIC SPECIES

The Turkish taxa are provided with lists of representative specimens. The method of citation of the specimens in convenient grid squares is based on land areas enclosed by 2° of latitude and 2° of longitude. For example, as seen on Map 2 (cf. Appendix) the land mass enclosed between 40° - 42° latitude and 28° - 26° longitude is given the grid epithet of A1. In order that readers may be able to place specimens cited for grid squares A1 and A2 in Turkey-in-Europe or Asiatic Turkey, the letter and number of the grid square is followed by (E) or (A), the former indicating occurrence in Turkey-in-Europe, the latter occurrence in Asiatic Turkey (Anatolia). Turkey-in-Europe is defined from Anatolia by the Straits of Gallipoli (Dardanelles), the Sea of Marmara and the Bosphorus. The letter and number of the grid is followed by the name of the Turkish provinces (Vilâyets), then follows the exact (when possible) place of collection, the altitudinal information (if any), the date, the collector and at the end the collection number. When modern Turkish names can be equated with the older Greek, Roman or German place names, the modern name is put into parenthesis after the former. When a place name cited on an herbarium label or in literature cannot be equated with a modern site, and when there is no indication of the general area of collection, the place name is followed by a question mark (?) in parenthesis. In the specimen citations when more than one specimen is cited for a given grid square, and if the province or locality of collection is the same as the preceding specimen, the abbreviation ibid. is used; if the grid square is identical but the province is different the /

the preceding citation is separated from the next by a semicolon. Unless indicated otherwise, all specimens cited have been examined. Much additional material has, of course, been examined and determined in numerous herbaria, but is not cited in the formal enumeration when it is regarded as unnecessary to the whole distribution pattern and would lead to many superfluous citations from identical localities. The collections made by the author in 1962 are numbered in the sequence of the Davis Anatolian collections, i.e. Dudley D. 25680 was collected by the author, but is numbered as a part of the Davis material.

Type specimens are listed for all the taxa enumerated - as holotypes, syntypes or lectotypes when necessary; however, for the European and Asiatic species allied to the Turkish representatives, the type specimens are the only ones cited. The Linnean species included in this study have all been typified. The herbaria in which the type specimens are to be found are clearly indicated, using the abbreviations listed in Index Herbariorum (part 1, ed. 4:1959). If the original material (either holotypes or syntypes) has not been seen, the herbaria where it is to be found is followed by n.v. (non vidi). The isotypes of the original material are listed for the various herbaria in which they have been seen by the author. In the case of most syntypes it was advantageous, because of taxonomic and typification confusion, to indicate the herbaria where the specimens which the original author examined are to be found. This is especially important in the enumeration of the types of synonyms of Turkish material in Sect. Odontarrhena, because Nyárády very frequently treated duplicate gatherings in different herbaria as different taxa. For example, under A. sibiricum (p.568), the /

the Sintenis gathering (no. 3684) in the Museum of Natural History, Department of Botany, Budapest (not seen) served as the holotype of A. lepidulum subsp. congregatum f. minoristellatum & f. maioristellatum; a duplicate of this collection in the Instutit für Spezielle Botanik und Herbarium Haussknecht, Jena (not seen) served as one of the original syntypes of A. microcarpum. Other duplicates were seen in the Herbaria of WU, W, G-BB, K and BM. Very often (especially in Boissier's species), the data furnished in the original reference as to date and area of collection (even collector) can be supplemented by information from the labels of the original or duplicate material. When this is the case, the added information is put in parenthesis.

A few words are needed regarding synonymy. The important European synonymy is cited, as well as all synonyms based on Turkish material. If the original types of the synonyms or duplicates of these specimens have been seen, the synonym is followed by an explanation mark (!). For example, the first synonym of A. sibiricum (p.568) reads "A. minutiflorum Boiss., Diagn., 1 (1), 73 (1842)!"; thereby indicating that the type material (in this case - as can be seen in the enumeration of specimens - the holotype and two isotypes) has been seen. Synonyms of which the type material has not been seen are only included when there is no doubt whatsoever regarding their equation. These citations are not furnished with an explanation mark. Only rarely are doubtful synonyms listed, but if present they are preceded by a question mark (?).

(1) Sect. MENIOCUS

1. A. linifolium Steph. ex Willd., Sp. Pl., 3, 467 (1800).

Key to varieties

Plant erect, stout-stemmed; stellate hairs ± sparse with long and few rays; fruiting racemes elongated, 3-7 cm. long
linifolium (E,T,O)

Plant reduced, prostrate, slender-stemmed; stellate hairs dense with short and few or many rays; fruiting racemes condensed, 1-3 cm. long
cupreum (T,O)

var. linifolium. Deles., Ic. Sel. Pl., 2, 13, t.42 (1823); Boiss., Fl. Or., 1, 286 (1867); Busch in Fl. Cauc. Crit., 3(4), 607 (1909); Popov, Man. Fl. Tashkent., fas. 1-2, f.222 (1923-1924); Grossh., Fl. Kavk., ed. 2, 4, 220, t.25, f.7 (1950); Fl. Ukr., 5, 345, pl. 80 (1953).

Syn.: Meniocus serpyllifolius Desv., Journ. Bot. Appl., 3, 173 (1813), non Desf.

A. linearifolium Lagasca, Gen. & Sp. Pl., 19 (1816)!

Meniocus linifolius (Steph. ex Willd.) DC., Syst. Nat., 2, 325 (1821)!

A. australiensis Turcz. in Bull. Soc. Nat. Mosc., 27(2), 297 (1854).

Type: (Crimea & Caucasus): Tauria (Crimea) et Armenia, Stephan (B,n.v., iso.G-DC)

Distribution /

<u>Distribution</u>: Widespread in Central, S. & E. Europe, N. Africa, Turkey, Syria, Lebanon, Israel, Iraq, Caucasus, Iran, Afghanistan, Pakistan, India, Siberia and introduced in Australia. Map 3.

TURKEY. A3.: Prov. Ankara, N.W. of Beypazari, - Nallihan, 29 May 1957, <u>Künne</u> 395. A4: Prov. Kastamonu, Sikeker Seker-Köprü (Küre and Kastamonu), 4 May 1892, <u>Sintenis</u> 3773. A5: Prov. Amasya, Amasya, 400-600 m., 14 May 1889, <u>Bornmüller</u> 1340. A6: Prov. Tokat, Tokat, 600-700 m., Apr. 1893, <u>Bornmüller</u> 3244. A7: Prov. <u>Gumusane</u>, Bayburt-Gümüşane, 1700 m., 20 Apr. 1960, <u>Stainton</u> 8222. A9: Prov. Kars, Kağizman-Tuzluca, 16 Apr. 1957, <u>Sauer</u> 269. A/B 8: Prov. Erzurum/Gümüşane, Bayburt-Erzurum, May 1853, <u>Huet</u>. B2: Prov. Uşak, Ouchak (Uşak), 910-940m., 24 May 1857, <u>Balansa</u> 1251 (229 & 369). B3: Prov. Eskisehir, Eskişehir, 2 May 1945, <u>Turkish Sugar Co</u>. 475 & 477; Prov. Afyonkarahisar, distr. Emirdağ, Emirdağ-Bolvadin, 10 km. S. of Emirdağ, 1100 m., 12 May 1956, <u>Huber-Morath</u> 13726. B4: Prov. Ankara, Angora (Ankara), nr. Judyie (?), 385 m., 4 May 1929, <u>Bornmüller</u> 13853; <u>ibid</u>., Ankara, 10 May 1907, <u>Frérés E.C</u>. 244. Prov. Konya, Yavşan Memlehasi nr. Tuz Gölü, 8 Jun. 1952, <u>Davis</u> 18691; Prov. Niğde/Konya, 4 km. past Halkenli Köy, w. side of Tuz Gölü, 1000 m., 17 Jun. 1962, <u>Dudley</u> (D.35928). B5: Prov. Kayseri, plain of Césarée (Kayseri), 1107 m., 25 Jun. 1856, <u>Balansa</u> 990. B6: Prov. Maraş, Elbistan, 1500 m., 7 May 1957, <u>Davis</u> 27642. B7: Prov. Elâziğ, Egin (Kemaliye), Jun. 1853, <u>Huet</u>. B8: Prov. Erzurum, Erzurum. Jun. 1853, <u>Huet</u>. C2: Prov. Antalya, Elmali-Korkuteli, 5 miles from Elmali, 1120 m., 31 May 1962, <u>Dudley</u> (D.35211). C3: Prov. /

Prov. Burdur, Buldar (Burdur), May 1845, _Heldreich_; Prov. Konya, Beyşehir-Konya, 4 km. from Beyşehir, 15 Jun. 1962, _Dudley_ (D. 35840). C4: Prov. Konya, Konya-Sultanhani, 18 miles from Konya, 1050 m., 17 Jun. 1962, _Dudley_ (D. 35918a).

Habitat: Disturbed and ruderal situations, cultivated and fallow fields, vineyards, sandy hills, gravelly plains, calcareous and gypsum outcrops, _Artemisia_, salt and _Astragulus_ steppe; alt. (120-) 350-2000 (-2700) m. Fl. Mar.-Jul.

var. _cupreum_ (Freyn & Sint.) Dudley, _comb_ & _stat. nov._

Syn.: _A. cupreum_ Freyn & Sint. in Bull. Herb. Boiss., ser. 2, _3_, 695 (1903)!

A. teheranicum Bornm. in Bull. Herb. Boiss., ser. 2, _4_, 1269 (1904)!

Meniocus linifolius f. _microcarpus_ Busch, _op. cit._, 610.

Type: (Russia): Regio Transcaspica, Krasnowodsk, 17 Mar. 1900, _Sintenis_ (holo. BRNU n.v., iso. G,G-BB,W,K,BM,E).

Distribution: Sporadically in Turkey, Syria, Iraq, Caucasus, Iran, Afghanistan, and Pakistan. Map 3.

TURKEY. A2(E): Prov. Istanbul, Rumel Hissar, 16 May 1915, _Post_. A4: Prov. Ankara, Ankara, Çubuk, 1000 m., _Markgraff_. B4: Prov. Ankara, Ankara, 7 Apr. 1958, _Kühne_. C4: Prov. Konya, Agios Philippos (Hagios Philibos, nr. Konya), 30 Apr. 1913, _Post_ B. 15. C5: Prov. Niğde/Adana, Ulukişla-Pözanti, 900 m., 2 Apr. 1957, _Davis_ 26300. Asia Minor, _Aucher_ 4100 & 280.

Habitat /

Habitat: Extreme steppe conditions and loose gravel; alt. 400-1300 m. Fl. Feb.-Mar. (-May).

As the type species of Sect. Meniocus this species possesses all the essential characters of this section, and though one of the widest-spread species of the genus, it shows very little variation. It may be easily distinguished from A. meniocoides and A. aureum, with which it has often been confused, by wingless seeds, much shorter styles, and smaller floral parts.

Zohary (1941) claims that A. minimum L. is the correct binomial for this taxon. Examination of the Linnaean Herbarium proves that this is not the case. A. minimum L. can only be treated as a synonym of Lobularia maritima (L.) Desv.; A. minimum sensu Willd. is a synonym of A. desertorum Stapf.

One variation worthy of notice but not of formal rank is the occurrence of narow and often folded leaves resembling those of A. meniocoides, on plants which grow in saline conditions (Davis 18691; Dudley; D. 35928). Immediately outside the salt areas, the leaves assume a normal appearance.

Varietal rank applied to A. cupreum as the differential characters of this taxon are consistent in small but sporadic populations in the south-eastern range of the species. The type gatherings of A. teheranicum (entitled by Bornmüller as A. linifolium subsp. teheranicum) are identical to those of A. cupreum and are consequently regarded as conspecific. Bornmüller allied the name A. linifolium var. metallicum, referring to dense indumentum, to material collected from the same locality as A. teheranicum, but fortunately it was never formally described.

2. A. meniocoides Boiss. in Ann. Sc. Nat., ser. 2, 17, 158 (1842); Boiss., Fl. Or., 1, 286, (1867).

Syn.: Meniocus filifolius Jaub. & Spach, Ill. Pl. Or., 1, 107, t. 53B (1843)!

A. tetraspermum Bertol. in Nov. Comm. Acad. Sc. Inst. Boron., 6, 226 (1844)!

A. kermanshahensis Cowan ex Parsa, Fl. Ir., 1, 733, f. 607 (1951)!

Plant annual, stems slender, 0.5-1 mm. diam., 3-10 cm. long. Leaves (5.5-) 10-18 x 0.5-1.5 (-2.5) mm., ± involute. Fruiting racemes often reduced, 2-5 cm. long. Sepals 1.4-2 (-2.5) mm. long. Petals obovate, entire, (1.5-) 2-3.5 x 0.5-1.5 (-2) mm. Long filaments 1.5-2 mm. long, unilateral wing connate for ½ the length of filaments or more, with free, always bifid apex o.3-0.4 (-0.5) mm. long. Short filaments 1-1.5 mm. long, with always bifid appendages 0.5-1 mm. long. Styles 0.5-1 mm. long. Seeds 1-1.8 x 0.5-1 mm, wings 0.1-0.2 mm. wide. Flowering Feb.-Apr.

Type: (Turkey or Syria): Mesopotamia, Aucher 281 (holo. G-B, iso. G,K,BM,OXF, holo. M. filifolius P n.v.).

Distribution: In the Irano-Turanian and Saharo-Sindian regions of S.E. Turkey, Syria, Lebanon, Israel, Iraq, Iran and Afghanistan. Map 4.

TURKEY. C6: Prov. Gaziantep, Port William (S. of Birecik), Mar. 1836, Chesney 25 (holo. A. tetraspermum TO n.v., iso. G,K); ibid., Yonas on the Euphrates, 25 km. E. of Aintab (Gaziantep), 914 m., Apr. /

Apr. 1908, Haradjian 1770a; ibid., Bal Zuz (Balkis) nr. Birecik, 1200 m., Apr. 1907, Haradjian 1043; ibid., Biredijik (Birecik), Mezra (Mezrea), 26 Mar. 1888, Sintenis 131; Prov. Hatay, Plain of Amurk (nr. Hassa) between Mt. Amanus and Kurt dağ, Apr. 1907, Haradjian 889. C7: Prov. Gaziantep, Rum Kala (Halfeti), 21 May 1888, Sintenis 157. C7/8: Prov. Urfa/Mardin, Djebel Taktak (?), (Urfa-Mardin), Haussknecht. C8: Prov. Mardin, Mardin, Mar. 1894, Post.

Habitat: In dry situations, fallow fields, steppe and limestone slopes; sometimes in association with Quercus aegilops; alt. 130-1200 (-2000) m. Fl. Feb.-Apr.

Differing from A. linifolium by winged seeds, longer styles, larger floral parts, and generally much narrower and frequently folded leaves.

Meniocus filifolius is based on the same material as A. meniocoides, but being described one year later is regarded as a synonym. Duplicates of Chesney 25 which served as the basis of A. tetraspermum when examined at the Kew herbarium and Delessert herbarium in Geneva presented no discontinuities contrasting with the characters of A. meniocoides; likewise, the type material of A. kermanshahensis.

It should be pointed out here that the petals of a couple of specimens (Sintenis 131 & 157) approach those of A. aureum in size. The leaves of these specimens also are atypical and more or less resemble those of A. aureum. However, in collections containing these two species together (Haradjian 1770a = A. meniocoides, 1770b = A. aureum) the diagnostic /

diagnostic characters are quite clear; in addition A. meniocoides has mature fruit while A. aureum is still flowering.

In South - Central Anatolia, Western Syria, Lebanon and Israel the two species occur in the same population with no apparent ecological or altitudinal preference indicated for either. A. aureum, however, replaces A. meniocoides in Central and Eastern Anatolia, while the latter species completely replaces the former to the east.

Since the enumeration of specimens was written, a recent gathering from Afghanistan (Hedge and Wendelbo 3418) has been identified as A. meniocoides.

3. A. aureum (Fenzl) Boiss., Fl. Or., 1, 286 (1867); Zohary in Pal. Journ. Bot., Jer. ser., 2, (2/3), 162 (1941).

Syn.: Meniocus aureus Fenzl, Pug. Pl. Nov. Syr. & Taur. Occid., 1, 13 (1842)!

Meniocus grandiflorus Jaub. & Spach, Ill. Pl. Or., 1, 105, t. 53A (1843), pro parte excl. plantam a Aucher 4100!

A. pleiospermum Fenzl, Ill. & Desc. Pl. Nov. Syr. & Taur. Occid., 54 (1843)!

A. meniocoides Boiss. var. aureum (Fenzl) Zohary, loc. cit.!

Plant annual, stems stout, 1-2 mm. diam., (3-) 5-20 cm. long. Leaves (8.5-) 12-30 x (1-) 2-4 mm., always flat. Fruiting racemes ± elongated, (4-) 6-13 cm. long. Sepals 2-3 mm. long. Petals spathulate, retuse or bilobed, 4-6.5 x 1-2 mm. Long filaments 2-4 mm. long, unilateral wing connate for half the length of filaments or less, with free, lanceolate or bifid apex 0.5-1 mm. long. Short filaments 2-3 mm. long, with lanceolate or bifid appendages 1-1.5 mm. long. Styles 1-1.8 mm. long. Seeds 1.5-2 x 1-1.5 mm., wings 0.2-0.4 mm. wide. Flowering Mar.-Jun.

Type: (Syria): Circa Aleppo, 22 Mar. 1841, Kotschy 27 (holo. W, also holo. A. pleiospermum, iso. G,G-B, K, BM,OXF,E, synt. M. grandiflorus P n.v.).

Distribution: An Irano-Turanian element of E. & S. Turkey, Syria and Israel. Map 4.

TURKEY. B7: Prov. Erzincan, Sdek (?), 20 Apr. 1890, Sintenis 130b; Prov. Elazig, Elâziğ-Kale, on the Euphrates, 22 miles E. of Elazig, 1300 /

1300 m., 4 Jun. 1957, Davis 28938; ibid., Harput, Jun. 1852, Nöe 857; Prov. Malatya, Malatya, 1000-2500 m., 5 Oct. 1932, Ajtaikovach; ibid., Arapkir-Denizli, 28 Apr. 1889, Sintenis 153. C4: Prov. konya, Ayos Philibos (Hagios Philippos), nr. Konya, Apr. 1913, Post B16: ibid., Çumra distr. Küçük köy; 3 May 1962, Helback 2400. C6: Prov. Gaziantep, Yonas, 25 km. E. of Aintab (Gaziantep), 914 m., Apr. 1908, Haradjian 1770b. C7/8: Prov. Urfa/Mardin, Assyria, Djebel et Taktak (?)(Urfa-Mardin) Apr.-Jun. 1867, Haussknecht.

Habitat: In dry, sterile desert-like conditions and marly vineyards; alt. 396-1300 (-2500) m. Fl. Mar.-Jun.

Differs from A. meniocoides with longer styles, larger and retuse or bilobed petals, usually larger fruits, and flat wider leaves.

Meniocus pleiospermum and M. grandiflorus were based on the same type material as M. aureus. The other syntype of M. grandiflorus (Aucher 4100) is identified as A. linifolium var. eupreum.

Zohary considers that the differences between A. aureum and A. meniocoides are very slight, and that it is preferrable to treat the former as a variety of the latter. There has been a considerable amount of misidentification of these taxa attributable to the failure to understand the constancy of the diagnostic characters. Though the distinction in petal size and leaf form occasionally breaks down (cf. A. meniocoides), the longer styles and retuse or bilobed petals remain diagnostic for A. aureum. In view of this, the retention of their identity in zones of overlap, and the different flowering times of the species, it seems more /

more advisable to retain A. aureum at specific rank. It is suggested that the reason why only a few specimens of A. aureum appeared in all the material from Israel examined by Zohary, is that A. aureum, in fact, is a much rarer plant in that particular area than A. meniocoides.

4. A. huetii Boiss., Fl. Or., 1, 287 (1867). Fig. 1A,b; fig. 1B, i,s: fig. 2,a.

Syn.: Meniocus hirsutus Boiss. & Huet, Diagn., 3 (5), 32 (1856)!

Lectotype: (Turkey, B8: Prov. Erzurum); in neglectis circa Erzeroum 1829 m., Jun, 4 Jul. 1853, Huet (1240) (orig. G-B, iso. G,K,BM,OXF).

Distribution: Endemic of the steppe areas in W. & Central Turkey and extending into the Armenian Highlands. Map 5.

TURKEY. A3: Prov. Ankara, 10 km. W. of Beypazari, 2 km. W. of Zavije, 1000 m., 26 May 1957, Kühne 202. A8: Prov. Erzurum, Tortum, 1853, Calvert 1240. A/B4: Prov. Ankara, Ankara, nr. Indize-su(?), 800-900 m., 4 May 1929, Bornmüller 13853. B2: Prov. Uşak, Cuchak (Uşak), 910-940 m., 21 May 1857, Balansa 1252 (230 & 368) (holo. M. hirsutus G-B, iso. G,W,K,BM). B4: Prov. Ankara, Ankara, 7 May 1933, Kotte 1021; ibid., dist. Haymana, 9 km. W. of Haymana, 1080 m., 11 May 1956, Huber-Morath 13723. B5: Prov. Kayseri, Argaei (Erciyas dağ) nr. Tpshamakli (?), 1600-2500 m., 29 May 1859, Kotschy 206. B8: Prov. Erzurum, Erzurum, May 1867, Calvert & Zohrab. C2: Prov. Antalya, Elmali dağ, 11 May 1869, Bourgeau; ibid., Elmali-Korkuteli, 5 km. from Elmali, 1100-1120 m., 31 May 1962, Dudley (D. 35212 & D. 35230).

Habitat: Disturbed situations, cultivated and fallow fields, vineyards and open steppe; alt. 800-2500 m. Fl. May-Jun.

The presence of simple setae (Fig. 1A, b) on the fruit of this species indicates that it belongs to a group of Sect. Meniocus which includes A. stylare, A. heterotrichum and A. blepharocarpum. From A. stylare, its closest ally, this species may be easily separated by its stout shorter styles, considerably smaller floral parts, and sparse, short setae interspersed with granular-appearing papillae on the surface of the fruit valves.

As Marschall-Bieberstein (1808) described A. hirsutum, Boissier and Huet's specific epithet hirsutus (1856) may not be applied to our species in Sect. Meniocus because it would create a later homonym.

It may be due to under-collecting that no specimens of A. huetii have been seen or recorded from the vast area in Eastern-Central Anatolia which intervenes between the two present distribution areas of this species.

5. A. stylare (Boiss. & Bal.) Boiss., Fl. Or. 1, 287 (1867).

Syn.: Meniocus stylaris Boiss. & Bal., Diagn., 3 (6), 16 (1859)!

Type: (Turkey, B5; Prov. Kayseri). Inter segetes ad basen montis Karamasdagh (5 lieues O du Caésarée) quinque leucis ad orientem urbis Caesareae siti, alt. c. 1500 m., Jun., 2 Jul. 1856, Balansa 486 (991) (holo. G-B, iso. G,W,K,OXF).

Distribution: Endemic of E. & Central Turkey, rarely in the Cilician Taurus. Map 5.

TURKEY. A6: Prov. Sivas, Yaghsian-Tchoudak (nr. Kayulhisar), 1600 m., 1858, Tchihatcheff (fide Fenzl in Tchih., Asie Min., Bot. 1 (3), 294: 1860). A7: Prov. Gümüşane, Gümüşane, 21 May 1862, Bourgeau; ibid., Molirva-mesere (nr. Sorda), 31 May 1894, Sintenis 5656. A8: Prov. Gümüşane, dist. Bayburt, Gümüşane - Bayburt, 21 km. from Bayburt, 1620 m., 15 Jul. 1958, Huber-Morath 14802; ibid., Bayburt, 11 Jul. 1862, Bourgeau 171. A/B6: Prov. Sivas/Tokat, Sivas - Tokat, N. side of Artova pass, Çamlibel dağ, 1850 m., 14 Jun. 1939, Reese. B6: Prov. Maraş, dist. Elbistan, Elbistan-Darende, 28 km N.E. of Elbistan, 1300 m., 27 Jun. 1953, Huber-Morath 12821. B7: Prov. Erzincan, Sipikor dağ (nr. Keçiş dağ), nr. Jerbatan, 1 Aug. 1890, Sintenis 3123. C5: Prov. Niğde, Pursuk (Porsuk nr. Ulukisla). 1300 m., 9 Jun. 1898, Siehe 89.

Habitat: Neglected fields, high steppe, and often in association with Quercus-Poterium scrub; alt. 1300-1850 m. Fl. May-Jul.

Of all the members of Sect. Meniocus, this species has the longest styles and the densest indumentum composed of the longest setae (up to 1 mm.) on the fruits. Aside from these characters, the lack of any granular papillae on the fruit surfaces, larger flowers, winged seeds, larger and broader leaves, stricter habit, and longer racemes of A. stylare distinguish it from A. huetii and A. blepharocarpum. Its larger, obtuse and elliptic fruits and deeply bilobed petals also conveniently separate it from A. blepharocarpum which in the eastern part of its disjunct range is sympatric with A. stylare.

An interesting phenomenon is noted with the setae on the fruit. For the most part these setae are simple and swollen (tuberculate) at the base, but occasionally bifurcate or trifurcate hairs are present (Sintenis 5656). This forking of an erect and stiff simple hair, thought to be a primitive type, illustrates a possible line of elaboration which leads to the stellate hair. An analogous situation occurs with A. strigosum, but in this case the furcate hairs have probably been derived from a stellate hair by reduction of some rays and lengthening and strengthening of others.

6. A. heterotrichum Boiss., Diagn., 1 (6), 15 (1845); Boiss., Fl. Or., 1, 287 (1867); Fl. Kazakh., 4, 281, t.35, f.10 (1961).

Syn.: A. bungei Boiss., op. cit., 274!

A. betpakdalense Rubtz. in Bull. Soc. Nat. Mosc., ser. Biol., 52 (2), 87, f.1 (1947).

Type: (Iran): ad muros hortorum prope ruinas Persepolis, 11 Apr. 1842, Kotschy 224 (holo. G-B, iso. G,W,K,BM,OXF,E)

Distribution: Iran and Kazakhstan in Russia. Map 4.

Habitat: In extreme steppic conditions.

The type material of A. bungei in the Boissier Berbarium at Geneva can only be regarded as synonymous with A. heterotrichum, and does not appear to deviate in a single character from the earlier described species. The uniovulate conditions in each locule, recorded by Boissier and necessitating treatment as the only annual within Sect. Odontarrhena, is attributable to faulty observation. The present author examined numerous fruits of the authentic material of A. bungei and consistently found four or five ovules in each locule. It is true, however, that infrequently only one seed developed in each locule, the others for some reason having aborted; but when this is the case the undeveloped ovules are always visible.

The inclusion of A. betpakdalense as a synonym was initiated by a comparison of its type description and figure and the figure in Flora Kazakhstan (1961) with the type collection and description of A. heterotrichum. No diagnostic characters exist enabling recognition of the former species.

A./

A. heterotrichum is the only species in Sect. *Meniocus* having setae on the fruits and an entirely extra-Anatolian distribution. After the species account was written, a collection from Afghanistan (*Hedge* and *Wendelbo*, 3005) provided a new specific record for that country and the most easterly station for this species.

7. <u>A. blepharocarpum</u> Dudley & Huber-Morath, <u>sp. nov.</u> pl. 2, Fig. 4, 1-13. Map 5.

Affinis <u>A. huetii</u> Boiss. sed habitu diverso, fructibus minoribus, stylo longiore, petalis maioribus, glandulis globosis (haud subulatis) differt.

<u>Herba</u> annua, 7-15 (-18) cm. alta et lata, e basi ramosa caulibus tenuibus erectis vel patentibus parce foliatis. <u>Planta</u> ex toto virescens vel cinereo-cana, saepe ad maturitatem rubro-purpurea, indumento pilis stellatis appressis minute punctatis brevibus ramosis 4-6-radiatis ut videtur multi-radiatis 0.2-0.4 mm. diam. vestita. <u>Folia</u> linearia, oblanceolata vel rare subspatulata, obtusa vel acuta, sessilia, vel ad basim sensim attenuata, (3.5-) 8-20 (-25) mm. longa, 0.5-2 mm. lata, summum versus decrescentia; summa subbracteata. <u>Inflorescentia</u> 5-12 (-20) cm. alta et lata, simplex vel corymbosa, ramulis simplicibus ascendentibus 2.5-5 (-8) cm. altis. <u>Pedicelli</u> 3.5-7.5 mm. longi, subhorizontales vel divergentes inter se 4-7 mm. distantes, pilis stellatis minutis appressis paucibus radiis inaequalibus parce vel copiose provisi. <u>Sepala</u> elliptico-ovata vel lanceolata, (1.5-) 2.5-3 (-3.5) mm. longa, 0.8-1 mm. lata, margine hyalina angusta, pilis stellatis appressis parce vel copiose vestita, interdum dorsaliter carinata 1-5 pilis stellatis basi manifeste tuberculatis provisa. <u>Petala</u> in sicco flava vel subflava, obovata, retusa vel subretusa rare integra, in unguem brevem angustum sensim attenuata, glabra vel solum in ungue pilis stellatis provisa, (2.5-) 3-4 (-5.5) mm. longa, 1-2.5 (3-3.5) mm. /

mm. lata. Filamenta longa (1.5-) 2-3.5 mm. longa, bilateraliter alata; ala una quam altera latior, 1-2-3-denticulata, apice libro 0.5 mm. longo. Filamenta brevia 1.5-2.5 mm. longa, appendice ad basim connato acuto vel minute 2-3-denticulato (0.5-) 0.7-1 (-1.5) mm. longo. Antherae auriculatae, apice obtusae vel acutae, 0.5-0.6 mm. longae. Glandulae bene evolutae, globosae, lobatae. Ovulae in placentatione laterali insertae, 2-3 (-4) per loculum. Stylus glaber, rigidus, tenuis, (0.7-) 1-1.5 (-2) mm. longus, stigmate magno provisus. Silicula ovato-orbiculata vel elliptica, obtusa vel truncata, rare acuta vel emarginata, 3.5-4.5 (-5) mm. longa, (2-) 2.3-3.2 (3.8) mm. lata, semper setis tenuibus vel robustis antrorsis basi dilatatis ad marginem provisa, valvis membranaceis manifeste nervosis aequaliter compressis minute muricatulis vel glabris vel setis eis ad margineum similibus copiose provisis. Semina brunnea, in aqua limosa, 1.5-2 mm. longa, 1-1.5 mm. lata, ala (0.1-) 0.2-0.3 mm. lata. Fl. Apr.-Jul., fr. May-Jul.

TURKEY. B4: Prov. Konya, distr. Kadinkan, Sarayönü-Cihanbeyli, Weizenfeldrand, 13 km. nordöstlich Sarayönü, 870 m., 1 Jun. 1956, Huber-Morath 13722 (holo. Hub.-Mor. iso. E). A3: Prov. Ankara, Ankara-Saiyar, Sakaryatal, 139 km. westlich Ankara auf Tertiärboden 26 Apr. 1955, Walter 1359 (Hub.-Mor.); ibid., westlich Beypazari, Yeniköy-Sararya Strasse, Steppe, 500 m., 27 May 1957, Künne 267 & 263a (STU); ibid., Beypazari, Nähe Abzweigung nach Tepeköy, Feld, 1 Jun. 1957, Kühne 496 (STU); ibid., Uytepe, Gipfelgrat, Steppe, 7 Jun. 1957, Kühne 733 & 726 (STU). A8: Prov. Gümüşane, distr. Bayburt /

Bayburt, Gümüşane- Bayburt, Linsenfeld, 21 km. vor Bayburt mit. A. stylare, 1620 m., 15 Jul. 1958, Huber-Morath 16485 (Hub.-Mor.). B4: Prov. Konya, Cihanbeyli, steppe, fl. lutea, 7 Jun. 1952, Davis 18636 (E,K,BM); ibid., Angora (Ankara), Frichès a Kodja-dagh 8 Jul. 1908, à Freres E.C., 458 (G-B.V.D. Post, E, as A. anomalum, & A. aetheocarpum in mss.); ibid., Kavakli Dere, Steppe im Gelände der Deutschen Botschaft, Andesitlehm, 900 m., 30 May 1958, Markgraff (Z, as A. huetii); ibid., Steppen-Probenfläche, 7 May 1958, Markgraff (Z- one sheet as A. linifolium, other sheet pro parte with A. parviflorum); ibid., Bergsteppe, Hussein bei Ankara, 4 Jun. 1932, Kotte 171 (K); ibid., Wegrand am alten Flugplatz von Ankara, 850 m., 11 Jun. 1949, Huber-Morath 9317 (Hub.-Mor.); ibid., distr. Şerefli Koçhisar, versalzte Steppe am Tuz gölü, 114 km. südlich Ankara, 11 km. südlich, Sererköy, 920 m., 26 Jun. 1959, Huber-Morath 16079 (Hub.-Mor.); ibid., Ankara-Gölkarindan, soma yol Lenari, 20 Jun. 1953, Birand & Zohary 2928 (ANK, as A. stylare). B7: Prov. Erzincan, Başköyukten, 6 m. somas Ekim tarlan Lenari, 1020 m., 30 May 1956, Birand 141 (ANK).

Habitat: Disturbed situations, cultivated and neglected fields, Astragalus and salt steppe, gypsum outcrops and tertiary rocks; alt. 500-1620 m. Fl. Apr. Jul.

A. blepharocarpum grows in small scattered populations in Central and Eastern Anatolia and is closely related to A. huetii with which it is broady sympatric. It differs from the latter by consistently being a more delicate and spreading plant, having smaller and often orbicular or ovate fruits with sparser setae (or none) on the valves, longer style, larger petals and globose glands (A. huetii possessing subulate, peg-like glands).

In the eastern part of its range A. blepharocarpum is partially sympatric with A. stylare (Huber-Morath 16485). A stylare has its center of distribution further south in the Cappadocian steppe and may be distinguished from the new species by its longer style, larger and bifid petals, and larger and elliptic fruit with consistently longer and denser setae on the valves.

In Sect. Meniocus, A. huetii, A. blepharocarpum, A. stylare and A. heterotrichum all possess simple stiff setae on the fruit, but A. blepharocarpum is the only species showing a wide range of variation in fruit indumentum. When the specimens were examined individually it appeared that three different combinations of indumentum types were present on the fruit (Fig. 4, 2-5). These indumentum states are: 1) marginal setae 0.2-0.4 mm. long and valve surfaces minutely papillose (Davis 18636); 2) marginal and surface stae 0.4-0.5 mm. long, and papillose or glabrous valve surfaces (Huber-Morath 13722); 3) marginal setae 0.2-0.4 mm. long and glabrous valves surfaces (Huber-Morath 1359b). It was soon evident when the gatherings were compared with one another that the indumentum on the fruit could not be employed to distinguish three distinct taxa. No geographical pattern /

pattern emerged to correlate with the three indumentum states which sometimes occurred not only on different plants from the same population, but also on fruits of the same plant.

This new species was first pointed out to the author by Dr. Huber-Morath in his private herbarium; however, it was first collected near Ankara in 1908 by Frères des E.C. and named twice (!) by Aznavour; as *A. anomalum* Azn. and *A. aetheocarpum* Azn. Unfortunately the Latin and French description which Aznavour attached to the original Frères des E.C. collection was never published, and Dr. Huber-Morath suggested the specific epithet *blepharocarpum* (Greek- *blepharis*, eye-lash) referring to the short setae on the fruit.

(2) SECT. PSILONEMA

8. A. alyssoides (L.) L., Systema, ed. 10, 2, 1130 (1759); Jacq., Ic. Fl. Aust., 4, t.338 (1776); Reich. Ic. Germ. & Helv., 2, t.18, f.4269 (1837-1838); Meyer in Mém. Acad. Sc. Pétersb., ser. 6, 6, (2), p.12 (upper) (1845); Boiss., Fl. Or., 1, 285 (1867); Schinz & Thell. in Bull. Herb. Boiss., ser. 2, 7, 406 (1907); Busch in Fl. Cauc. Crit., 3 (4), 601 (1909); Bornm. in Beih. Bot. Centralb., 38, 479 (1921); Nyár. in Mag. Bot. Lap., 24, t.1,f.24 (1924); Mansfeld in Fedde Rep. Sp. Nov., 46 114 (1939); Hylander in Upps. Univ. Årssk., 7, 182 (1945); Grossh., Fl. Kavk., ed. 2, 4, 220,t.25,f.6 (1950).

Syn.: Clypeola alyssoides L., Sp. Pl., 2, 652 (1753)!
Clypeola campestris L., op. cit., 652 & 1231.
A. calycinum L., Sp. Pl. ed. 2, 2, 908 (1759)!
A. campestre L., op. cit., 909, pro parte!
Psilonema calycinum (L.) Meyer in Bull. Acad. Sc. Pétersb., 7, 132 (1840)!
A. calycinum f. deciduum Busch, op. cit., 602, 605 & 606.
A. calycinum f. siliculosum Busch, op. cit., 603
A. brodense Zap. in Pozpawy Wydz Mat. Prozyr. Akad. Uniejet., 12, 223 (1912).

Type: (Europe): in Austria et Gallia, Clypeola No. 2, sub. "Alysson incanum luteum serpilli folio." (BM-Hort. Clifford).

Distribution: Widespread in W., Central, S. and E. Europe, N. Africa, Afghanistan, India and introduced in N. America. Doubtfully recorded /

recorded from Turkey, Syria, Lower Iraq, North Iran.

TURKISH RECORDS. A2(A): Prov. Bursa, Bithynia Olympo (Ulu dağ), Sestini (fide Fenzl in Tchih., Asie Min., Bot. 1 (3), 313: 1860). A7: Prov. Trabzon, Boz-tepe, 21 Jun. 1917, Schischkin (fide P.H. Davis in LE); Prov. Trabzon/Gümüşane, nr. Vischera, Kalanema Dere, 500 m., Jun. 1908, Blumencron (fide Handel-Mazzetti in Ann. Hofmus. Wien, 23, 156: 1909). B10: Prov. Doğanbayazit, Dutach-Burnubulak, 26 May 1916, Schischkin (fide Schischkin in Ber. Tomsk. Staats-Univ., 80, 465: 1929) & P.H. Davis in LE). C6: Prov. Gaziantep, Killis, 7 Apr. 1893, Post 335 (fide Post in Bull. Herb. Boiss., 3, 163: 1895). Tokat-Erzurum, Aucher (fide Fenzl, loc. cit.).

Habitat: Ruderal and disturbed areas.

Though this species was described before A. dasycarpum, the latter, following Meyer's (1831) circumscription and citation, is the type species of the genus Psilonema - a group later reduced to a section of Alyssum. A. alyssoides is seldom confused with A. dasycarpum due to the dissimilar fruit shape, wingless seeds, longer and basally dilated styles, and hertermorphic fruit indumentum characteristic of the latter. More often A. alyssoides is confused with A. minus (A. campestre mult. auct. and A. parviflorum). The filaments of A. alyssoides are subulate and wingless, edentate and unappendaged. In addition, the always persistent sepals, sparsely dispersed and short-rayed stellate hairs on the fruit, usually smaller fruit, and always glabrous styles of A. alyssoides distinguish it from A. minus.

The /

The valid specific epithet for this taxon was furnished by Linnaeus (1753) under Clypeola No. 2. He transferred it to Alyssum in his Systema Naturae, ed. 10 (1759). In the second edition of Species Plantarum (1763) Linnaeus re-described the same material but called it Alyssum calycinum. Most botanists now accept the binomial A. alyssoides which is typified by a specimen extant in the Clifford Herbarium (BM).

There occurs in Species Plantarum ed. 1 an example of a Linnaean nomenclatural confusion. Clypeola No. 3 (p. 652) is published without a trivial epithet the name campestris being provided in the Errata (p. 1231.). In this work Linnaeus cites Sauvage, Methodus Foliorum Monspeliensis..., 71 (1751) which reads "No. 405 Clyp. annua siliculis bilocularibus dispermis calyce persistente...". That Linnaeus later altered Sauvage's circumscription in the second edition of Species Plantarum to read"...calycibus caducis" is not relevant to the problem of typifying Clypeola campestris or, as it later became, Alyssum campestre in Systema Naturae, ed. 10 (1759). Even though no specimens of Alyssum or Clypeola exist in the Linnaean Herbarium which are marked with an "M" to indicate their origin from Sauvage (cf. Savage, 1945; Stern, Introduction to Species Plantarum, facsimile, 1957), the Sauvage citation must be regarded as the basis of Clypeola campestris. It is also logical to assume that the mention of persistent sepals for Clypeola campestris could only apply to A. alyssoides, rather than to the other taxon generally referred to as Alyssum campestre.

Further evidence is gathered from the citation "Alyss. incanum serpilli folio minus" given by Sauvage as referring to Tournefort, Institutiones /

Institutiones rei herbariae, _1_, 217 (1700). Tournefort in this work refers to the polynomial "_Alysson dictum campestre minus_" in C. Bauhin, _Pinax_, 107 (1623). This Bauhin polynomial is cited by Linnaeus (1753) as a synonym of _Clypeola campestris_ and as a possible synonym of _Clypeola alyssoides_ in _Hortus Cliffortianus_, 329 (1738).

In Nathort's _Flora Monsperliensis_, 21 (1756) - the dissertation edition _not_ that in the _Amoenitates Academiae_, 4 (1759) - Linnaeus refers _Clypeola campestris_ to No. 1137 in Magnol, _Botanicam Monspeliense_, edition of 1688. Linnaeaus's own copy of this work (at the Linnaeus Society, London) is numbered and No. 1137 falls on the entry on page 251 reading "_Thlaspi dictum campestre minus_..." which refers to the same Bauhin polynomial cited by Tournefort. At the same time (1756) Linnaeus established _Clypeola minor_ referring to No. 1138 in Magnol. This specific epithet should be regarded as representing the _Alyssum campestre_ of _Species Plantarum_, ed. 2, _pro parte_ and of _Systema Naturae_, ed. 12, _2_: 1767. (Rothmaler, 1941; Briesthoffer, 1956; Heywood, 1961). See the discussion of _A. minus_.

Professor H. Huber of the Botanical Section of the University of Basel in Switzerland (in a letter) states that though there are no authentic specimens of "_Thlaspi Alysson dictum campestre minus_" in the Bauhin Herbarium, C. Bauhin wrote in Catalogus plantarum circa Basileam... (1622) that it is common in the fields around Basel. As only two species of _Alyssum_ are known from near Basel, the alpine _A. montanum_ and the common weed _A. alyssoides_, it may be inferred that the Bauhin description refers to the latter.

Rather /

Rather than complicate further this nomenclatural confusion, it is preferrable to retain the binomial A. alyssoides (1753) for the species with persistent sepals. Clypeola campestris (1753) is rejected and treated as a synonym of A. alyssoides because of the taxonomic and nomenclatural confusion which surrounds Linnaeus's use of the name A. campestre.

That there should exist approximately 30 taxonomic "splits" from A. alyssoides at species, varieatas or forma rank and almost twice as many recombinations is taxonomically untenable. In such a widespread species a certain number of single character deviations are bound to occur but seldom on the population basis. Type material has been examined of most of the taxa described by Jordan, Sennan, Nyárády, Prodan, etc. It is obvious that differential characters are minute and inconsequential and often not constant on individual plants. Possibly A. calycinum var. pumilum Hal. in Denk. Math.-Naturwiss. Kl. Acad. Wissen. Wien, 61, 496 (Syn.: A. calycinum var. minus Velen. in Sitz. Böhm. Gesell. Wissen., 27, 3: 1902; A. conglobulatum Fil. & Jav. in Mag. Bot. Lap., 9, 146; 1910; A. alyssoides f. pumilum (Hal.) Hayek, Prod. Fl. Pen. Balc., 1: 1925) which forms small sporadic populations in S.E. Europe, might be accepted at infra-specific level. It differs from the typical A. alyssoides in its reduced habit (not more than 3-5 cm. tall), few-fruited condensed racemes, and smaller metallic colored leaves.

It is strange that no specimens of this widespread European and Asiatic species have been seen by the author from Anatolia, though recorded /

recorded several times. Bornmüller (1921) claims that it is very rare in the regions covered by Boissier's Flora Oreientalis. The only Anatolian specimen cited by Boissier was taken from Meyer; the specimen from near Damascus (Gaillardot) should be referred to A. demascenum. It seems safe to assume that A. alyssoides does occur in Turkey, though very rarely. The reliable Handel-Mazzetti record (Blumencron) from Trabzon coincides with a Schischkin gathering from the same area. Hedge collected this species from the first time (No. 3146, 1962) in Afghanistan, and assures the author that the nature of the locality precludes the likelihood of its being an alien.

9. A. damascenum Boiss. & Gaill., Diagn., 3 (6), 18 (1859); Boiss., Fl. Or., 1, 285 (1867); Bouloumoy, Fl. Lib. & Syr., pl. 38, f.2 (1930); Zohary in Pal. Journ. Bot., Jer. ser., 2 (2/3), 161 (1941).

Type: (Syria): in cultis inter Merre et Damascum (Jardin e Ganchedulu), 18 Mar. 1847, Gaillardot 817 (holo. G-B).

Distribution and Habitat: a Saharo-Sindian species of dry hillsides, cultivated and fallow areas from Syria, Jordan and Israel. Fl. Mar.-Apr.

This species, which has never been recorded from Turkey, is sometimes confused with A. minus (A. campestre multo auct. and A. parviflorum) which it resembles in its fruit indumentum and shape. A. damascenum may be quickly distinguished by observing that its filaments are always narrowly winged, edentate and unappendaged; those of A. minus are widely winged, dentate and appendaged. Occasionally specimens of A. contemptum collected in Israel have been confused with A. damscenum, due solely to a very superficial facies resemblance. Upon closer examination, A. contemptum (Sect. Alyssum) has widely winged, toothed and appendaged filaments, elliptic fruits the valves of which are unequally inflated similar to those of A. szowitsianum (Fig. 2, B), very small globose nectaries, and entire or merely emarginate petals. The fruits of A. damascenum are orbicular with equally inflated valves, erect and peg-like nectaries, and deeply bifid petals.

10. A. dasycarpum Steph. ex Willd., Sp. Pl., 3 (1), 469 (1800).

Key to varieties

Inflorescence elongated, many-flowered; plant erect; leaves oblanceolate to obovate .... dasycarpum (E,T,O)

Inflorescence condensed, few-flowered; plant prostrate; leaves broadly spathulate .... minus (O)

var. dasycarpum. Boiss., Fl. Or. 1, 285 (1867); Busch in Fl. Cauc. Crit., 3 (4), 600 (1909); Popov, Man. Fl. Tasch., fas. 1-2, f. 221 (1923-1924); Grossh., Fl. Kavk., ed. 2, 4, 218, t.25,f.5 (1950); Dudley in Notes Roy. Bot. Gd. Edin., 24 (2), 157, f.1B (1962).

Fig. 1B, b, h; fig. 2, c.

Syn.: Psilonema dasycarpa (Steph. ex Willd.) Meyer in Ledeb., Fl. Alt., 3, 150 (1831) & Ledeb., Ic. Pl. Fl. Russ., 3, t.202 (1831)!

A. dasycarpum var. pterospermum Bordz. in Bull. Jardin Bot. Kieff, 7-8, 17 (1928).

A. calycinoides Hausskn. in Bornm., Symb. ad Fl. Anat., 58 (1936), pro syn!

Type: (Russia): in Siberia ad Kamam et Volgam fluvium, Stephan (holo. LE n.v., iso. G-DC, K,BM).

Distribution: Widespread in E. Europe, Caucasus, Turkey, Syria, Jordan, Lebanon, Israel, Iraq, Iran, Transcaspian, Afghanistan, Pakistan and India.

TURKEY. A2(E): Prov. Istanbul, Kalamiche, 7 Jun. 1916, Aznavour.

A4 /

A4: Prov. Çankiri, in valley of Cakmakli-dere, 800-900 m., 4, 5, 6 Jun. 1929, <u>Bornmüller</u> 18860 & 13859. A6: Prov. Tokat, Tokat, <u>Aucher</u> 4096. A7: Prov. Gümüşane Gümüşane at Guans nr. Sobran (Kovans), 4 Jul. 1894, <u>Sintenis</u> 6143. A8: Prov. Erzurum, Horasan, 1600 m., 13 Jun. 1957, <u>Davis</u> 29378. A/B8: Prov. Gümüşane/Erzurum, Bayburt-Erzurum, valley of Kassuklu, 1524-1829 m., May 1853, <u>Huet</u>. B 3/4: Prov. Ankara, Ankara-Polatli, 40 km. from Sakarya, 13 km. S.W. of Polatli, 720 m., 11 May 1956, <u>Huber-Morath</u> 13732. B4: Prov. Ankara, Angoradur Monasteri, Ankara, 10 May 1907, Frérés E.C.; Prov. Konya, Yavsan MEmlehasi, nr. Tuz Gölü, 8 Jun. 1952, <u>Davis</u> 18706, <u>ibid</u>., Prov. Niğde/Konya, Sultanhani-Cihanbeyli, 4 km. from Halkenli, W. side of Tuz Gölü, 1000 m., 17 Jun. 1962, <u>Dudley</u> (D. 35927). B5: Prov. Kayseri, Inceşu-Develi, 3 km. S. of Inceşu, 1050 m., 17 Jun. 1951. <u>Huber-Morath</u> 10984; <u>ibid</u>. Çalasse (Talas), nr. Kayseri, 27 Jun. 1856, <u>Balansa</u> 489; <u>ibid</u>., Erdschias Dagh (Erciyas dağ), Lerca dağ nr. Kononia, 1600 m., May. 1902, <u>Zedebour</u>; Prov. Kayseri/Yozgat, Kayseri-Yozgat, at Koprülü, 1200 m., 23 Jun. 1890, <u>Bornmüller</u> 1936. B6: Prov. Sivas, 4 km. W. of Sivas, 13 Jun. 1939, <u>Reese</u>; B7: Prov. Erzincan, Erzincan near Albuschikchan, 7 May 1890, <u>Sintenis</u> 2176; Prov. Erzurum, Erzurum, <u>Zohrab</u> 375. C2: Prov. Denizli, Tavas-Denizli, 800-900 m., 10 Jun. 1962, <u>Dudley</u> (D. 35560a). C4: Prov. Konya, Konya, 4 Jun. 1937, <u>Reese</u>. C5: Prov. Niğde, Niğde-Ulukişla, S. side of pass, 47 km. to Ulukişla, 1450 m., 10 Jun. 1953, <u>Huber-Morath</u> 12818. C6: Prov. Konya, Konya, 2 Apr. 1913, <u>Post</u> 14 (20).

<u>Habitat</u> /

Habitat: Disturbed and ruderal situations, roadsides, fallow and cultivated fields, vineyards, limestone ridges and screes, salt and Artemisia steppe; alt. (100-) 720-2000 (-2580) m. Fl. Mar.-Jun.

var. minus Dudley, loc. cit., f.1A.

Type: (Iran): inter Ispahan et Hamadan, ad pagum Mohammedi, 1800 m., 17 Mar. 1892, Bornmüller 2174 (holo. E, iso. W,G,K,BM,OXF).

Distribution and Habitat: Sporadic in desert-like conditions, fallow land and stony hillsides in Syria, Iran and Afghanistan. Fl. Mar-Apr.

A. dasycarpum may be distinguished from all other oriental species in Sect. Psilonema by its dimorphic and strigose fruit indumentum, longer and basally dilated styles, and wingless seeds. The sparser and longer hairs of the dimorphic fruit indumentum of the Spanish and North African A. granatense Boiss. & Reut., also in Sect. Psilonema, resemble those of A. hirsutum (Sect. Alyssum) more than those of A. dasycarpum. The fruits of A. granatense are at least twice as large as those of A. dasycarpum. A. strigosum (Sect. Alyssum) is sometimes confused with A. dasycarpum because of its dimorphic indumentum. However, the longer furcate hairs, larger fruits, winged, dentate and appendaged filaments, larger floral parts, winged seeds and widely divergent pedicels are diagnostic for A. strigosum.

No specimens have been seen from anywhere in the range of this species with winged seeds, the character on which the Caucasian var. pterospermum /

pterospermum was based. The light colored, often translucent radicles on immature seeds of A. dasycarpum and many other species of Alyssum could be misinterpreted as a wing formation if the structure was only superficially examined.

11. A. homalocarpum (Fisch. & Meyer) Boiss., Fl. Or., 1, 285 (1867); Burtt in Kew Bull., 283 (1949); Rech. fil. in Ark. För Bot., 5 (1), 169, f.14 (1959).

Syn.: Psilonema homalocarpum Fisch. & Meyer in Ind. Sem. Hort. Petrop., 6, 63 (1839) & Linnaea, 14, Literb., 163 (1840)!
A. horebicum Boiss. in Ann. Sc. Nat., ser. 2, 17, 156 (1842)!
A. musili Velen. in Sitzb. Böhm. Gesell. Wissen., 11, 12 (1911) & in Fedde Rep. Sp. Nov., 13, 25 (1915)!
A. nomismocarpum Rech. fil., Aellen & Esfand. in Phyton, 3, 56 (1951)!

Type: (Egypt): semina in Arabia Petraea (cultivated from seed in the St. Petersburg Botanic Garden), Schimper (holo. LE n.v., iso. G-B,GH,K).

Distribution: Egypt, Arabia, Kiwait, Iraq, Iran, Beluchistan and rarely in Syria, Jordan and Israel.

Habitat: A Saharo-Sindian species of dry silty river beds, limestone and sandy slopes and calcareous cultivated areas. Fl. Feb.-Mar.

This is the only glabrous fruited species in Sect. Psilonema which has early deciduous sepals. There is a considerable variation in the fruit size, the smallest measuring c. 3 x 3 mm., the largest 7 x 7 mm. A. nomismocarpum is said to differ from A. homalocarpum by having longer racemes, fragile stems, larger silicules and shorter pedicels. None of these characters is satisfactory to warrant specific separation when the complete range of morphological variation of A. homalocarpum is /

is reduced to synonomy. Likewise, A. musili (type from PRC) and A. horebicum (type seen at G - Boissier Herbarium) do not possess any morphological discontinuities sufficient to separate them from A. homalocarpum.

Rechinger draws attention to the tendency of the leaves in this species to have minute teeth, a feature which is not known to occur in any other known Alyssum, although it is a common characteristic of Aurinia saxatilis (Alyssum saxatile). At the same time, he comments that the papillose fruit margin is also unique in Alyssum. In fact, though this condition is very rare in the genus, it is found in at least one other species, A. euboeum. The papillose fruit margins of these species are similar to those of Aurinia rupestris (Alyssum rupestre, Ptilotrichum scardicum and P. cyclocarpum).

(3) SECT. ALYSSUM

12. _A. desertorum_ Stapf in Denks. Math.-Naturw. Kaiser. Akad. Wissen., _51_, 302 (1886).

Key to varieties

1. Silicules glabrous
   2. Plant erect or decumbent; fruiting racemes elongated, (3-) 4-10 cm. long, many-fruited .... _desertorum_ (E,T,O)
   2. Plant prostrate, reduced; fruiting racemes short, 1-2 cm. long, few-fruited .... _prostratum_ (T,O)
1. Silicules with minute stellate hairs on margin .... _himalaysensis_ (O)

var. _desertorum_. Reich., Ic. Fl. Germ. & Helv., _2_, t. 18, f. 4268 (1837-1838); Meyer in Mém. Acad. Imp. Sc. St. Pétersb., ser. 6, _6_, pl. 2 (upper) (1840); Busch in Fl. Cauc. Crit., _3_ (4), 584 (1909); Nyár. in Mag. Bot. Lap., _24_, t. 1, f. 25 (1925); Grossh., Fl. Kavk., ed. 2, _4_, t. 24, f. 9 (1950); Dudley in Notes Roy. Bot. Gd. Edin., _24_ (2), 158, f. 2B (1962). Fig. 1B, a, x; fig. 2, b.

Syn.: _A. minimum_ Willd., Sp. Pl. _3_ (1), 464 (1800), _pro parte, non L._ (1753)!

Psilonema minimum (Willd.) Schur, Enum. Pl. Transs., 62 (1866).

A. vindobinense Beck, Fl. Nied. Österr., 469 (1893).

A. sartorii Heldr. ex Maire & Peitit., Matér. Etude Fl. Geog. Biol. Or., _4_, 33 (1908).

? _A. desertorum_ f. _sarensis_ Busch, _op. cit._, 588.

A. /

A. minimoides Pau in Trab. Mus. Nat. Cienc. Nat. Madrid, ser. Bot., _14_, 15 (1918)!

A. desertorum var. _persicum_ Prodan in Cont. Bot. Cluj., _1_ (17), 4 (1930)!

A. desertorum var. _ponticum_ Prodan, _loc. cit_!,

A. desertorum var. _rossicum_ Prodan, _op. cit._, 3!

Lectotype: (Caucasus-Azerbaydzhan): in deserto prope Jelizabethpol, (Kirovabad) 5 Apr. 1882, _Pichler_ (orig. W, iso. K).

Distribution: Widespread in Central, E. and S. Europe, Aegean Islands, Cyprus, Turkey, Caucasus, Syria, Lebanon, Israel, Iraq, Iran, Afghanistan, Beluchistan, and India.

TURKEY. A1(E): Prov. Tekirdağ, Istanbul-Tekirdağ, 5 km. W. of Marmaraerglisi, 0-15 m., 11 May 1962, _Dudley_ (D. 34639). A2(E): Prov. Istanbul, Terkos gölü, E. side, Karaburum-Tahlisiye, 50-60 m., 8 May 1962, _Dudley_ (D. 34546). A2(A): Prov. Bilecik, river Kara nr. Bilecik, 300-400 m., _Bornmüller_ 13850. A3: Prov. Bolu, 3 km. S. Seben, Bakular dağ, 850 m., _Kühne_ 2056b. A4: Prov. Çankiri, Çankiri, 900 m., Jun. 1929, _Bornmüller_ 13858. A5: Prov. Amasya, Amasya, 500 m., 15 Apr., 1889, _Bornmüller_ 1342. A6: Prov. Samsun, Samsun-Amasya, Karadağ, 5 May 1890, _Bornmüller_ 1938. A7: Prov. Gümüşane, 30 km. S.E. of Gümüşane, 1500 m., 15 Jul, 1958. _Huber-Morath_ 14805; _ibid._, Godena (nr. Basben), 8 May 1894, _Sintenis_ 5498. A8/9: Prov. Erzurum, Pasinler-Horasan, nr. Aras river, 1700 m., 12 Jun. 1957, _Davis_ 29456. A9: Prov. Kars, Sarikamiş nr. Kars, 27 Jun. 1914, _Litwinov_. A/B8: Prov. Gümüşane/Erzurum, Bayburt-Erzurum/

Bayburt-Erzurum, nr. Meimouseur, (?) 1829 m., May 1853, Huet. B2: Prov. Kütahya, Kütahya-Tavşanli, 10 km. from Tavşanli, 800-900 m., 23 Jun. 1962, Dudley (D.36113); Prov. Uşak, Uşak, 910 m., 23 May 1857, Balansa 1248. B3: Prov. Eskişehir, dist. Sivrihisar, 2 km. E. of Sivrihisar, 1100 m., 11 May 1956, Huber-Morath 13729. B4: Prov. Ankara, Ankara, 14 Apr. 1958, Merton 3281; Prov. Konya, Cihanbeyli, 7 Jun. 1952, Davis 18631. B6: Prov. Maraş, Mehmet Bey, 10 km. from GöKsün, 1350 m., 5 May 1957, Davis 27594; Prov. Sivas/ Malatya, 31 km. S.E. of Gürüş 1500 m., 15 Jul. 1958, Huber-Morath 14805. C2: Prov. Denizli, Cadmus (Honaz dağ), W. of Cadmus, 1800-2000 m., 3 Jun. 1938, Huber-Morath 5646; Prov. Muğla, Muğla-Kale, 35 miles from Muğla, 900 m. 9 Jun. 1962, Dudley (D.35544b); Prov. Antalya, Elmali-Korkuteli, 5 miles from Elmali, 1120 m., 31 May 1962, Dudley (D. 35213); ibid., Fethiye-Elmali, 150 km. from Fethiye, 20 km. to Elmali, nr. Sutlegen, 1050 m., 30 May 1962, Dudley (D.35208). C3: Prov. Antalya, Korkuteli-Kizilcadağ, 10 miles from Korkuteli, 1400 m., 31 May 1962 Dudley (D. 25265); ibid., Adalia (Antalya), Mt. Sous-Sous (Aladağ) m.8 May 1860, Bourgeau. C4: Prov. Konya, Çumra dist., Kücük köy, 29 Apr. 1960, Helbaek 2362a; ibid, Agios Philippos (Hagios Philibos) nr. Konya, 30 Apr. 1913; Post 282 (13). C5: Prov. Adana, Pozanti, Bürücek, 1300 m., 31 Jun. 1957, Davis 26334. C8: Prov. Mardin, Mardin, Mar. 1867, Haussnecht.

AEGEAN ISLANDS. B1: Lesbos, 400 m., 18-24 May 1934, Rechinger 5889. C1: Samos, 500 m., 18-20 Jun. 1936, Rechinger.

Habitat: Disturbed and ruderal situations, cultivated and fallow fields /

fields, sandy banks and dunes, dried river beds, gravelly banks, salt steppe; often associated with Juniperus, Quercus coccifera and Q. pubescens macchie and Pinus brutia or Pinus nigra woods; alt. sea level-2000 m., Fl. May-Jun.

var. prostratum Dudley, op. cit., 159, f. 2A.

Type: (Iran): ad Teheran in desertis, c. 1200 m., 26 Feb. 1892, Bornmüller 2170 (holo. E, iso. W, G, K, BM, OXF).

Distribution: Sporadic in Turkey, Iraq, Iran and Russian Armenia.

TURKEY. A1(E): Prov. Istanbul, Hatis-Fenerbsgtuhe (Fenerbuhçe - S.E. of Kadiköy on Marmara sea), 25 Apr. 1917, Aznavour. A6: Prov. Tokat, Tokat, 600-700 m., 6 Apr. 1893, Bornmüller 3245. B4: Prov. Ankara, Ankara, 14 Apr. 1958, Merton 3282 pro parte. C2: Prov. Burdur, dist. Yeşilova, Solda Gölü , Yeşilova, 1100 m., 4 Apr. 1956, Davis 25622.

Habitat: Gravelly plains, sand dunes, stony hillsides and steppic situations; alt. 600-2153 m. Fl. Mar.-Apr.

var. himalayensis Dudley, op. cit. 158, f. 3C.

Type: (Tibet): Hugel 1191 (holo. W).

Distribution and habitat: Mountain scree in Tibet, India and Turkestan; alt. 1219-1845 m. Fl. Mar.-Apr.

This species has sometimes been put into the genus or Sect. Psilonema (Schur, 1866; Nyárády, 1925 & 1927), presumably because of its erect, subulate nectaries similar to those of A. dasycarpum and A. alyssoides. However, the long filaments of A. desertorum are always winged and dentate or abruptly constricted towards the apex, and the short filaments always provided with a bifid appendage. These filament characters clearly indicate inclusion in Sect. Alyssum.

A. desertorum has occasionally been misidentified as A. alyssoides, probably due to the similar size and shape of their fruits. A. desertorum may be distinguished, apart from the filament characters, by its deciduous sepals and its glabrous fruit (or rarely sparsely pubescent on the margins- var. himalayensis). Among the annual species in Sect. Alyssum, A. desertorum most closely resembles A. turkestanicum in facies and habit, but the always uniform fruit indumentum, very narrow and deeply emarginate petals, inconspicuous sepal margins and minute reduced nectaries are diagnostic for the latter species.

Willdenow did not appreciate that A. minimum L. does not apply to any species of Alyssum, but rather refers to Lobularia maritima (L.) Desv. (fide Linnaean Herbarium and Stapf, 1886). Though Willdenow refers directly to Linnaeus's A. minimum and cites the same polynomial synonyms, his added description could only apply to a species of Alyssum. Stapf (1886) supplied the binomial A. desertorum to include A. minimum sensu Willd., non Linnaeus. Evidently neither Beck nor Pau knew of Stapf's name when they provided additional nomina nova (A. vindobinense /

(A. vindobinense and A. minimoides, respectively) for the taxon which Willdenow misunderstood as A. minimum. Fragments of the type collection of A. minimoides kindly sent on loan by the Keeper of the Herbarium at the Instituto Botanico Antionio-José Cavanilles, Madrid, Spain are identifiable as A. desertorum; likewise, type material of A. vindobinense which was seen at Vienna (W). Duplicates of the type gatherings of Prodan's varieties have been examined (K,G, and W), and it is concluded that the discontinuities defining these taxa are not significant or consistent when the pattern of variation for the whole species range is considered.

In small but sporadic populations certain characters apparently related to extreme xerophytic habitats are constantly expressed. It is convenient to give the plants in these populations the epithet var. prostratum, to distinguish them from the common, usually erect and more robust, typical variety.

Another variety, var. himalaysensis, appearing only in the eastern-most part of the species' range, differs from the type variety by having a row of minute stellate hairs on the margins of the fruit. This feature morphologically links A. desertorum to A. turkestanicum which has stellate hairs of a similar type uniformly distributed on the fruits.

13. A. turkestanicum Regel & Schmalh., Desc. Pl. Nov. Rar., 6 (1882); Lipsky in Acta Hort. Petrop., 23, 79 (1904); Rech. fil., Symb. Afgh., 4, 31, f.10 as A. afghanicum (1959).

Syn: A. desertorum Stapf var. aralo-caspium Lipsky, op. cit., 80.

A. afghanicum Rech. fil. in Phyton, 3, 55 (1951)!

Lectotype: (Russia): Samarkand, Feb., Fedtschenko (orig. H or LE n.v., iso. K)-chosen by Lipsky, loc. cit.

Distribution and Habitat: High, dry steppe of the Transcaspian in Russia, Iran and Afghanistan; alt. 1600-2743 m. Fl. Jun.

Rechinger correctly allied A. afghanicum to A. desertorum, but apparently did not realize that his taxon had been described earlier as A. turkestanicum. Lipsky realized that the material cited with the description of A. turkestanicum was mixed: one gathering with glabrous fruits, the other with pubescent fruits. The pubescent-fruited collection best fits the type description, and Lipsky correctly concluded that it was the actual basis of A. turkestanicum and that the glabrous fruited specimens clearly represented A. desertorum. The type descriptions and specimens of A. turkestanicum and A. afghanicum (Koelz, holo. W) compare favorably and do not appear to deviate in any characters sufficient to necessitate specific separation. Lipsky also described A. desertorum var. aralocaspicum differing from the typical form by having pubescent fruits. It is strange that he did not compare his variety to A. turkestanicum, for the pubescent fruits could only apply to that species.

14. A. foliosum Bory & Chaub., Exp. Sc. de Morée, 185, t. 23 f. 1 (1832); ibid., Nouv. Fl. Pelop. Cycl., 42, t. 25 f. 1 (1838).

Key to varieties

Silicules 3-4.5 mm. long and wide; fruiting racemes condensed, 1-2 cm. long, 10-fruited or less; upper involucral leaves c. 5 mm. long, rarely longer — foliosum (E,T,O)

Silicules 5-7 mm. long and wide; fruiting racemes elongated 3-4 cm., always more than 10-fruited; upper involucral leaves 10-20 mm. long — megalocarpum (E,T)

var. foliosum Boiss., Fl. Or., 1, 282 (1867).: Hal., Consp. Fl. Gr., 1, 97 (1900); Hayek, Prod. Fl. Pen. Balc., 1, 438 (1925); Rech. fil. Fl. Aegaea, 224 (1943).

Syn.: A. aucheri Boiss. in Ann. Sc. Nat., ser. 2, 17, 156 (1842)!
A. subtumidum Boiss. & Heldr. ex Nyman, Consp. Fl. Europ., 1, 56 (1878)!

Type: (Greece): in rupestribus Graecia, Messenia, P. Phigalée, Bory (P,n.v.)

Distribution: Greece, Crete, Cyprus, Aegean Islands, and the Mediterranean coast of Anatolia. Map 6.

TURKEY. B1: Prov. Izmir, Koukouloudja (?), nr. Izmir, 3 Apr. 1854, Balansa 64; ibid., Izmir, Mt. Tenhtalii Dagh, 240-270 m., 26 Jan. 1906, Bornmüller 9082. C3: Prov. Antalya, Tchandeer (N. side of Çalbali dağ), Forbes 113. Asia Minor, Aucher 256 (holo. A. aucheri G-B, iso. G,K). Pamphylia, 1846, Pestalozza.

AEGEAN /

AEGEAN ISLANDS, C1: Samos, Mt. Kerkis, 1219 m., 2 May 1940, Davis 1662K; ibid., 700 m., 10 Apr. 1934, Rechinger 3877c; Kalymnos, Mt. Hagh Hias, 12 Apr. 1887, Forsyth-Major 640; Kos, 800 m., 7 Jun. 1935, Rechinger 8048; Ikaria, Peranora Vouno, 650 m., Runemark et. al. 16425; (fide Runemark in Bot. Not., 113, 433: 1960); C1/2: Rhodos, 1200 m., 16 May 1935, Rechinger 7343b; ibid., 10 Jul. 1936, Rechinger 1935.

Habitat: Calcareus scree; often in Pinus brutia woods: alt. 240-1219 m. Fl. (Jan.-) Mar.-May.

var. megalocarpum Hal. in Mag. Bot. Lap., 10, 123 (1912).

Type: (Greece): e M. Malevo Laconiae (prope Hayos Joannis, rare), 2 Apr., 20 May 1850, 1067 m., Orphanides 646 (holo. W-Hal., iso. W, G-BB).

Distribution: Greece, Aegean Islands, and the Mediterranean coast of Anatolia. Map 6.

TURKEY. B1: Prov. Çanakkale, Renkoei (Erenköy), Menderes Dagh nr. Dumbrekköy, 3 Apr., 8 May 1883, Sintenis 223; Prov. Izmir, Yamanlar dağ, 1000 m., 22 May 1962, Dudley (D. 34890). C2: Prov. Muğla, Muğla-Kale, 16 km. from Muğla, 1250., 28 May 1962, Dudley (D. 35088a); ibid., Fethiye-Elmali, 68 miles from Fethiye, 1120 m., 30 May 1962, Dudley (D. 35182a).

AEGEAN ISLANDS: Samothrake, Mt. Phenogari, 1000 m., 18-20 Jun. 1936, Rechinger 9803; Thasos, Mt. Elias, 25 May 1891, Sintenis & Bornmüller 495.

Habitat /

<u>Habitat</u>: Limestone scree, river beds, grassy meadows in the shade of <u>Pinus nigra</u>; often in <u>Phlomis</u> or <u>Quercus</u> scrub and <u>Pinus nigra</u> and <u>Cedrus libani</u> forests; alt. 1000-1250 m. Fl. Apr.-May.

The large globose strongly inflated fruits with very narrow flattened margins, and the occurrence of involucral leaves distinguish this species from <u>A. desertorum</u> and all the other glabrous-fruited annuals in Sect. <u>Alyssum</u>.

The fruits of <u>A. aucheri</u> are slightly larger than those on the type material of the typical variety of <u>A. foliosum</u>; those of <u>A. subtumidum</u> (and some of the material from Cyprus) are slightly smaller. However, in the absence of any other visible difference or geographical correlation, these slight quantitative differences do not merit formal recognition.

The epithet of this species has been applied erroneously to <u>A. minutum</u> occurring in Italy (Fiori & Paoletti, 1899 and Fiori, 1924). Whereas <u>A. foliosum</u> is entirely restricted to Greece, the Aegean Islands and Western Anatolia, <u>A. minutum</u> is a very widespread European and Oriental species which is common in Italy.

Varietal rank is maintained for the infra-specific taxa of <u>A. foliosum</u> because the differential characters, though constant in limited populations, are all quantitative and directly related to one another. The distribution areas of these varieties are partially sympatric; var. <u>foliosum</u> has a wide distribution extending in a southernly /

southernly direction into Crete and Cyprus, and var. megalocarpum has a more northerly distribution pattern, replacing the typical variety in N.E. Greece and N.W. Anatolia.

The turgid type of inflated fruit characteristic of A. foliosum is unique in the genus and resembles closely the inflated fruits of Aurinia corymbosa and Au. petraea. Infrequently some specimens of both varieties of A. foliosum (Sintenis 223 and Davis 1662) have a few minute stellate hairs on the apex and styles of the immature fruits. These hairs are deciduous, causing the mature fruits to be completely glabrous. A similar occurrence has been observed in an allied taxon, A. fulvescens var. fulvescens.

15. A. minutum Schlect. ex DC., Syst. Nat., 2, 316 (1821); Meyer in Mém. Acad. Sc. Pétersb., ser. 6, 6 (2), t.1 (upper) (1845); Boiss., Fl. Or., 1, 281 (1867); Velen., Fl. Bulg., 41 (1891); Fiori & Paol., Ic. Fl. Ital., 1, 166, f. 1448 as A. foliosum (1899); Busch in Fl. Cauc. Crit., 3 (4), 583 (1910); Vierh. in Verh. Zoo-Bot. Gesell., 64, 258 (1914); Negodi in Nuovo Giorn. Bot. Ital., n.s., 38, 454 (1931); Bornm., Symb. ad Fl. Anat., 56 (1936). Fig. 1B, d, j, w.

Syn.: A. compactum De Not. ex Ces., Ic. Stirp. Ital., fasc. 3, 15, t.5 (1843).

A. psilocarpum Boiss., Voy. Bot. Espagne App. II, 718 (1845)!

A. modestum Boiss. & Bal., Diagn., 5 (6), 17 (1859)!

A. potemkini Akin. & Schmal., Fl. Cent. & S. Russ., 1, 20 (1889).

A. minutum var. condensatum Post, Addenda Fl. Syr., Pal., Sinai, 4 (1892)!

A. ponticum Velen. in Nacht Sitz. Böhm. Gesell. Wissen., 37, 9 (1893)!

A. minutum subsp. moesiacum Velen., loc. cit.!

A. minutum var. moesiacum (Velen.) Velen., Suppl. Fl. Bulg., 1, 27 (1898)!

A. minutum var. ponticum (Velen.) Velen., loc. cit.!

A. calycinum L. f. subcalvum Bola in Mem. Roy. Accad. Sc. Torino, ser. 2, 60, 207 (1909)!

A. foliosum Bory & Chaub. var. compactum (De Not. ex Ces.) Fiori in Bull. Soc. Bot. Fr., 1, 105 (1924)!

A. /

A. argaeum Bornm., loc. cit.!

Type: (Russia?): ad rupes Siberiae? "Schlect. in h. Willd. ex Stev.! obs. ined."; Steven (holo. B, n.v.). Paratype - "v.s.sp. in h. Stev. ex Pallas"; Pallas (H, n.v.). There are fragments collected in 1820 by Steven in G-DC.

Distribution: Widespread in E. and S. Europe, N. Africa, Crete, Aegean Islands, Cyprus, Turkey and Syria.

TURKEY A2(E): Prov. Istanbul, Scoumroukeuy, Domuzdere, 18 Aprl. 1897, Aznavour; A2(A): Prov. Bursa, Bursa-Soğukpinar, 10 km. from Soğukpinar, 500-1000 m., 16 May 1961, Dudley (D.34747); ibid., Mt. Olympo (Keschish dagh- Keşiş dağ - Uludağ of Bithynia, not of Armenia) 1200-1400 m., 22 May 1899, Bornmüller 4116. A3: Prov. Bolu, 5 km. N.E. of Seben, N.E. of Solaklar, 800 m., 10 May 1958, Kühne 2116; A4/5: Prov. Kastamonu, Tosya, nr. Tzulak-Tschesme (Suluk Çeşme), 21 May 1892, Sintenis 5183. B1: Prov. Çanakkale, Thymbra, Fugluh dagh (Dumbrek valley, Troy - Ezine), 23 Mar. 1883, Sintenis 224 pro parte; Prov. Balikesir, Kaz dağ, Beypinar, 1500 m., 20 May 1962, Dudley (D.34841); Prov. Izmir, Pergam (Bergama), Jun. 1833, Montbret. B2: Prov. Uşak/Kütahya, Alma dağ, N. of Ouchak (Uşak), 3 Jun. 1857, Balansa 370 (orig. synt. A. modestum, G-B, iso. G). B4: Prov. Ankara, Hüssern nr. Ankara, 1000 m., 5 May 1933, Kotte 1039. B5: Prov. Kayseri, Mt. Argée (Erciyas dağ), Cekir yaila, 2117 m., 9 Jul. 1856, Balansa 484 (992) (orig. synt. A. modestum, G-B, iso. W,G); ibid., nr. Tschamakli (?), 1600 m., 30 May 1859, Kotschy 260; ibid., 2300 m., 13-16 Jun. 1890, Bornmüller 1939 (holo. A. /

A. argaeum JE, n.v., iso, W, G-BB); Prov. Niğde, Hasan dağ, nr. Taspinar yayla, 2100-2300 m., 16 Jun. 1952, Davis 18940. C2: Prov. Muğla, dist. Fethiye, Elbis dağ, yayla-Elmali, 1 Apr. 1956, Davis 25572. C3: Prov. Antalya, Çalbali dağ, Guzel Çam, 1500 m., 24 Apr. 1958, Markgraf pro parte. C4: Prov. Konya, Agios Philippos (Hagios Philibos nr. Konya), 30 Apr. 1913, Post 281. C6: Prov. Adana, dist. Bahçe, Dildel dağ above Haruniye, 1000 m., 18 Apr. 1956, Davis 26102 pro parte; Prov. Hatay, E. side Hassan Beyli pass, 6-12 Apr. 1893, Post 336 (holo. A. minutum var. condensatum, G-BB, iso. BM, K). Bithynia, 1825, Thirke (orig. synt. A. modestum, G-B)

AEGEAN ISLANDS. B1: Lesbos (fide Candargy in Bull. Soc. Bot. Fr., 45, 110: 1898).

Habitat: Fallow fields, serpentine or limestone scree, sandy slopes and shale ledges, metamorphic rock nr. melting snow; often in Pinus nigra woods and Quercus macchie; alt. 800-2300 m. Fl. Mar.-Jul.

A. minutum is closely allied to the annuals in Sect. Alyssum, i.e. A. smyrnaeum and A. fulvescens with persistent sepals and usually glabrous fruits. The shorter and strongly dilated styles, and the smaller, pale to almost white, emarginate and densely strigose petals distinguish A. minutum from the other species.

The reasons for treating A. compactum as a synonym of A. minutum are stated at great length by Negodi (1931). The view of Busch, who had seen type material of A. potemkini , is followed here. Though the present /

present author has not seen type material of this binomial, its description does not appear to offer any conclusive evidence warranting specific separation. Type gatherings of all the other synonyms have been examined and must be regarded as conspecific with _A. minutum_, especially when the sum total of the variation pattern is considered within the complete species range.

The application of the binomials, _A. calycinum_ (_A. alyssoides_) and _A. foliosum_, to this species can most certainly be attributed to a misunderstanding of the specific limits of the taxa concerned.

The petals of _A. minutum_ are very unusual (Fig. 1B, d). Aside from appearing strigose with a very dense indumentum, the petal limb is 2-3 times narrower than the claw. No other species of _Alyssum_ is known to have this petal type.

16. A. smyrnaeum Meyer in Bull. Acad. Sc. Pétersb., 7, 132 (1840); ibid., in Mém. Acad. Sc. Pétersb., ser. 6, 6 (2), 12, t.1 (lower) (1845); Boiss., Fl. Or., 1, 281 (1867); Vierh. in Verh. Zoo-Bot. Gesell., 64, 259 (1914); Bornm., Symb. ad Fl. Anat., 56 (1936).

Type: (Turkey, B1: Prov. Izmir): in collibus Smyrnae, Mar. 1827, Fleischer (holo. LE, n.v., iso. G-B, W, K, BM, E).

Distribution: Greece, Aegean Islands, Turkey-in-Europe and the Mediterranean coast of Anatolia. There is one record from N. Turkey. Map 8.

TURKEY. A1(E): Prov. Çanakkale, Helles, 23-24 Apr. 1923, Ingoldby 91; ibid., Prov. Edirne, Kavakli Keui (Meriç), Sintenis & Bornmüller. A5: Prov. Amasya, nr. Khausa, 500 m., 2024 Apr. 1889, Bornmüller 1339. B1: Çanakkale, Thymbra, mts. above Keler-Oba (in Dumbrek valley, Troy - Ezine), 27 Mar. 1883, Sintenis 224b pro parte; ibid., Fugluh dagh, 23 Mar. 1883, Sintenis 224 pro parte; ibid., Alexandra Troas (Troy) Apr. 1856, Kirk, pro parte; Prov. Balikesir, Edremit-Kaz dağ, 15 km., Beypinar - Zetunli, 500 m., 20 May 1962, Dudley (D. 34868b); Prov. Izmir, Yamanlar-dağ; 300 m., 22 May 1962, Dudley (D. 34869 & D. 34877a); ibid., Izmir, 17 Apr. 1854, Balansa 67. B2: Prov. Balikesir, Bigadiç, 150 m., 21 Mar. 1956, Davis 25143. C2: Prov. Muğla, Muğla-Kale, 1 km. from Muğla, 720 m., 28 May 1962, Dudley (D. 35055); ibid., 20 km. from Muğla, 1100 m., 28 May 1962, Dudley (D. 35107a).

AEGEAN ISLANDS. B1: Lesbos (fide Cand. in Bull. Soc. Bot. Fr. 45, 116: 1898). C1: Samos, Mt. Ambelos, 1140 m., 10 Apr. 1934, Rechinger 3877b /

3877b.

Habitat: Fallow fields, limestone shale, scree and wet ledges of S. exposure; often in *Pinus brutia* woods and *Quercus* and *Phlomis* macchie; alt. 150-840 m. (-1250) m. Fl. Mar.-Apr.

Differing from *A. fulvescens* by its shorter styles, smaller petals, narrower sepal margins, edentate long filaments, shorter pedicels, generally smaller fruits, few-fruited condensed racemes and shorter stature.

The Greek record (not seen) of this species (Vierhapper, 1914) may well represent *A. minutum*. *A. smyrnaeum* may be easily separated from *A. minutum* by its longer and slender styles, and its larger, glabrous or only sparsely pubescent, bilobed and flavous petals.

17. A. fulvescens Sibth. & Smith, Prod. Fl. Graec., 2, 13 (1813).

Key to varieties

Fruit always glabrous fulvescens (E,T)

Fruit with sparse indumentum of short, few-radiate, minute stellate hairs stellatocarpum (T)

var. fulvescens, Meyer in Mém. Acad. Sc. Pétersb. 6, ser 2 (2) 12, t. 2 (lower) (1845); Boiss. Fl. Or. 1, 280 (1867). Fiori & Paol., Ic. Fl. Ital., 166, f. 1445 (1899); Hal., Consp. Fl. Gr. 1, 97 (1900); Hayek, Prod. Fl. Pen. Balc., 1, 437 (1925); Rech. fil., Fl. Aegeae, 224 (1943). Fig. 3.

Syn.: A. flavescens Bory & Chaub., Exped. Sc. de Morée, 185 (1832) & ibid., Nouv. Fl. Pelep. Cycl., 42 (1838).

A. fulvescens var. eu-fulvescens (Sibth. & Smith) Huber-Morath in Fedde Rep. Sp. Nov., 48, 274 (1940)!

Type: (Levant): in Peleponneso et insula Cypro, Sibthorp (holo. OXF).

Distribution: Southern Greece?, Aegean Islands, Cyprus, and the Mediterranean coast of Anatolia. Map 7.

TURKEY. B1: Prov. Izmir, Mt. Pagus nr. Izmir, 15 Mar. 1866, Balansa 1363; ibid., Yamanlar dağ, 1000 m., 22 May 1962, Dudley (D. 34877b & D.34878); ibid., Izmir, mt. above Bournebet (Bornova), May 1842), Boissier pro parte; ibid., Yamanlar dağ, 900 m., 22 May 1906, Bornmüller 9075 pro parte. C1: Prov. Aydin, Mesogis (Aydin dağ) above Thralles (Aydin), 1842, Boissier; Prov. Muğla, Milaş-Muğla, 25 km. from /

from Milaş, 700 m., 27 May 1962, Davis 35045. C2: Prov. Muğla, Marmaris, 30 m., 24 Mar. 1956, Davis 25284; Prov. Aydin/Muğla, Çine-Yatağan, 400 m., 23 Mar. 1956, Davis 25206.

AEGEAN ISLANDS. B1: Lesbos, 1200 m., 16-23 Jun. 1932, Rechinger 2045b; Chios, 1822, Oliver; ibid., Aucher 273; ibid., Aghios Georgios Sekonis, 350 m., 29 Mar. 1939, Platt 38; ibid., Mt. Aropos, above Vrontendo, 305-914 m., 10-22 Apr. 1856, Orphanides 645. C1: Samos, Mt. Kerkis, 914-1829 m., 1 May 1940, Davis 1670; ibid., Mt. Ambelos, 700 m., 10 Mar. 1934, Rechinger 3941; Kalymnos, 7 Apr. 1887, Forsyth-Major 73

Habitat: Limestone scree, miccashist slopes, open dry sandy hillsides, sand dunes and often in the shade of Pinus brutia; alt. (30-) 400-1200 (-1829) m., Fl. Mar.-May.

var. stellatocarpum Huber-Morath, loc. cit.

Lectotype: (Turkey, B1: Prov. Izmir): Lydien, Çiplak Dagh ob Armudlu im westlichen Tmolus (Boz dağ), 980 m., 22 May 1935, Huber-Morath 2576 (orig. Hub.-Mor.).

Distribution: An endemic race confined to the Mediterranean part of Western Anatolia. Map 7.

TURKEY. B1: Prov. Izmir, Mts. above Bournebet (Bornova), May, Jul. 1842, Boissier pro parte; ibid., Yamanlar dağ, 900 m., 22 May 1906, Bornmüller 9075 pro parte. B2: Prov. Izmir/Manisa, Boz dağ Köy, E. Tmolus, 1300 m., 23 May 1935, Reese & Wall (synt. Hub.-Mor.). Lycia Ugunklu dağl, Luschan.

Habitat: Limestone mountain scree; alt. 900-1300 m. Fl. May.

This species is closely allied to A. smyrnaeum (which was first designated as A. fulvescens) but differs from that species in possessing much longer styles, larger petals, dentate long filaments, usually larger fruits, longer pedicels, wider sepal margins, longer fruiting racemes, and a more robust habit.

Following Articles No. 24 and No. 26 in the International Code of Botanical Nomenclature (1961), the epithet eu-fulvescens must be rejected for the typical variety. A. flavescens by being based directly on the citation of Sibthorp and Smith's A. fulvescens, is probably an orthographic error.

The infra-specific taxon with a very sparse but uniform and persistent fruit indumentum, var. stellatocarpum, has been observed to form very small population units of 5-10 plants which are sometimes collected within the larger populations of the typical variety (e.g. Boissier and Bornmüller 9075 from Yamanlar dağ).

Though this species was originally described from S. Greece and Cyprus, the author has not seen any Greek specimens or records; the species is known definitely to occur on Cyprus. The original collection extent in the Sibthorp Herbarium at Oxford does not furnish any clue to the area of collection.

Occasionally a few minute stellate hairs occur at the apex and on the styles of immature fruits of a few specimens of the typical variety (Davis 25284; Dudley: D. 34878). As in A. foliosum, these hairs are deciduous and the mature fruits are entirely glabrous.

18. <u>A. strictum</u> Willd., Sp. Pl., <u>3</u>, 464 (1800); Boiss., Fl. Or. <u>1</u>, 283 (1867); Busch in Fl. Cauc. Crit., <u>3</u> (4), 590 (1909); Bornm., Symb. ad Fl. Anat., 57 (1936); Zohary in Pal. Journ. Bot., Jer. ser., <u>2</u> (2/3), 161 (1941). Fig. 1B, n.

<u>Syn.</u>: <u>A. densiflorum</u> Desf. in Ann. Mus. Hist. Nat., <u>11</u>, 379, pl. 35 (1808)!

<u>A. confertum</u> Willd. ex Boiss. in Ann. Sc. Nat., ser. 2, <u>17</u>, 155 (1842)!

<u>Type</u>: (Turkey): in Armenia, <u>Tournefort</u> (holo. BM, holo. <u>A. densiflorum</u> P, n.v.).

<u>Distribution</u>: Central, S. and E. Anatolia, Syria, Lebanon, Turkish Kurdistan, N. Iraq, Iran and Caucasus. Map 6.

TURKEY. A7: Prov. Gümüşane, Stadodopi (nr. Elias dağ), 28 Jun. 1894, <u>Sintenis</u> 6064; <u>ibid</u>., Charawak (?), 24 May 1894, <u>Sintenis</u> 5614. B4: Prov. Ankara, nr. Ankara, 800-900 m., 4 May 1929, <u>Bornmüller</u> 13855. B5: Prov. Kayseri, Develi, 22 Jun. 1952, <u>Davis</u> 19176B; <u>ibid</u>., Bakir dağ above Kisge, 1400 m., 28 Jun. 1952, <u>Davis</u> 19284; <u>ibid</u>., Kassanoglu nr. Gorumunse (m. Bakir dağ) 1219 m., 12 May 1859, <u>Kotschy</u> 39; <u>ibid</u>., Erdschias dagh, (Erciyas dağ), Alu dagh, 1600-1900 m., Jun. 1902, <u>Zedebour</u>. B6: Prov. Sivas, Mt. Tschnemli-bel (Çamlibel dağ) 1400-1500 m. 29 May 1 Jun. 1890, <u>Bornmüller</u> 1706 (1934, 1933). B7: Prov. Tunceli, Tunceli to Pülümür, c. 30 miles from Tunceli, 1300 m., 7 Jun. 1957, <u>Davis</u> 29252; Prov. Erzincan, Sipikor dağ, 5 Jul. 1889, <u>Sintenis</u> 1195. B8: Prov. Erzurum, Erzurum-Tercan, 1800 m, Arigir Adin, 1957, <u>Davis</u> C. 2742. C5: Prov. Içel Taurus, Gulek Boghas (Külek boğ) /

bog), 22 Jun. 1855, Balansa 428. C6: Prov. Maraş, Koyunoluk dağ, Maraş- Goksun, 1200 m., 4 May 1957, Davis 27582 pro parte: ibid., nr. Yemis dağ, 600 m., 3 May 1957, Davis 27421; ibid., Ahir dağ above Maraş, nr. Kandil, 2 May 1957, Davis 27474: Prov. Hatay, Ak-Dagh (Amanus Mt. Akma Dagh or Alma dagh), Aucher 262 (holo. A. confertum, G-B, iso. G, K, BM). C7: Prov. Urfa, dist. Siverek, E. of Siverek, 800 m., 19 May 1957, Davis 28290.

Habitat: An Irano-Turanian species of cultivated and fallow fields, steppe, eroded shale slopes, disturbed forest clearings, gravel terraces, on limestone, metamorphic and basaltic substrates; alt. (600-) 1000-2057 m. Fl. Apr.-Jun.

This taxon is closely allied to A. contemptum, A. unbellatum, A. szowitsianum and A. marginatum, all with an ombrochorous and hydrochastic method of seed dispersal (Zohary, 1941 and 1949). A. strictum may be distinguished from all of these species by its long spicate racemes, glabrous petals and dendroid teeth on the long filaments; from A. szowitsianum (with which it has often been confused) by its greenish fruit with a sparser indumentum of few-rayed and divergent stellate hairs (those of A. szowitsianum being whitish with a dense appressed indumentum of many-rayed stellate hairs). The entire petals, larger elliptic fruits and longer styles of A. strictum permit it to be separated easily from A. contemptum. Judging from the notes of the record of A. strictum cited by Zohary (1941), the specimen with shortly toothed /

toothed long filaments, small fruits and whitish flowers probably represents A. contemptum.

A. densiflorum was based on the same Tournefort collection which defines A. strictum. The type collection of A. confertum does not appear to differ from any gatherings of A. strictum except by having smaller fruits. As these smaller fruits are obviously immature, A. confertum must be treated as synonymous with A. strictum.

The range of distribution of A. strictum is entirely contained within the ranges of two of its close allies, A. szowitsianum and A. contemptum.

19. A. contemptum Schott & Ky. in Öst. Bot. Wochbl., 4 (22), 177 (1854); Fenzl in Tchih. Asie Min. Bot. 1 (3), 315 (1860); Rech. fil. in Ark. För Bot., ser. 2, 5 (1), 168 pl. 11 (1959).

Syn.: A. campestre L. var. compactum Turrill in Kew Bull., 297 (1930)!

A. davisii Cowan ex Parsa, Fl. Ir., 1, 749, f. 623 (1951)!

A. minus (L). Rothm. var. compactum (Turrill) Briest in Bull. Soc. Bot. Fr. 103 (2) 154 (1956).

Type: (Turkey, C5: Prov. Içel): in Tauro Ciliciae (from seed cultivated at Vienna), Kotschy (In Tauri Bulgar Dagh, ad enclytas angustus Gullek (Külek bog) Boghas in reg. m. 1158., 1853) (holo. W. iso. G-B, G-BB).

Distribution: S.E. Anatolia and the Cilician Taurus, Russian Armenia, Syria, Lebanon, N. Iraq and N. Iran. Map 9.

TURKEY. A7: Prov. Gümüşane, Gümüşane, 3 Jun. 1862, Bourgeau 167 pro parte. A9: Prov. Kars, Yagmurlu dağ, Karaurgan-Sarikamis, 2200 m., 13 Jun. 1957, Davis 29484. B6: Prov. Kayseri, Seriz-Pinarbasi, Mt. pass at Sopan dağ, 24 km. S. of Pinarbasi, 1720-1750 m., 22 Jun. 1955, Huber-Morath 10986. B7: Prov. Tuncili, Pülümur, 1550 m., 8 Jun. 1957, Davis 29266; Prov. Malatya, 7 km. from Malatya, 1400 m., 9 Jun. 1960, Stainton et. al. 5455; Prov. Malatya/Elâziğ, Arapkir - Denizlu baseki (Denizli, 7 km. N. of Keban), 28 Apr. 1889, Sinten.. 193 pro parte. B9: Prov. Van, Van, 1899-1900, Maunsell. B/C5: Prov. Adana/Kayseri, nr. Feke, Bakir dağ on top of Sencan dere, 2200 m., 30 Jun. 1952, Davis 19412. C5: Prov. Içel, Gusgutathal (nr. /

(nr. Külek), 1400 m., 1895, Siehe 244. C6: Prov. Maraş, Göksun-Külekőy, 1300 m., 4 May 1957, Davis 27570; ibid., Koyunoluk dağ between Maraş - Göksun, 1200 m., 4 May 1957, Davis 27582 pro parte; ibid., Akher dagh (Ahir dağ), 1829-2134 m., Aug. 1908, Haradjian 2334; Prov. Hatay, dist. Belan, Karlik tepe above, Soguk Oluk, 1200 m., 23 Apr. 1957, Davis 27091; Prov. Gaziantep/Syria. Aleppo-Aintab (Gaziantep), May 1865, Haussknecht.

Habitat: Mainly a plant of the Irano-Turanian region, growing in disturbed and ruderal situations, cultivated fields, eroded shale cliffs, chalky hillsides and metamorphic and igneous slopes and scree; alt. (180-) 1158-2200 m. Fl. Apr.-Jun.

Considered by Boissier (1867) as a synonym of A. szowitsianum, A. contemptum though sympatric with the former, is morphologically distinct (Samuelsson in Rechinger, 1959). The fruit indumentum of A. contemptum is composed of stellate hairs with long, few and divergent rays and is very much sparser than that of A. szowitsianum. The fruiting racemes of A. contemptum, though not as long as the spicate ones of A. strictum, are broadly cylindrical in contrast to the usually congested and pyramidal ones of A. szowitsianum. Furthermore, the ovate fruits of A. contemptum are usually smaller and the long filaments are always furnished with bilateral wings which may be dentate or edentate at the apex. The long filaments of A. szowitsianum and of all the other hydrochastic annual species in Sect. Alyssum, excluding A. contemptum, are provided with a unilateral wing usually less than ½ the filament length /

length, or if bilaterally winged, the apex of the wings are "arboreously" dentate as is the case in A. strictum.

The type gatherings of A. campestre var. compactum and A. davisii are from the same general area in Iran and do not differ visibly from any collections of A. contemptum except in their smaller fruits. While the fruits of A. davisii are smaller because immature, the smaller ones of A. campestre var. compactum appear to reflect the depauperate condition of the plants growing in very dry and sterile environments.

20. A. umbellatum Desv., Journ. Bot. App., 3, 173 & 184 (1814); Boiss., Fl. Or., 1, 282 (1867); Rouy, Ill. Pl. Eur. Rar., 2, t. 45 (1895); Busch in Fl. Cauc. Crit., 3 (4), 588 (1909).

Syn.: A. brachystachyum Marsch.-Bieb., Suppl. Fl. Taur. Cauc., 3, 434 (1819)!

A. umbellatum var. corymbulosum Boiss., loc. cit.!

A. xiphocarpum Cand. in Bull. Soc. Bot. Fr., ser. 3, 4, 153 (1897).

A. campestre L. var. subumbellatum Rech. fil., Neu Beitre. zur Fl. Krete, 77 (1943)!

A. minus (L.) Rothm. subsp. subumbellatum (Rech. fil.) Briest. in Bull. Soc. Bot. Fr., 103 (2), 154 (1956)!

Type: (Russia-Crimea): in Tauriae maxime meridionalis glareosis ad torrentium latera (holo. LE n.v., holo. A. brachystacyum, iso. E).

Distribution: Yugoslavia, Greece, Crete, Aegean Islands, Cyprus, Western Anatolia and the Crimea. Map 9.

TURKEY. A2(E): Prov. Istanbul, 17 Apr., 20 May 1904, Aznavour; ibid., nr, Dracos, 7 May 1905, Aznavour 274; ibid., (E), Florya, 1 Apr. 1894, Aznavour 174., ibid., (E), Therapia, Mar. 1866, Schmutt 3369. A2(A): Prov. Izmit, Nicodmedicum (Izmit)- Hirsek, Grisebach (fide Fenzl in Tchih., Asie Min., Bot. 1 (3), 311: 1860). B1: Prov. Çannakkale, Renkoi (Erenköy), Dumbrek valley, 12 Apr. 1883, Sintenis 274; Prov. Balikesir, Edremit-Kaz dağ, 15 km. Beypinar - Zetunli, 500 m., 20 May 1962, Dudley (D. 34868a); Prov. Manisa, between Menemen (?) and Manisa, nr. Deirmendere, 100-200 m., 8 May 1906, Bornmüller /

Bornmüller 9072; Prov. Izmir, gulf of Izmir, 4 Apr., 8 May 1854, Balansa 63 (holo. var. corymbulosum G-B, iso. G, W, K, BM); ibid., Yamanlar dağ, 600 m., 13 May 1906, Bornmüller 9071. B2: Prov. Uşak/Kütahya, Alma dağ, N. of Ouchak (Uşak), 3 (13) Jun. 1857, Balansa 1250 (371). Asia Minor, 1833, Aucher 272/

AEGEAN ISLANDS. B1: Lesbos, 6 May 1877, Post 196; ibid., 940 m., 19 May 1934, Rechinger 5564. C1: Ikaria, 18-24 Apr. 1934, Rechinger 4326.

Habitat: Found along the sea coast, in cultivated fields and on calcareous rocks and scree; alt. sea level-940 m. Fl. Apr.-May.

Among the ombrochorous and hydrochastic species of Alyssum, A. umbellatum has the largest floral parts and the only strongly umbellate racemes which are broader than long. Occasionally this species has been confused with A. szowitsianum (A. pyramidatulum); however, in addition to the characters stated above, the sparser fruit indumentum of stellate hairs with long and divergent rays, and usually longer styles are diagnostic for A. umbellatum. A. umbellatum is completely allopatric from all its allies.

The material used to typify A. umbellatum was also used to define A. brachystachyum, and the latter being published at a later date must be regarded as a synonym. Though the fruits of A. umbellatum var. corymbulosum and A. campestre var. subumbellatum are smaller than the typical fruits of most collections of A. umbellatum, this feature is the only apparent morphological discontinuity and does not appear to be associated /

associated with any geographical pattern. The type material of _A. campestre_ var. _subumbellatum_ does not appear to differ from any of the numerous collections of _A. umbellatum_ from Crete or from any of the Greek and Anatolian gatherings. The collections of Candargy from Lesbos have never been located (Rechinger, 1943). However, as the type description of _A. xiphorcarpum_ fits very closely the material of _A. umbellatum_ collected from Lesbos, there is little doubt that Candargy's name is best treated as a synonym of _A. umbellatum_.

It should be remarked here that the lowermost pedicels are approximately 2 or 3 times longer than the upper ones in all of the hydrochastic species. These basally swollen pedicels are appressed to the rachis of the raceme when in a dry state; the mature fruit overlap and appear imbricated. In the presence of moisture, the pedicels diverge widely bringing the fruits into an almost horizontal position. The rain then washes the loosened valves and mucilaginous seeds to the ground (Zohary, 1941 & 1949).

21. <u>A. szowitsianum</u> Fisch. & Meyer in Ind. Sem. Hort. Petrop., <u>4</u>, 31 (1837); <u>ibid</u>., in Linnaea, <u>12</u>, Literb., 151 (1838); Hohen. in Bull. Soc. Nat. Mosc., <u>6</u>, 373 (1838); Boiss., Fl. Or. <u>1</u>, 283 (1867); Busch in Fl. Cauc. Crit., <u>3</u> (4), 590 (1909); Rech. fil. in Ark. För Bot., ser. 2, <u>5</u>, 168, pl. 3 as <u>A. pyramidatulum</u> (1959); Fl. Kazak., <u>4</u>, 280, t. 35, f. 11 as <u>A. stenostachyum</u> (1961). Fig. 1A, n; fig. 2, g.

<u>Syn.</u>: <u>A. pyramidatulum</u> Bornm. in Beih. Bot. Centralb., <u>38</u> (2), 481 (1921)!

<u>A. pyramidatulum</u> var. <u>druzorum</u> Zohary in Pal. Journ. Bot., Jer. ser., <u>2</u> (2/3, 161 (1941).

<u>A. stenostachyum</u> Botsch. & Vved., Bot. Mat. Herb. Bin. Uzb. Fil AN SSSR, <u>3</u>, 181 (1941).

<u>Syntypes</u>: (Caucasus): Altioribus montibus Talüsch, Meyer (orig. LE n.v., photo. E, iso. G-B); and (Turkey, B10: Prov. Ağri); in monte Araret (Mt. Ararat- Ağri dağ), <u>Hohenacher</u> (orig. LE n.v., iso. K).

<u>Distribution</u>: Widespread in S., Central and E. Anatolia, Caucasus, Syria, Lebanon, Jordan, Israel, N. Iraq, N. and Central Iran, Kazakhastan, Afghanistan and Pakistan. Map 8.

TURKEY. A6: Prov. Sivas, Yaghsian (nr. Koyulhisar), 1858, <u>Tchihatsheff</u> 736 (<u>fide</u> Fenzl in Tchih., Asie Min., Bot. <u>1</u> (3), 314: 1860). A7: Prov. Gümüşane, Stadodopi (nr. Elias dağ), 10 Jul. 1894, <u>Sintenis</u> 7495. A/B6: Prov. Sivas, Çamlibel dağ, 1400-1500 m., 1 Jun. 1890, <u>Bornmüller</u> 1706. B4: Prov. Ankara, Ankara, 14 Apr. 1958, <u>Merton</u> 3288. B5: Prov. /

Prov. Kayseri, nr. Develi, 27 Jun. 1952, Davis 19198A. B6: Prov. Maraş, Mehmet Bey, 10 km. N. of Göksun, 1300 m., 5 May 1957, Davis 27592; Prov. Malatya, Doğanşehir, 1200 m., 10 May 1957, Davis 27701. B7: Prov. Elâzığ, Harput, nr. Seroldbunar (?) 17 May 1889, Sintenis 392; Prov. Malatya/Elâzığ, Arapkir Denislü baseki (Denizli, 7 km. N. of Keban), 28 Apr 1889, Sintenis 193 pro parte. B8: Prov. Erzincan, Erzurum- Erzincan, Tercan, 6 Sept. 1957, Rechinger 15112. B10: Prov. Ağri, nr. Doğubayazit, 2000 m., 4-5 Nov. 1957, Rechinger 14981. C2: Prov. Denizli, Honaz dağ, Huber-Morath; Prov. Antalya, Elmali-Korkuteli, 21 miles from Elmali, 1300 m., 31 May 1962, Dudley (D. 35239a); ibid., Elmali dağ, 8 May 1860, Bourgeau 70. C6: Prov. Hatay, AMasus, Kaş yaylasi, 1600 m., 22 Apr. 1958, Markgraf 11186; Prov. Maraş, Ahir dağ, above Maraş, 1300-1500 m., 2 May 1957, Davis 27379; Prov. Gaziantep, Killis (Kilis), 6 Apr. 1893, Post 335; ibid., Gaziantep on S.W. slopes of Dülük Baba, 1900 m., 11 May 1957, Davis 27822. C7: Prov. Urfa/ Diyarbakir, Süverek nr. Karadjadagh (Karacadağ), 25 May 1888, Sintenis 712. D5/6: Prov. Hatay, Mt. Cassius (Akra dağ), 9 Jun. 1887, Post.

Habitat: An Irano-Turanian element of desert and steppic conditions, volcanic, serpentine, conglomerate and limestone slopes and scree, loamy and sandy river beds, fallow and cultivated fields, marly vineyards; often associated with Juniperus, Poterium and Cedrus; alt. (200) 900-2800 m. Fl. Feb.-Jun.

Differs from A. umbellatum by its pyramidal racemes which are longer than broad, consistently smaller floral parts, and much denser appressed fruit indumentum; from A. marginatum by its larger obtuse or truncate fruits, pubescent and larger styles, wider seed wings and usually longer racemes.

The type collection of A. pyramidatulum (Post; April 12, 1900 from Babeska in Syria) has been examined. The only difference between this taxon and most of the gatherings of A. szowitsianum is the difference in style length; the longest styles of A. pyramidatulum measure up to 1.5 mm. long. Some gatherings of A. szowitsianum collected in Anatolia (Davis 27822; Dudley: D. 35239a) show a considerable variability in style length on individual plants, measuring from 0.4-1.5 mm. long. No significant difference in raceme length or form is noticeable between A. pyramidatulum and A. szowitsianum. This author sees no necessity for maintaining A. pyramidatulum as a distinct species.

For the most part the differences between A. pyramidatulum and A. umbellatum which are cited by Bornmüller and reiterated by Zohary (1941) are identical with those separating A. szowitsianum and A. umbellatum.

It must be pointed out that the long filaments of all the long-styled plants which could be identified as A. pyramidatulum are not bilaterally winged or even occasionally edentate as suggested by Zohary in his emended description of this species. Though not having seen the material which Zohary cited, the form and measurements of the long filaments led this author to suspect that these specimens should be referred /

referred to <u>A. contemptum</u>, and that the material with smaller fruits and shorter styles probably represents depauperate forms of <u>A. szowitsianum</u>.

A comparison of the type description of <u>A. stenostachyum</u> and the description and illustration in Flora Kazakhastan (1961) with material of <u>A. szowitsianum</u> collected from the same general area, and from N. Iran and Caucasus, provides no discernable differences which could be used to maintain <u>A. stenostachyum</u> at specific rank.

22. A. marginatum Steud. ex Boiss. in Ann. Sc. Nat., ser. 2, 17, 157 (1842); Walper, Rep. Bot. Syst., 1, 144 (1842); Boiss., Fl. Or., 1, 282 (1867); Zohary in Pal. Journ. Bot., Jer. ser., 2 (2/3), 161 (1941); Rech. fil. in Ark. För Bot., 5 (1), pl. 12 (1959).

Syn.: A. marginatum Steud., Nomen. Bot., ed. 2, 68 (1841), nomen nudum!

A. cryptopetalum Bunge in Arb. Nat. Ver. Rega, 1, 142 (1847)!

A. marginatum var. cryptopetalum (Bunge) Boiss., op. cit., 283!

Type: (Egypt): in monte Sinai inter saxa et rupes unio iter, 11 Apr. 1835, Schimper 126 (holo. STU n.v., iso. G-B, G, W, K, BM, E).

Distribution and Habitat: Sandy deserts, steppe and low hills in Egypt, Arabia, Syria, Lebanon, Israel, Iraq, Iran, Kazakhastan, Afghanistan, Pakistan and India; alt. 390-2134 m. Fl. Mar.-Jun.

The type description of A. cryptopetalum states that it differs from A. marginatum mainly in having longer racemes, shorter petals, larger fruits and winged seeds (sic - the seeds of A. marginatum are always narrowly winged). The depauperate type material of A. cryptopetamum in the Boissier Herbarium at Geneva and the Natural History Herbarium at Vienna do not show any of these differences, and is easily equated with A. marginatum. Before Zohary realized that A. marginatum was easily distinguished from A. szowitsianum, he applied the name A. szowitsianum var. brevistylum (never described) to specimens of A. marginatum from Syria and Israel.

23. A. rostratum Stev. in Mém. Acad. Pétersb. 3, 295, t.15 f. 1 (1809); Reich., Ic. Fl. Germ. & Helv., 2, pl. 20 f. 4272 (1837-1838); Boiss., Fl. Or. 1, 280 (1867), Pro parte; Busch in Fl. Cauc. Crit., 3 (4), 578 (1909).

Syn.: A. marschallianum Andrz. ex DC., Syst. Nat., 2, 308 (1821)!
A. vernale Stev. in Bull. Soc. Nat. Mosc. 29, 296 (1856), non Kit.

Type: (Russia-Ukraine): in Bessarabia ad agorum versus circa Bender, in rupibus calc. ad Tyram fluvium, Steven (H, n.v.).

Distribution: Yugoslavia, Hungary, Roumania, Bulgaria, Western Russia, Caucasus.

24. A. macropodum Boiss. & Bal., Diagn., 3 (6), 18 (1859); Boiss., Fl. Or., 1, 280 (1867); Huber-Morath in Fedde Rep. Sp. Nov., 48 275 (1940).

Key to varieties

Silicules with homomorphic indumentum of minute stellate hairs; styles with ± sparse indumentum similar to that on silicules on lower ½, often glabrous macropodum (T)

Silicules with heteromorphic indumentum of bifurcate, tuberculate hairs intermixed with minute stellate hairs; styles with dense indumentum similar to that on silicules at least ¾ their length heterotrichum (T)

var. macropodum

Syn.: A. macropodum var. eu-macropodum (Boiss. & Bal.) Hub.-Mor., loc. cit.!

A. macropodum var. eu-macropodum f. genuinum Hub.-Mor., loc. cit.!

A. macropodum var. eu-macropodum f. longistylum Hub.-Mor., loc. cit.!

Type: (Turkey, B5: Prov. Kayseri): in planitie Caesareae in Cappadocia alt. 1100-1107 m., Jun., Jul. 1856, Balansa 987 (986 & 490) (holo. G-B, iso. Hub.-Mor., W, G, K, E).

Distribution: Endemic to the S.W. and Central Anatolia. Map 7.

TURKEY. B5: Prov. Kayseri, Kayseri-Incesu, 27 km. W. of Kayserim, 1040 m., 9 Jun. 1953, Huber-Morath 12820; ibid., 5 km. S. of Incesu, S. of Kayseri /

Kayseri, 10 Jun. 1939, Reese; ibid., Kayseri, 1000-1300 m., 21 May 1890, Bornmüller 1931 (holo. f. genuinum Hub.-Mor., iso. G-B, W,); Prov. Niğde, between Niğde and Taşpinar, foot of Hasan dağ, 15 Jun. 1952, Davis 18871. B6: Prov. Sivas, Gürün Sivas, 5 Km. N. Gürün, 1520 m., 22 Jun. 1953, Huber-Morath 12819. C2: Prov. Antalya, Elmali-Korkuteli, 17 km. from Elmali, 1100 m., 31 May 1962, Dudley (D. 35231); C3: Prov. Antalya, Korkuteli, 18 Apr. 1936, Tengwall 383. C4: Prov. Konya, Ereğli-Karapinar, 22 km. N.W. of Erğli, 870 m., 29 May 1956, Huber-Morath 13730; C5: Prov. Niğde, Mt. above Niğde, 10 Jun. 1937, Reese (holo. f. longistylum, Hub.-Mor.).

Habitat: Disturbed situations, cultivated fields, chalk slopes and rich soil; alt. 870-1120 m. Fl. Apr.-Jun.

var. heterotrichum Huber-Morath, loc. cit.

Lectotype: (Turkey, B/C2: Prov. Afyonkarahisar): Steppe zwischen Dinar und Denizli, c. 35 km. westlich von Dinar, 1 Jun. 1935, Reese & Wall 1805 (orig. Hub.-Mor.).

Distribution: Endemic to S.W. Anatolia. Map 7.

TURKEY. C2: Prov. Burdur, Tefenni-Burdur, 18 km. from Tefenni, 1100 m., 10 Jun. 1938 (orig. synt. Hub.-Mor.). Turkey, Prov. Konya (?), Kalamich (?), 2 Jun. 1916, Post.

Habitat: Neglected fields and steppe; alt. 1100 m. Fl. Jun.

In over-all facies, shape and size of its leaves and fruits and wingless seeds, this species (especially its var. heterotrichum) with dimorphic fruit indumentum, very closely resembles A. dasycarpum in Sect. Psilonema. The diagnostics which separate A. macropodum from A. dasycarpum are its larger deeply emarginate petals which are furnished with denticulate claw margins, winged, dentate and appendaged filaments, longer and often rostrate styles, and longer more widely divergent pedicels. From its closest ally in Sect. Alyssum, A. stapfii, A. macropodum may be distinguished by having smaller elliptic and obtuse or truncate fruits, deciduous sepals, smaller emarginate petals with denticulate claw margins, usually longer styles, and minute stellate hairs on the fruits or, as is the case with A. macropodum var. heterotrichum, dimorphic indumentum.

Since the length of the styles on individual plants of this species varies considerably, from 2.0-3.5 mm., it does not seem feasible that f. longistylum should be granted any formal rank. The presence of two types of hairs on the fruits, styles and pedicels is consistent in local populations occurring in the north-westerly extension of the species. The plants with this characteristic indumentum were described by Huber-Morath as var. heterotrichum. A recent gathering of var. macropodum (Dudley, D.35231) from Pisidia contained one plant on which the fruit and style indumentum tended to be slightly dimorphic. This intermediate state, however, did not prevail on the pedicels.

25. A. minus (L.) Rothm. in Fedde Rep. Sp. Nov., 50, 77 (1941); Turrill in Journ. Bot. Lond., 73, 261 (1935); Maire in Bull. Soc. Hist. Nat. Afr. du Nord., 30, 258 (1939); Zohary in Pal. Journ. Bot., Jer. ser., 2 (2/3), 161 (1941); Rech. fil. in Ark. För Bot. 2 (5), 345 (1953); Briest. in Bull. Soc. Bot. Fr., 103 (2), 153 (1956).

Plant annual, up to 25 cm. tall. Leaves oblanceolate or obovate-spathulate, c. 5 mm. wide. Fruiting racemes strict, up to 15 cm. long, branches when present divergent or ascending, rarely divaricate. Pedicels with ± strigose indumentum. Sepals deciduous. Petals gradually attenuate, emarginate or entire, 2-2.5 (-3.5) x 0.4-0.9 mm. Long filaments narrowly or widely winged, 1-dentate at apex or edentate, 1.5-2 mm. long. Short filaments 1.5-2 mm. long, with connate, bifid or lanceolate appendages ½ the length of filaments. Styles rigid, less than 2 X wider at base than apex, pubescent, 0.7-1.6 mm. long. Silicules ± unequally inflated, with homomorphic indumentum of equally or unequally rayed, large or small stellate hairs. Seed wings (0.2-) 0.3-0.4 mm. wide.

Key to varieties

Styles 0.7-1.3 (-1.5) mm. long, densely pubescent the entire length with appressed, minute short-rayed stellate hairs; rays of stellate hairs on silicules equal, overlapping, 0.3-0.5 mm. long; silicules elliptic-ovate, 3.3-4.2 (-5.5) x 2.8-3.6 (-4.5-5) mm., obtuse or rarely emarginate; pedicels divergent or ascending; long filaments c.1-0.2 mm. wide minus (E,T,O)

Styles /

Styles 1-1.6 mm. long, sparsely pubescent at base with long-divergent-rayed stellate hairs; rays of stellate hairs on silicules unequal, not overlapping, 0.5-0.8 mm. long; silicules orbicular, 4-7.5 mm. long and wide, emarginate; pedicels horizontal; long filaments 0.3-0.4 mm. wide ... micranthum (E,T,O)

var. minus. Deles., Icon. Select. Pl., 2, t. 39 (1824); Sibth. & Smith, Fl. Gr. 7, t. 626 (18-30); Reichenb., Ic. Fl. Germ. & Helv., 2, t. 18, f. 4270b (1837-1838); Nyár. in Mag. Bot. Lap. 24, t. 1, f. 28 (1925).

Syn.: Clypeola minor L. in Nathorst Fl. Monsp., 21 (1756), dissertation.

A. campestre L., Sp. Pl. ed. 2, 2, 909 (1763) pro parte, non 1753!

Moenchia Roth. campestris (L.) Roth., Tent. Fl. Germ., 1, 273 (1788).

A. parviflorum Marsch. - Bieb., Suppl. Fl. Taur. Cauc., 3, 434 (1819)!

A. collinum Brot., Phyto. Lusit., 2, 209, t. 180 (1827).

A. campestre var. hirtum Koch in Flora, 24 (2), 463 (1841).

A. micropetalum Fisch. ex DC. var. procumbens DC. ex Ledeb., Fl. Ross. 1, 139 (1841)!

A. campestre ssp. parviflorum (Marsch-Bieb.) Semal., Fl. Srednee i Yuzhnse Rossie, Krimea, i sver Kavkaza, 1, 88 (1895)!

A. /

A. campestre var. parviflorum (Marsch-Bieb.) Busch in Fl. Cauc. Crit., 3 (4), 593 (1909)!

A. campestre var. sartorianum Heldr. ex Hal. in Mag. Bot. Lap., 11, 123 (1912)!

A. campestre var. ambiguum Azn. in Mag. Bot. Lap., 12, 158 (1913)!

A. minus subsp. procumbens (DC. ex Ledeb.) Briest., op. cit. 154!

A. campestre multo auct. pro max. parte!

Type: Original description and circumscription in Magnol, Botanicum Monspeliense, ed. 2, 251 (1688). "Thlaspi Alysson dictum minus, capsulis majoribus rotundis, non foliatis; Thlaspi montanum luteum I.B. In priori juxta capsulam quatuor adsunt foliola viridia, in isto vero nulla sunt, capsulae etiam multum differunt; in iisdem locis reperitur, & eodem tempore floret. Addit I.B. Thlaspi montanum minimum Monspeliensium folio laciniato, circa Boutonet collectum, quid sit ignoramus."

Distribution: Common widespread weed of W., Central, S. and E. Europe, the Atlantic Islands, N. Africa, Aegean Islands, S. and Central Russia, Caucasus, Turkey, Syria, Lebanon, Israel, Iraq, Iran and Afghanistan. Map 10.

TURKEY. A2(E): Prov. Istanbul, Tchenguelkeuy, 14 May 1896, Aznavour (holo. A. campestre var. ambiguum G-P); ibid., Therapia, 11 Apr. 1887, Aznavour 175; ibid., Kiathane, 30 Apr. 1903, Aznavour; ibid., 3 Apr. 1864, Coumany; ibid., hills S. of Bosporous, Apr. 1906, Post /

Post; ibid., Rumel Hissar, 7 Apr. 1906, Post: A2(A): Prinkipo (Büyük ada), Apr. 1876, Murmann 71; ibid., Prinkipo, Lada (Büyük ada), 1 May 1904, Aznavour 175; Prov. Bursa, Olympo Bithynia (Ulu dağ), 1844, Nöe; ibid., Ulu dağ, 10 km. from hotel, 1000 m., 16 May 1962, Dudley (D. 34716b). A3: Prov. Bolu, 3 km. S. of Seben, Bakirlar 850 m., 9 May 1958, Kühne 2056a. A6: Prov. Tokat, Niksar, 26 Mar. 1957, Sauer 168. B1: Prov. Çanakkale, Thymbra, Renköi (Erenköy), Dumbrek valley, nr. Harrid Tepe, 2 & 4 & 5 May 1883, Sintenis 996 & 996b pro parte. B2: Prov., Bursa-Keles, 20 km. from Keles, 1000 m., 17 May 1962, Dudley (D. 34793); Prov. Afyonkarahisar, Denizli-Burdur, 10 km. before Dinar, 1000-1200 m., 10 Jun. 1962, Dudley (D. 35643). B6: Prov. Kayseri, above Pinarbasi, 1829 m., 18 Jun., 1954, Davis 21933. B8: Prov. Erzincan, Tercan-Aşkale, above Tercan, 1650 m., 8 Jun. 1957, Davis 29350; Prov. Muş/Erzurum, Bingol dağ, valley of Göschlar, 1524 m., 9 Aug. 1859, Kotschy. C2: Prov. Denizli, Honaz Dağ, Tavas, 18 km., W. of Tavas, 1300 m., 4 Jun. 1938, Huber-Morath 5569; Prov. Muğla, Muğla-Kale, 16 km. from Muğla, 1250 m., 28 May 1962, Dudley (D. 35088b); Prov. Muğla/Antalya, Fethiye-Elmali, 120 km. from Fethiye, past Kaşnova, nr. Sütleğen, 1250 m., 30 May 1962, Dudley (D. 35195); Prov. Muğla, Marmaris-Muğla, 20 miles from Marmaris, 9 Jun. 1962, Dudley (D. 35504a); Prov. Burdur, Burdur-Antalya, 5 miles from Bucak, 720 m., 11 Jun. 1962, Dudley (D. 35694b); Prov. Denizli, Cybra (nr. Çameli), Forbes 47. C3: Prov. Antalya, dist. Manavgat, Manavgat-Ferzinuluni, 700 m., 8 Apr. 1956, Davis 25771B; ibid., Çalbali dağ, Güzel Çam, 1500 m., 24 Apr. 1958, Markgraf /

Markgraf pro parte. C4: Prov. Antalya, Amanur-Kaş yaylasi, 1600 m. m, 22 Apr. 1958, Markgraf 1186 pro parte. C5: Prov. Adana, Pozanti, 760 m., 1917, Christian; ibid., Kozan-Feke, 550 m., 12 Apr. 1957, Davis 26593. C6: Prov. Adana, dist. Bahçe, Dumanli dağ, above Haruniye, 1200 m., 19 Apr. 1957, Davis 26833; Prov. Maraş, Maraş, 762 m., 6 May 1934, Balls 981 pro parte. Turkey-in-Europe, 1846, Noë 350;

AEGEAN ISLANDS. B1: Samos, summit Mt. Prophet Elias nr. Vathy, 500 m., 1 Jun. 1934, Rechinger 3562. C1: Phurni, 25-26 Apr. 1934, Rechinger 4628 & 4710. C1/2 Rhodos, Mt. Prophet Elias (Mt. Profeta), nr. Salakos, 600 m., 11 May 1935, Rechinger 7181.

Habitat: Disturbed and ruderal situations, limestone scree and ledges, serpentine and clay out-crops, conglomerate slopes, metamorphic ledges and slopes, grassy meadows, neglected and cultivated fields, vineyards, borders of forests, sand dunes, river banks, steppe; frequently associated with Abies, Pinus brutia, P. nigra, Cedrus, Quercus aegilops and Q. coccifera and Phlomis. alt. (100-) 500-1500 (-2600) m. Fl. Apr.-Jun.

The application of the binomial A. minus (L.) Rothmaler requires some explanation. If the assumption is correct (cf. discussion under A. Alyssoides) that Clypeola campestris, which first appeared in Species Plantarum, ed. 1, 2, 652 & 1231 (1753) and later served as the basionym of Alyssum campestre (Systema Naturae, ed. 10:1759) can be referred to Clypeola alyssoides of Species Plantarum, ed. 1, 2: 1753 (transferred to Alyssum in Systema /

Systema Naturae, ed.10:1759), then the next unambiguous binomial must be found and applied to the plant that has long masqueraded as A. campestre.

Turrill (1935) recognised the confusion implicit in the Linnaean "A. campestre" and claimed that as Linnaeus himself used the name in different senses, and that this initial confusion has been a persistent source of error, "A. campestre" must be rejected as a nomen confusum. Turrill advocated the application of A. parviflorum Marsch-Bieb. (1819). Degen in Fl. Velebit. (1937) rejected A. parviflorum and instead favoured the application of A. collinum Brot. (1827). It is interesting to note that Marschall von Bieberstein (1809) used A. campestre in the sense of A. alyssoides. The view that A. parviflorum is the correct epithet for this species has been followed by a number of authors subsequent to Turrill (see above for important references). However, Turrill and the other workers not only included A. micropetalum despite its obviously dimorphic fruit indumentum - a diagnostic feature of A. strigosum - as a synonym or variety of A. parviflorum; they also made no mention of Linnaeus's Clypeola minor :1756 (Alyssum minus (L.) Rothmaler: 1941).

Rothmaler (1941) in his extensive enumeration of Linnaean taxa in the Dissertations and the Amoenitates Academicae, pointed out that Clypeola campestris on page 21 of Nathorst's Flora Monspeliensis (dissertation edition of 1756) was to be referred to Clypeola alyssoides (1753). What is more important is that Rothmaler recombined the epithet Clypeola minor, occurring on the same page, as Alyssum minus. It is clear from an examination of the protologues that Rothmaler's equation of Clypeola minor (Alyssum minus) with Alyssum campestre in Systema Naturae, ed. 10:1759 (the basionym of which is Clypeola campestris: 1753) is/

is incorrect (cf. Heywood, 1961).

At this point it might be useful to hypothesise that Linnaeus recognised the confusion surrounding his usage of the epithet campestre, and attempted several times to rectify it. In the second edition of Species Plantarum (1763) he altered Sauvage's original diagnosis of Clypeola campestris to read "... calycibus caducis", thereby hoping to exclude Clypeola alyssoides which has persistent sepals. In an attempt to drop the epithet alyssoides entirely from use in the same work, Linnaeus redescribed Clypeola alyssoides (or Alyssum as it had now become) as Alyssum calycinum. Unfortunately, the specimens which Linnaeus (Linnean Society, London) used to describe Alyssum campestre in the second edition of Species Plantarum are mixed; among them is a plant (828:10) of A. alyssoides which is labelled in Linnaeus's handwriting as A. campestre. In the republished version of Nathorst's Flora Monspeliensis in Amoenitates Academicae, 4 (1759) Linnaeus deleted Clypeola minor, which appeared in the Dissertation edition, and substituted Clypeola alyssoides in its place. Though Linnaeus here tried to drop the name Clypeola minor, priority rights must be applied and Rothmaler's combination of this epithet as Alyssum minus is to be accepted as referring to the taxon with deciduous sepals.

In the Dissertation edition of Nathorst's Flora Monspeliensis, 21 (1756), Linnaeus refers Clypeola minor to No.1138 in Magnol, Botanicum Monspeliense, edition of 1688. Because of the discordant elements in the Linnaen Herbarium, none of which can be directly applied as the lectotype of Clypeola minor, Magnol's description or references are accepted as the basis of Clypeola minor (i.e. Alyssum minus). In Linnaeus's /

Linnaeus's numbered copy of Magnol's work (Linnean Society, London), No.1138 falls on page 251 and reads "<u>Thlaspi Alysson dictum minus capsulis majoribus rotundis, non foliatis</u>...". Magnol back-references this citation to two polynomials in J. Bauhin, <u>Historia Plantarum</u>, <u>2</u> (1651). The first of these polynomials, "<u>Thlaspi montanum luteum</u>..." is found on page 928 of Bauhin's work and is accompanied by a figure which can be identified as the taxon commonly referred to as "<u>Alyssum campestre</u>" with deciduous sepals and large fruits. This figure cannot be applied to <u>A. alyssoides</u> which has persistent sepals and smaller fruits.

The establishment of <u>Clypeola minor</u> as the basionym of this species necessitates reducing to synonymy <u>Alyssum parviflorum</u> and <u>A. collinum</u> which at one time or another have been suggested as the correct name for <u>A. minus</u>.

<u>A. campestre sensu lato</u> as used by many authors (e.g. Busch, 1909) has long been an anomaly with regard to its specific limits. Our interpretation of <u>A. minus</u> is in the narrow sense and is applied to the widespread European and Oriental annual weed with <u>homomorphic</u> indumentum (only one type of hair) on the fruits. The taxa (<u>A. strigosum</u>, <u>A. hirsutum</u>, etc.) with <u>dimorphic</u> fruit indumentum of small stellate hairs with appressed or divergent rays in addition to furcate or simple, long and tuberculate hairs, are excluded from <u>A. minus</u> (cf. key). In addition to the homomorphic fruit and style indumentum, the usually smaller, elliptic or ovate, and asymmetrically inflated fruits of <u>A. minus</u> var. <u>minus</u> distinguish it from both subspecies of <u>A. strigosum</u>. Some difficulty may be experienced in distinguishing <u>A. minus</u> var. <u>micranthum</u> from <u>A. strigosum</u> subsp. <u>strigosum</u> because the shape, size and inflation of their fruits are similar, but/

but the dimorphic indumentum of the fruits and pedicel is always diagnostic for A. strigosum subsp. strigosum. Though the pedicel indumentum of A. minus var. micranthum frequently appears strigose, this condition is not due to the presence of two types of hairs, but to the spreading, divergent and unequal rays of the stellate hairs. The glabrous and shorter styles, and the divergent-spreading pedicels of A.strigosum subsp. strigosum are also of value in separating this taxon from A. minus var. micranthum. The same differential characters used to seperate A. strigosum subsp. cedrorum from A. strigosum subsp. strigosum distinguish A. strigosum subsp. cedrorum from both varieties of A. minus. It must, however, be stressed that the most reliable diagnostic of A. strigosum is the occurrence of dimorphic indumentum on its fruit and pedicels. This character is easily observed on immature fruits and ovaries as well as on those which are fully developed.

Though A. minus is extremely polymorphic with respect to habit and fruit size, probably attributed to the diverse environments in which this species grows, the specific limits are no longer as confused as indicated by Rechinger (1953). The exclusion of A. strigosum with its dimorphic indumentum allows A. minus to be conveniently defined in a narrower sense.

The fruits of A. campestre var. ambiguum are larger than those normally expected in A. minus. The type collection of A. campestre var. ambiguum appears to be a shade form with stout and very robust stems, and broadly obovate sparsely pubescent leaves. A shady habitat provided with an abundance of moisture probably accounts for the large fruits.

The minute appressed stellate hairs on the fruits of A. campestre var. hirsutum Koch are consistent with the attributes of A. minus var. minus mimus, and accordingly Koch's variety is regarded as a synonym. The dwarf habit and small fruits of A. campestre var. sartorianum from Kythnos (Cyclades) are not typical of all A. mimus populations occurring on that island. Furthermore, these quantitative characters are found throughout the whole range of the species, especially in dry and sterile environments, so that taxonomic recognition is not warranted.

var. micranthum (Meyer) Dudley, comb. nov.

Syn.: A. micranthum Meyer in Ind. Sem. Petrop., 1, 22 (1835)! Fisch. in Linnaea, 10, Literb. 83 (1836); Hohen. in Bull. Soc. Nat. Mos., 6, 373 (1838)!

A. campestre var. micranthum (Meyer) Boiss., Fl. Or., 1, 284 (1867), pro parte!

A. campestre var. radiatum Busch, Krim. Papers, 4, 125 (1906)!

A. campestre var. emarginatum Andrean. in Ind. Hort. Bot. Univ. Budap., 3, 29 (1938).

A. campestre var. edentulum Andrean., loc. cit.

A. minus subsp. micranthum (Meyer) Briest., op. cit., 154!

Type: (Crimea and Caucasus): in Tauria, in Iberia et in Campis ad Mare Caspium. (Meyer (LE n.v., iso. "Lenkoran" G-B, W).

Distribution: Sporadically in N. Greece, Crete, N.Africa, Crimea, Caucasus, Transcaspian, Turkish and Russian Armenia, N. Turkey, Syria, Lebanon, Israel, Jordan, N. Iraq and N. Iran. Map 10.

TURKEY. A3: Prov. Bolu, 15 km. S.W. of Seben, Kurtdumanitepe, 1000 m., 14 Apr. 1958, Kühne 2234; Prov. Ankara, 15 km. W. of Beypazari, Ukyudağ, 1100 m., 31 May 1957, Kühne 472. A4: Prov. Ankara, Ravli, Cubuk Su, 4 Jun. 1954, Davis 21433; Prov. Kastamonu, nr. Seidler (nr. Küre), 4 Apr. 1892, Sintenis 3184. A7: Prov. Gümüşane, Gümüşane, 1400 m., 18 May 1960, Staint on et al 5054. A/B10: Prov. Kars, Castell. Chorvirab, nr. Aras, 823 m., 25 Mar. 1902, Alexeenko (holo. A. campestre var. radiatum LE n.v., iso. E). B3: Prov. Eskişehir Eskişehir-Kütahya, 3 km. from Eskişehir, 900 m., 22 Jun. 1962, Dudley (D. 36060). B4: Prov. /

Prov. Ankara, Ankara-Sivrihisar, 10 miles from Ankara, 21 Jun. 1962, Dudley (D. 35996b). B8: Prov. Erzurum, Erzurum, nr. Permis (?), Jun. 1853, Huet. B9: Prov. Van, Van, 1899-1900, Maunsell. C4: Prov. Konya, Çumra distr. Küçük köy, 29 Apr. 1962, Helbaek, 2362. The following specimen is intermediate between the varieties: C2: Prov. Denizli, Cadmus, Honaz dağ, 800 m, 4 Jun. 1938, Huber-Morath 5568. A number of intermediates occur in N. Africa, Iran and Lebanon.

Habitat: Waste land, cultivated fields and pastures, steppic hillsides, river valleys, forestry plantations, dry S. facing igneous, limestone and gypsum slopes; alt. (30-) 500-1600 (-2200) m. Fl. (Feb.-) Apr.-Jun.

The major features distinguishing this taxon from the typical expression of A. minus are its larger orbicular fruits, sparsely pubescent and longer styles, and the coarse and sparser stellate hairs with long, unequal divergent rays on the fruits. The long filaments of var. micranthum are more often edentate than those of the typical variety.

The differential characters of the varieties of A. minus are obvious when typical material of each is examined, but in some areas, intermediate specimens are quite numerous, i.e. North Africa, Iraq and Iran. In the light of the occurrence of intermediates, and the fact that var. micranthum occurs sporadically as small populations, recognition at subspecific rank would not be justified.

Type gatherings of A. campestre var. radiatum (E) from the Crimea have been examined, and do not appear to differ in any feature from the original /

original material of A. minus var. micranthum collected from the Crimea and Caucasus.

The erect-rayed stellate hairs on the fruits of A. minus var. micranthum superficially resemble the strigose fruit indumentum of A. strigosum. However, the homomorphic indumentum of A. minus var. micranthum and the dimorphic indumentum of A. strigosum are easily observed and can be used with certainty to distinguish these taxa.

26. A. stapfii Vierh. in Verh. Zoo.-Bot. Gesell., 64, 261, t. 7, f. 1 (1914); Grossh., Fl. Kavk., ed. 2, 4, 218, f. 4 as A. buschianum (1950). Fig. 1A, c; fig. 1B, e.

Syn.: A. campestre L. var. genuinuum Boiss., Fl. Or. 1, 284 (1867), pro parte!

A. stapfii f. persistens Bornm. in Beih. Bot. Centralb., 38 (2), 479 (1921)!

A. buschianum Grossh. in Journ. Soc. Bot. Russe, 14 (3), 307 (1929)!

A. pseudo-calycinum Zohary in Pal. Journ. Bot., Jer. ser., 2, 160, f. 11-15 (1941)!

A. antilibanoticum Rech. fil. in Ark. För Bot., ser. 2, 1 (5), 305, pl. 11 (1950)!

A. minus (L.) Rothm. subsp. stapfii (Vierh.) Briest. in Bull. Soc. Bot. Fr., 103 (2), 154 (1956)!

Plant annual, up to 20 cm. tall. Leaves broadly obovate or spathulate, up to 10 mm. wide. Fruiting racemes widely spreading, up to 10 cm. long, branches divaricate. Pedicels with ± appressed indumentum. Sepals persistent. Petals constricted at middle, bilobed, (2.5-) 3- 5 x 1-2 mm. Long filaments widely winged, 1-3-dentate at apex or edentate, 2.5-3.5 mm. long. Short filaments 2.5-3 mm. long with connate bifid or denticulate appendages ½ the length of filaments. Styles rostrate, at least 2 X wider at base than apex, 1-2 mm. long, sparsely pubescent. Silicules equally inflated, with homomorphic indumentum of ± long, few-rayed stellate hairs /

hairs. Seed wings 0.1-0.2 mm. wide.

Lectotype: Iran unter der ephemeren Vegetation am Fusse des Kuh Bil, 19 May 1885, Stapf (orig. W, iso. K).

Distribution: S.E. and S. Turkey, The Armenian Highlands, Caucasus, Syria, Lebanon, Israel, Iraq, Iran and Afghanistan. Map 12.

TURKEY. A8: Prov. Gümüşane, nr. Bayburt, 20 Jun. 1862, Huet. A9: Prov. Kars, dist. Sarikamiş, nr. monastery Surp Oganes, 18 May 1916, Schischkin. A8/9: Prov. Erzurum, Pasinler-Horasan, 1650 m., 12 Jun. 1957, Davis 29413 pro parte. B5: Prov. Kayseri, Calasse (Talas) nr. Kayseri, 1300 m., 27 Jun. 1857, Balansa 481 (993 pro parte). B8: Prov. Erzurum, Erzurum, Jun. 1853, Huet. B9: Prov. Muş, dist. Malazgirt, 1500 m., 1 Jun. 1916, Schischkin. C6: Prov. Gaziantep, S.W. slopes of Dülük Baba, 900 m., 11 May 1957, Davis 27830; ibid., Aintab (Gaziantep), Apr. 1886, Post. C7: Prov. Urfa, Urfa-Hilvan, 8 km. from Urfa, 100 m., 18 May 1957, Davis 28202. C8: Prov. Diyarbakir, Çinar-Diyarbakir, 700 m., 27 May 1957, Davis 28694.

Habitat: Limestone slopes and screes of S.W. exposure, gravelly hills, calcareous vineyards, in thorn hedges, river banks and dry Astragalus steppe; alt. (100-) 900-2600 (-3048) m. Fl. Mar.-Jun.

This species belongs to the omborochorous complex of species which includes A. minus (previously known as A. campestre). A. stapfii differs from A. minus, with which it has often been confused, by its persistent sepals, lax inflorescence with branches almost as long as the main axis and with widely distant and spreading pedicels, broader obovate to spathulate leaves, styles strongly dilated, basally larger bilobed and deep /

deep yellow petals approximately twice as large as the sepals, and ± symetrically inflated fruits which are furnished with an indumentum of few-rayed, unbranched and appressed stellate hairs (Fig. 1A, c).

Boissier (1867) designated one plant of this species (Boissier from Palestine) as A. campestre var. genuinum; however, the rest of the specimens in his herbarium under this name have dimorphic indumentum on the fruits and are easily identified as A. strigosum. Both Zohary's A. pseudo-calycinum and Rechinger's A. antilibanoticum were allied to A. xanthocarpum (A. macrostylum). On the basis of its homomorphic indumentum, A. stapfii is more closely allied to A. minus, than to any taxon possessing dimorphic indumentum, such as A. xanthocarpum, A. strigosum and A. hirsutum. Type collections and descriptions of A. pseudo-calycinum and A. antilibanoticum when compared with those of A. stapfii and all the additional material available today, do not appear to show any constant differences to justify retention as separate taxa.

The styles of A. antilibanoticum are often somewhat longer than the usual ones of A. stapfii, but as with A. pyramidatulum and A. szowitsianum, this quantitative difference is not significant in all populations or even on all plants. A photograph of the cotype of A. buschianum (E, BM) and additional material labeled by Grossheim as A. buschianum have been seen (BM, GH). Though of dwarf stature, and (in type material) more canescent indumentum, A. buschianum is clearly conspecific with A. stapfii.

Bornmüller's A. stapfii f. persistens from Iran was first identified by him as A. alyssoides, and has slightly smaller fruits than those of most collections of this species in the western part of its range. A number of gatherings, including one of the original gatherings of A. stapfii from Iran /

Iran, differ from the Anatolian, Syrian and Israeli collections of this species only in having slightly smaller fruits and shorter styles.

The extension of this species into Anatolia has never before been acknowledged, though Schischkin specimens labeled as A. buschianum from Eastern Anatolia were seen by P.H. Davis in the Leningrad Herbarium.

27. A. strigosum Banks & Solander in Russell, Natural Hist. Aleppo. 2, 257 (1794): DC. Syst. Nat., 2, 325 (1821); DC., Prod. Syst., Nat. 1, 165 (1824); Eig in Journ. Bot. Lond., 75. 188 (1937); Zohary in Pal. Journ. Bot. Jer. ser., 2, (2/3), 161 (1941).

Plant annual, up to 25 cm. tall. Leaves oblanceolate or obovate-spathulate, c. 5 mm. wide. Fruiting racemes strict, 2-10 (-15) cm. long, branches when present divergent or ascending. Pedicels with strigose indumentum. Sepals deciduous or persistent. Petals gradually attenuate, entire or emarginate or bilobed, 2-3 (-3.5) x 0.4-0.9 (-1.4) mm. Long filaments 1.5-2 (-2.5) mm. long with connate 1-2-dentate appendaged ½-¾ the length of filaments. Styles rigid, less than 2 X wider at base than apex, glabrous or sparsely pubescent, 0.5-1.5 mm. long. Silicules ± equally inflated, with heteromorphic indumentum of coarse or sericeous unequally bifurcate, slightly tuberculate, elevated hairs 0.5-1.5 mm. long and appressed stellate hairs. Seed wings 0.2-0.3 (-0.4) mm. wide.

Key to subspecies

Sepals persistent on immature fruit only; stiff bifurcate hairs on silicules 0.4-0.6 (-1) mm. long; styles 0.5-1 mm. long; petals entire or emarginate, 2.5-3 mm. long; silicules 3-5.5 mm. long and wide — strigosum (E,T,O)

Sepals long persistent in fruit; bifurcate hairs on silicules ± sericeous 1-1.5 mm. long; styles 1-1.5 mm. long; petals bilobed, 4-4.5 mm. long; silicules 5-6.5 x 4-7 mm. — cedrorum (T,O)

subsp. /

subsp. strigosum. Sibthorp & Smith, Fl. Gr, 7, 20 t. 62 as A. campestre (1830). Pl. 3. Fig. 1A, g, h; fig. 1B, y.

Syn.: A. micropetalum Fisch. in Besser, Cat. Hort. Crem., 8 (1816), nomen nudum!

A. micropetalum DC., Syst. Nat. 2, 313 (1821).

A. campesre L. var. micropetalum (Fisch. ex DC.) Koch in Flora, 24 (2), 463 (1841)!

A. campestre var. pilosum Post, Fl. Syr., Pal., Sinai, ed. 1, 1, 85 (1896)!

A. campestre, multo auct. pro min. parte!

Type: (Syria): environs of Aleppo, Russell (holo. BM).

Distribution: Widespread in N. Africa, S. and E. Europe, Crimea, Aegean Islands, Crete, Cyprus, Turkey, Syria, Lebanon, Jordan, Israel, Arabia, Iraq, Caucasus, N. and Central Iran and Afghanistan. Map 11.

TURKEY. A1(E): Prov. Tekir dağ, Tekirdağ-Malakara, above Kumbağ, 30-50 m., 11 May 1962, Dudley (D. 34669). ibid., Prov. Çanakkale, Dardanelles, May 1867, Calvert. A2(E): Prov. Istanbul., Antigone, Wimmer 256; ibid., Pendik, 29 Apr. 1892, Aznavour 175; A2(A): Prov. Istanbul, Prinkipo (Büyük ada), St. Nicolas, 23 May 1909, Aznavour 1754; ibid., Diakos-Kartal, 2 May 1897, Aznavour 176B; Prov. Izmit, Nicodemia (Izmit), Aucher 4092; Prov. Bursa, Mudanya, 12 May 1899, Barbey 4114; ibid., Ulu dağ, 10 km. from Ulu dağ hotel, 1000 m., 16 May 1962, Dudley (D. 34716a). A3: Prov. Bolu, 3 km. E. of Hamzebev yayla nr. Yakuplar yayla, 1150 m., 19 Jun, 1957 Kühne 906; Prov. Ankara, Nallihan-Beypazari, 15 km. W. Beypazari, 750 m., 29 May /

May 1957, Kühne 396. A4: Prov. Kastamonu, Tosya, Beschtrichan (c. 10 km. W. of Tosya), 28 Jun. 1892, Sintenis 36896. A5: Prov. Amasya, Amasya, 15 Apr. 1889, Bornmüller 1336. A8: Prov. Gümüşane, Bayburt, 2 Jul. 1862, Bourgeau. B1: Prov. Çanakkale, Thymbra (nr. Erenköy, 5 Apr. 1883, Sintenis 996, & 996 b. pro parte: ibid., Alexandria Troas (Troy), Apr. 1856, Kirk pro parte; Prov. Izmir, Izmir, 1 Apr. 1854, Balansa 68; ibid., 30 Sept. 1833, Montbret; B2: Prov. Afyonkarahisar, Denizli-Dinar, 25 km. from Dinar, Aci gölü, 800-900 m., 6 Jun. 1962, Dudley (D. 35610). B4: Prov. Ankara, Ankara, 14 Apr. 1958, Merton 3283. B5: Prov. Adana, Siş (?) - Hadjin (Saimbeyli) 4 Jun. 1906, Post 365. B6: Prov. Sivas, Sivas, 1898, Maunsell; ibid., B7: Prov. Erzinçan, Egin (Kemaliye), 1 Jun. 1890, Sintenis 2459: Prov. Diyarbakir, 3 km. N. of Ergani, 1000 m., 2 Jun. 1957, Davis 29051. B8: Prov. Erzurum, Erzurum nr. Busambra (?), 3 Jun. 1856, Huet. C2: Prov. Muğla, Yatağan, 100 m. 1 Apr. 1956, Davis 25560; ibid., Muğla-Kale, 20 miles from Kale, 1000 m., 9 Jun. 1962, Dudley (D. 35550b): Prov. Burdur, Yeşilova-Denizli, 18 miles from Yeşilova, 810 m., 1 Jun. 1962, Dudley (D. 35320). C3: Prov. Antalya, Kunköy, Antalya-Serik, 2 m., 6 Apr. 1956, Davis 25664; Prov. Konya, Beyşehir-Konya, 3 km. from Beyşehir, 1100 m., 15 Jun. 1962, Dudley (D. 35827). C4: Prov. Içel, Anamur, 5 m., 14 Apr. 1956, Davis 25964. C5: Prov. Içel, Gülek bogas (Külek bog) 8 Apr. 1958, Markgraf; Prov. Adana, Pozanti, 800 m., 2 Aprl. 1957, Davis 26321; Prov. Niğde, in Ortakayaardi valley, 1200 m., 19 Jun. 1952, Davis 19043. C6: Prov. Maraş, 10 km. S. of Maraş, 1 May 1957 /

1957, Davis 27340; ibid., Hassan Beyley (nr. Maraş), Apr, 1893, Post 333 (synt. A. campestre var. pilosum, G-BB); Prov. Hatay, above Iskenderun, 300 m., 23 Apr. 1957, Davis 26990; ibid., Mt. Amanus, Apr. 1913, Haradjian 4555; Prov. Gaziantep, Yonas, 25 km. from Aintab (Gaziantep), 610 m., Apr. 1908, Haradjian 1769; Prov. Urfa, Bal Kuz (Balkis nr. Birecik), 366 m., Apr. 1906, Haradjian 1062.

AEGEAN ISLANDS. C1: Samos; Kaamariatusa nr. Chorio, 18-20 Jun. 1932, Rechinger 9702; ibid., 500 m., 1 May 1934, Rechinger 3562. C1/2: Rhodos, 600 m., 11 May 1935, Rechinger 7181; ibid., 15 Apr. 1886, Forsyth-Major.

Habitat: Disturbed and ruderal situations, weathered limestone, serpentine and igneous rocks, slopes and scree of S.W. exposure, cultivated and fallow fields, river banks, sand dunes, eroded clay slopes, vineyards, Astragalus steppe; often in mixed Quercus scrub, Cistus scrub, and Pinus brutia and P. nigra woods; alt. (2-) 50-1500 m. (-1829) m. Fl. (Feb.-) Mar.-Jun.

Though described in 1794, this binomial has been ignored until a relatively recent date, when its application to "A. campestre" sensu lato with dimorphic indumentum (on the pedicels and sepals as well as on the fruits) was indicated by Eig (1937). Until Eig rediscovered the Solander type of this species, most workers have considered the plants with dimorphic indumentum as components of A. campestre sensu lato, most usually as var. or subsp. micropetalum (e.g. Boissier, 1867); Busch, however, (1909) erroneously treated it as A. campestre var. parviflorum, Boissier /

Boissier (1867) realised that A. strigosum and A. cedrorum (now A. strigosum subsp. cedrorum) had a pronounced dimorphic fruit indumentum, and naturally enough in the absence of the abundant material which is available today, treated these taxa as synonomous with A. hirsutum. Zohary (1941) following Boissier's example considered A. strigosum and A. hirsutum synonomous, but chose the earliest name, A. strigosum, as the correct epithet.

The characters distinguishing A. strigosum from A. hirsutum are its always bifurcate usually stiff hairs, the rays of which are of equal lengths and never more than 1.5 mm. long, and the short tuberculate bases of these hairs measuring c. 0.5 mm. long. The tuberculate hairs on the fruits of A. hirsutum are usually simple and sericeous, measuring up to 3 mm. long; the tuberculate bases of these hairs measure also up to 1.5 mm. In addition to the characters of indumentum, A. strigosum is a plant of shorter stature with shorter racemes; its styles are shorter and its petals are smaller and gradually attenuate (as in Fig. 1B, a). The petals of A. hirsutum are constricted at the middle and are furnished with dilated claws (as in Fig. 1B, e). The distribution area of A. hirsutum is much narrower than that of A. strigosum, being seldom found south of 37 degrees latitude and not known at all from Syria, Lebanon or Israel.

Examination of the fragmented duplicates of the type material of Fischer's A. micropetalum in the De Candolle Herbarium at Geneva reveals that this binomial should be treated as synonymous with A. strigosum subsp. strigosum rather than as a separate species or as an infra-specific taxa of "A. campestre". The immature fruits on the authentic material of A. micropetalum are furnished with a prominent dimorphic indumentum (indicated in the type description), and as this character is not diagnostic for A. campestre /

A. campestre sensu stricto (now A. minus) the application of A. micropetalum to that taxon is erroneous (cf. discussion under A. minus).

Post (1896) followed Boissier's guide by regarding A. strigosum as a synonym of A. hirsutum, but also described A. campestre var. pilosum to contain those plants of "A. campestre" from Southern Anatolia and Lebanon with long-rayed stellate hairs on their fruits. The material Post used to describe this variety has been seen by the present author, and by possessing the diagnostic characters, including the dimorphic indumentum, of A. strigosum subsp. strigosum, must be regarded as synonymous with it.

subsp. cedrorum (Schott & Ky.) Dudley, stat. nov.; Fenzl in Tchih., Asie Min., Bot. 1(3), 314 (1860).

Syn.: A. cedrorum Schott & Ky. in Öst. Bot. Wochbl., 11, (21),169 (1854)

A. strigosum var. macrocarpum Zohary in Pal. Journ. Bot., Jer. ser., 2 (2/3), 161 (1941)!

A. strigosum var. cedrorum (Schott & Ky.) Briest. in Bull. Soc. Bot. Fr., 103 (2), 154 (1956)!

Type: (Turkey, C5: Prov. Içel): in Tauro inter Cedros, Kotschy (originally cultivated from seed in the Vienna Botanic Gardens, holo. W, iso. G-B).

Distribution: Found mainly in the Lycian and Cilician Taurus, and extending into Cyprus and N.E. Anatolia. Map 11.

TURKEY. A7: Prov. Gümüşane Aymeme-bogas (nr. Elias dağ, S. of Gümüşane) 10 Jul. 1894, Sintenis 6218. B5: Prov. Kayseri, Erdschias-dagh (Erciyas dağ), Erd, nr. Erverek, 1300 m., Jun. 1902, Zedebour. B6: Prov. Adana, dist. Saimbeyli, Saimbeyli, 1100 m., 13 Apr. 1957, Davis 26685. B7: Prov. Sivas, Kirkgöz (nr. Divriği) 1300 m., 12 Apr. 1936, Tengwall 310. C2: Prov. Muğla, Muğla-Kale, c. 35 miles from Muğla, 10 miles from Kale, 900 m., 9 Jun. 1962, Dudley (D. 35544a); Prov. Denizli, Cibyra (nr. Çameli), Forbes 45; ibid., Yeşilova-Denizli, c. 40 miles from Yeşilova, c. 40 miles from Denizli, 1090 m., 1 Jun. 1962, Dudley (D. 35328) Prov. Antalya, Antiphellus (Kaş), Forbes 44; ibid., Fethiye-Elmali, 150 km. from Fethiye, 20 km. from Elmali, beyond Sutleğen, 1050 m., 30 May 1962, Dudley (D. 35209); ibid., Elmali, 11 May 1960, Bourgeau 69. C3: Prov. Isparta, dist. Sütcüler /

Sütcüler Cimer Ova on W. side of Sarp dağ, 1500 m., 28 Jul. 1949, Davis 15804; Prov. Burdur: Burdur-Antalya, 5 km. from Bucak, 720 m., 11 Jun. 1962, Dudley (D. 35694a); Prov. Antalya, Korkuteli-Kizilçadag, 10 miles from Korkuteli, 1400 m., 31 May 1962, Dudley (D. 35262); ibid., Çalbali dağ nr. Cukur Ardic yayla, 1700 m., 15 Jul. 1949, Davis 15388; ibid., dist. Akseki, gorge below Erenkaya, Manavgat-Akseki, 700 m., 10 Apr. 1956, Davis 25814; C4: Prov. Içel, dist. Gülnar, Bozağac-Akirini, between Gülnar-Gilindire, 700 m., 14 Apr. 1956, Davis 26049. C5: Prov. Içel, Namrun-Şamlar, 500 m., 4 Apr. 1957, Davis 26386; ibid., Mersin, 9 May 1855, Balansa 165; Prov. Adana, dist. Karaisali, nr. Bürücek, Pozanti, 1000 m., 21 Apr. 1956, Davis 26142; ibid., Kamechly (Kamuşli), 15 Jun. 1850 m., Balansa 482. C6: Prov. Maraş, Maraş, 6 May 1934, Balls 981 pro parte; Prov. Hatay, Belen, 1938 Zohary (holo. A. strigosum var. macrocarpum HUJ, n.v.).

Habitat: Disturbed and ruderal situations, neglected and cultivated fields, limestone slopes and scree, volcanic plateaus, steppe; often in Quercus scrub and Pinus brutia woods; alt. 300-1700 m. Fl. Apr.-Jul. The following specimens are intermediate between the two subspecies: A3: Prov. Ankara, 10 km. W. Beypazari, 2 km. W. Zaviye, 880 m., 26 May 1957 Kühne 198. B1: Prov. Izmir, Smyrna (Izmir), Apr. 1827, Fleischer pro parte. B3: Prov. Eskişehir, Sivrihisar-Eskişehir, 80 km. from Eskişehir, 900 m., 22 Jun. 1962, Dudley (D. 36046). B5: Prov. Kayseri, Erschias dagh (Erciyas dağ), May 1902, Zedebour. B6: Prov. Maraş, Göksun, 1250 m., 6 May 1957, Davis 27621. B7: Prov. Tunceli, Tunceli-Pülümür, 6 miles from Pülümür, 1000 m., 7 Jun. 1957, Davis 29215.

C2: Prov. Burdur, Yeşilova-Denizli, 4 miles from Yeşilova, at Salda gölü, 1100 m., 1 Jun. 1962, Dudley (D. 35308). C3: Prov. Antalya, Adalia (Antalya) May 1845, Heldreich 465. C6: Prov. Gaziantep, S. of Kizilhisar dere, Gaziantep-Kilis, 30 km. S. of Gaziantep, 750 m., 13 May 1957, Davis 28008. Much of the material from Cyprus appears to be intermediate in morphology, however, with a predominence of subsp. cedrorum characters.

This taxon was originally thought to be a species (A. cedrorum) distinct from A. strigosum, but the presence of a large number of intermediate specimens from Anatolia and Cyprus (mostly occurring within the distribution range of subsp. cedrorum) indicates that subspecific rank is more appropriate. The relatively limited distribution of subsp. cedrorum is completely contained within the much wider area covered by subsp. strigosum. By studying plants raised from seed of wild gatherings in Anatolia, it appears that the populations of subsp. cedrorum maintain their morphological identity. This is true also of populations of subsp. strigosum and the populations of intermediates. Subspecies strigosum, subsp. cedrorum and the intermediates do not appear to grow in mixed populations; the plants in each population are always identifiable as one subspecies or the other, or as intermediates. At present for convenience of identification the subspecific classification is acceptable, but a biosystematic study of the processes leading to the differential and then stabilisation of the expressions of the subspecific and intermediate populations would be rewarding. A. strigosum would be an excellent experimental medium because it is easily cultured and under cultivation can fulfil its life cycle in not more than two months. Within the framework of a biosystematic project it would also be valuable to incorporate a critical anatomical study of the tuberculate furcate hairs /

hairs on the fruits to provide some information in regarding their ontogeny and possible phylogeny.

Zohary's A. strigosum var. macrocarpum was collected from the Amanus in Turkey where subsp. cedrorum normally occurs. The fruit measurements of A. strigosum var. macrocarpum correspond exactly with collections of subsp. cedrorum from the Amanus, the Lycian Taurus (Davis 15388) and Cyprus. Though not having seen the type material of A. strigosum var. macrocarpum, it is probably safe to regard it as conspecific with subsp. cedrorum.

The ombrochorous method of dehisence and dispersal (Zohary, 1941) of both subspecies of A. strigosum, A. minus and A. stapfii was observed on cultivated plants and in the field in 1962. The valves of the fruits of these species do not fall off automatically when mature as in the anemochorous method (most species in Sect. Odontarrhena). The separation tissue which forces the valves from the replum margins in the anemochorous species does not form (or only to a limited extent) in the ombrochorous species; the valves of these species remain adhering to the replum margins throughout the dry period until the first rains. The splashing of rain or from a watering can loosen the valves so that moisture penetrates to the seeds. This moisture causes the seeds not only to swell but to form a thick layer of mucilage around themselves. This process pushes the valves away from the replum from the inside, and allows the continued action of the rain to wash the valves and seeds to the ground. In some cases when the rain is of very limited duration, the mucilaginous seeds slide out from between the loosened valves and replum and fall to the ground. The whole process, from the time moisture is first applied till the time that the seeds are fastly adhering to the soil particles, was observed to take less than an hour, and usually not more than a half hour.

The /

The hygrochastic movement of the pedicel characteristic of the ombrochorous and hygrochastic species (i.e. _A. szowitsianum_, _A. marginatum_ and _A. umbellatum_) is not evident for the strictly ombrochorous species: their fruits and pedicels when mature are already in a median position.

28. A. xanthocarpum Boiss. in Ann. Sc. Nat., ser. 2, 17, 154 (1842); Boiss., Diagn. 3 (5), 37 (1856); Busch in Fl. Cauc. Crit., 3 (4), 582 (1909); Bornm., Symb. ad Fl. Anat., 55 (1936). Fig. 1A, d; fig. 1B, k; fig. 2, d.

Syn.: A. macrostylum Boiss. & Huet, in Boiss., Fl. Or., 1, 279 (1867)!

Lectotype: (Turkey, C6: Prov. Gaziantep): Akdagh (nr. Gaziantep), Aucher 263 (orig. G-B, iso. BM,K - synt. A. macrostylum).

Distribution: Central, S. and E. Anatolia, extending into the Armenian Highlands, the Caucasus, N. Syria and rarely into Lebanon. Map 13.

TURKEY. A4: Prov. Çankiri/Kastamonu, Ilgaz dağ, 22 km. N. of Ilgaz, 1550 m., 20 Jun. 1955, Huber-Morath 14806; Prov. Ankara, distr. Kizilchamam, 2 km. from Kizilchamam, 1070-1100 m., 18 Jun. 1955, Huber-Morath 14808. A5: Prov. Kastamonu, Giaur dagh (above Tosya), 17 May 1892, Sintenis 3862; ibid., N. side of Ilgaz dağ, 1500 m., 28 Jul. 1962, Davis 38285. A6: Prov. Tokat, Tokat, 600-700 (1300-1400) m., Apr. 1893, Bornmüller 3246. A7: Prov. Gümüşane, Molirva-meschere (nr. Sorda), 31 May 1894, Sintenis 5656 pro parte; ibid., Aghakoi (nr. Sorda), 31 May, 20 Jul. 1894, Sintenis 5558. A8: Prov. Gümüşane, Bayburt, 18 Jul. 1862, Bourgeau 166 (orig. synt. A. macrostylum, G-B). A9: Prov. Çoruh, nr. Tansot, 10 May 1907, Woronov; Prov. Kars, distr. Kagizman, nr. Karakurt, 6 May 1914, Turkevicz; B6: Prov. Sivas/Tokat, Çamlibel dağ, above Yenichan, 29 May 1890, Bornmüller 1929. A/B8: Prov. Erzurum/Gümüşane, Askale-Bayburt, 20 km. N.W. of Askale, 2000 m., 27 Jun. 1951, Huber-Morath 10988. B5: Prov. Kayseri, Bakir dağ, nr. top of Seneandere, 2200 m., 30 Jun. 1952, Davis /

Davis 19411; ibid., Mt. Kassan Oghla (?), Gorumse at Tscheschme yayla (nr. Bakir dağ), 2134 m., 19 May 1859, Kotschy 130 (orig. synt. A. macrostylum G-B, iso. G, G-BB, W,K,BM). ibid., Erdschias Dagh (Erciyas dağ) above Hadschilar, 2200-2500 m., May 1902, Zedebour. B6: Prov. Sivas, Bey dağ, S. of Zara, 1 Jun. 1960, Stainton et. al. 5304. B7: Prov. Erzincan, Kainartschar (nr. Szanduk), 10 May 1890, Sintenis 2211, pro parte. B8: Prov. Erzurum, Erzurum, 1829-1900 m., Jun. 1853, Huet (orig. synt. A. macrostylum, G-B, iso. G,K,BM). C6: Prov. Maraş, Akher dagh (Ahir dağ), 600-1000 m., Jul. 1907, Haradjian 1668; Taurio Orient, 1834, Montbret. Armenia, Tokat-Erzurum, Aucher 4089A (orig. synt. A. xanthocarpum, & A. macrostylum, G-B, iso. K).

Habitat: Steppe, metamorphic scree, dry calcareous rock, sandstone slopes, mountain meadows; often in mixed Pinus and Abies forests; alt. (600-) 1500-2500 m. Fl. Apr.-Jul.

The dimorphic fruit indumentum of coarse, stiff, furcate and shortly tuberculate hairs and smaller stellate hairs of this species is similar to that of A. strigosum. A. xanthocarpum is easily distinguished from the latter by its much longer basally dilated styles, longer floral parts, longer pedicels, simple unbranched racemes, and usually larger, broadly elliptic or ovate, obtuse or acute fruits.

It is not known why Boissier did not approve of his earlier epithet A. xanthocarpum, and redescribed both its syntypes, plus additional material, as A. macrostylum. He thought that possibly the variation in density and length of the furcate hairs, noticeable in the additional material rendered the epithet xanthocarpum unsuitable.

The fruit indumentum of this species shows an interesting variation.

That /

That of some of the Southern and Central Anatolian collections (Aucher 263, Haradjian 1668 and Davis 19411) is quite dense and the mature fruits appear brownish-yellow - the feature accounting for the specific epithet. The indumentum of some of the Northern and Eastern Anatolian gatherings (Bourgeau 166, Huber-Morath 10988 and Davis 38285) is comparitively sparse; the mature fruits appearing greenish. It is also interesting to point out that the tuberculate furcate hairs on the less pubescent fruits show a trend towards reduction in length of the major erect rays and are provided with more subsidiary basal rays, but the furcate hairs of the densely pubescent form are seldom less than 1 mm. long and are only rarely furnished with any subsidiary basal rays. The variation in the fruit indumentum of this species allows some insight into the gradual elaboration of the tuberculate long-rayed furcate hairs from the stellate hair. It could be hypothesised that the prototype of this species had fruits furnished with two dissimilar types of stellate hairs, one tuberculate and the other sessile. In the process of time and the action of selection pressures the tuberculate hairs gradually elonged and strengthened two of their rays at the expense of the other rays, coupled with an increase in the density of indumentum. The end-product of this process is examplified by some of the southern populations of the species, while the northern populations have retained a relatively less advanced condition. As the other specific diagnostic characters do not seem to vary, and both indumentum states occasionally occur in southern and northern populations, it is not feasible to recognise this variation as an infra-specific taxon.

The choice of the lectotype for this species stems from the fact that the Aucher 263 syntype is much better material than the other syntype (Aucher 4098a) being provided with flowers and fruits and more accurate information regarding the area of collection.

Bornmüller /

Bornmüller (1936) correctly maintained that A. macrostylum var. calycocarpum Hausskn. (1904-1905) was not to be equated with A. xanthocarpum, but was rather conspecific with the closely allied A. bulbotrichum.

29. A. hirsutum Marsch.-Bieb., Fl. Taur. Cauc., 2, 106 (1808); ibid., Suppl. Fl. Taur. Cauc. 3, 433 (1819).

Plant annual, up to 40 cm. tall. Leaves oblanceolate or obovate circa 5 mm. wide. Fruiting racemes strict, up to 20 cm. long, rarely reduced, branches divergent or ascending. Pedicels with strigose indumentum. Sepals deciduous. Petals constricted at middle, bilobed, (2.5-) 3-4.5 (-5) x 1-1.5 mm. Long filaments widely winged, 1-2-dentate at apex or edentate, 3-4 mm. long. Short filaments 2.5-3 mm. long, with free, or rarely connate, 1-3-dentate appendages, ± as long as filaments. Styles ± rostrate, less than 2 X wider at base than apex, glabrous, 1.5-2.5 mm. long. Silicules ± equally inflated, with heteromorphic indumentum of simple or unequally bifurcate, sericeous, strongly tuberculate, elevated hairs 1-3 mm. and appressed stellate hairs. Seed wings 0.3-0.5 mm. wide.

Key to varieties

Plant 12-40 cm. tall; fruiting racemes elongated 8-13 cm. long; silicules 3-4-seeded; petals sparsely pubescent (3-) 3.5-4 mm. long; styles 1.5-2 mm. long ..... hirsutum (E,T,O)

Plant 2-4 cm. tall; fruiting racemes condensed, 1-2 cm. long; fruit consistently 1 - seeded; petals densely pubescent, 4.5-5 mm. long; styles up to 2.5 mm. long ..... caespitosum (T)

var. hirsutum. Deles., Icon. Select. Pl., t. 40 (1824); Boiss., Fl. Or. 1, 284 (1867), pro parte; Velen., Fl. Bulg., 40 (1891); ibid., in Sitz. Böhm. Gesell. Wissen., 37, 10 (1893); ibid., Suppl. Fl. Bulg., 1, 26 (1898); Busch in Fl. Cauc. Crit., 3 (4), 597 (1909); Hayek /

Hayek, Prod. Fl. Pen. Balc., 439 (1925); Grossh., Fl. Kavk., ed. 2, 4, 217 t. 25, f. 2 (1950). Fig. 1A, i; fig. 2, f.

Syn.: A. campestre L. var. hirsutum (Marsch-Bieb.) Koch in Flora, 24 (2), 463 (1841)!

A. polyodon Boiss. & Buhse in Nouv. Mem. Soc. Nat. Mosc., 12, 17 (1860)!

Psilonema hirsutum (Marsch-Bieb.) Schur., Enum. Pl. Transs., 62 (1866).

A. campestre subsp. hirsutum (Marsch.-Bieb.) Schmal., Fl. Srednee i Yuzhnse Rossie, Krimia i svec. Kavkaza, 1? 88 (1895)!

A. minus (L.) Rothm. subsp. micropetalum (Fisch. ex DC.) Briest. var. micropetalum f. polyodon (Boiss. & Buhse) Briest. in Bull. Soc. Bot. Fr., 103 (2), 154 (1956)!

Type: (Caucasus and Crimea): crescit in Tauriae et Iberiae campis apricis, Marschall a Bieberstein (orig. LE, photo. E).

Distribution: Yugoslavia, Bulgaria, Romania, W. Russia, Crimea, Caucasus, Turkey-in-Europe, Central and E. Anatolia and Russian Armenia. Map 12.

TURKEY. A2(E): Prov. Istanbul, Fenerbergtsche, 25 Apr. 1917, Aznavour. A3: Prov. Ankara, 10 km. W. of Beypazari, 2 km. W. of Zaviye, 820 m., 26 May 1957, Kühne 176B; A4: Prov. Çankiri, Çakmaklidere, 800 m., 16 Jun. 1929, Bornmüller 13857. A5: Prov. Kastamonu, Tosya nr. Karavak-Tschesme (m. Kösen) 10 May 1892, Sintenis 3687; Prov. Amasya, 400-600 m., 2 May 1889, Bornmüller 1338; ibid., Merzifon, 4 Apr. 1891, Manisdjian /

Manisdjian 30. A8: Prov. Gümüşane, Bayburt, 20 Jun. 1862, Bourgeau. B4: Ankara, Ankara, 14 Apr. 1958, Merton, 3283; ibid., Ankara-Sivrihisar, 10 miles from Ankara, 21 Jun. 1962, Dudley (D. 35996a); B5: Prov. Kayseri, Karahisar to Arapli, 14 km. S. of Karahisar, 1200 m., 9 Jun. 1953, Huber-Morath 12822. B8: Prov. Erzurum, Erzurum, Jun. 1853, Huet; Prov. Bingöl, 54 km. W.S.W. of Erzurum, Erzurum - Erzincan, 6 Sept. 1957, Rechinger 15084. C3: Prov. Antalya, Elmali-Korkuteli, 21 miles from Elmali 1300 m., 31 May 1962, Dudley (D. 35238). C4: Prov. Konya, above Sille, 1100 m., 5 Jun. 1948, Huber-Morath 9278. C5: Prov. Içel, Bouloukli (?), nr. Mersin, 9 May 1855, Balansa.

Habitat: Disturbed and ruderal situations, steppe, neglected fields, river banks and limestone rock; alt. 400-1200 m. Fl. Apr.-Jun.

var. caespitosum Dudley, var. nov. Pl. 4, Map 12.
A typo habitu valde diverso, inflorescentia umbelliformi congesta paucifructa, indumento siliculorum densiore pilis simplicibus basi tuberculatis longioribus differt.

TURKEY. C2: Prov. Burdur, Fethiye-Dirmil, Passhöhe, 7 km. vor Dirmil, 500 m., 9 Jun. 1938, Huber-Morath 5150 (holo. Hub.-Mor.)

Though this species, together with A. strigosum has often been regarded as a component of the "A. campestre" aggregate and the two have been mutually confused, they are on the basis of their prominent dimorphic fruit indumentum of long simple (A. hirstum) or short furcate (A. strigosum) /

(A. strigosum) tuberculate hairs and appressed stellate hairs more closely allied to A. xanthocarpum, A. bulbotrichum, A. trichocarpum and A. cephalotes, than to A. minus ("A. campestre" sensu stricto) or A. stapfii both of which have homomorphic indumentum.

Boissier (1867) not only considered A. strigosum and A. cedrorum as synonyms of A. hirsutum, but also thought of A. polyodon and A. parviflorum as synonyms of A. campestre var. micropetalum. A. strigosum with its subsp. cedrorum is specifically distinct from A. hirsutum; A. micropetalum with its dimorphic fruit indumentum is a later synonym of A. strigosum subsp. strigosum; and A. parviflorum is referred to A. minus in the narrow sense (cf. discussions under A. minus and A. strigosum).

A. polyodon differs from the typical expression of A. hirstum only in its reduced stature. In all other diagnostic characters, the type material of A. polyodon is consistent with the normal A. hirsutum. The reduced habit of A. polyodon is very similar to that of a number of other Crimean collections (e.g. Callier 19 & 538) which appear to have been growing under unfavourable conditions and accordingly are depauperate.

If the very dwarf plants of A. hirsutum from Pisidia did not have any other correlated differences, namely denser fruit indumentum with longer tuberculate hairs and umbellate few fruited racemes, it would be taxonomically unsound to grant such plants any formal rank. At least one population in S.W. Anatolia, however, constantly maintains these expressions, and by doing so, justifies the recognition of the very rare but distinctive var. caespitosum.

30. A.bulbotrichum Hausskn. & Bornm. in Mitt. Thür. Bot. Ver. n.f., 10, 3 (1904-1905); Bornm., Symb. ad Fl. Anat. 51 & 55 as A. macrostylum (1936).

Syn.: A. macrostylum Boiss. & Huet var. calycocarpum Hausskn., op. cit., 4.!
A. montanum L. subsp. repens (Baumg.) proles bulbotrichum (Hausskn. & Bornm.) Baumg. in Beil. Jahresb. Nied-Öst. Land.-Lehrers. Wien.-Neust. 35, 15 (1908)!

Syntypes: (Turkey, A5: Prov. Amasya): Amasia in declivibus lapidosis alpinis montis Akdagh, 17-2000 m., May 1889, Bornmüller 1343, (JE n.v., iso. W,K) & 12 May 1890, Bornmüller 1930 (JE n.v.).

Distribution: Rare Endemic to Anatolia. Map 13.

TURKEY. A4: Prov. Kastamonu, Tosya, Giaur dagh (above Tosya, above Ekintschik), 29 May 1892, Sintenis 4027 (holo. A. macrostylum var. calycocarpum (JE n.v., iso. K,W,G,BM,G-BB). A5: Prov. Amasya, Amasya, Ak dağ, above Tafra (Jafrayayla), 25 May 1890, Bornmüller 1820, ibid., Amasya, Manisidjian. 1193. B7: Prov. Erzincan, Kainartschar (nr. Szanduk), 10 May 1890, Sintenis 2211 pro parte. C5: Prov. Içel, Dumbelch (Dembra) pass, Mersin, 2000 m., Jun. 1909, Siehe 402.

Habitat: Montane; alt. 1700-2000 m. Fl. May-Jun.

This species was originally described as perennial; however, as none of the duplicates of the original Bornmüller gatherings or subsequent collections shows any development of sterile shoots (the characteristic feature of all the perennial Alyssa) it must be assumed that A. bulbotrichum is/

is an annual, but of a sprawling diffuse habit. Its sprawling habit is similar to that of A. repens, and its original description as a perennial led Baumgartner to consider that A.bulbotrichum was closely related to A. repens, and gave it the rank of "proles" under the latter. That A. repens is perennial can always be observed by the formation of copious sterile shoots. The annual habit, dimorphic fruit indumentum, larger fruits, unidentate narrowly winged long filaments, unbranched cylindrical racemes, densely pubescent petals and longer basally dilated styles of A. bulbotrichum establish it as distinct from and only remotely allied to A. repens.

The closest ally to A. bulbotrichum in the annual Alyssa with dimorphic fruit indumentum appears to be A. trichocarpum. From the latter, A. bulbotrichum may be distinguished by its wingless seeds, larger ovate or broadly elliptic fruits, yellowish-green appearance and narrowly winged unidentate long filaments (the long filaments of A. trichocarpum are widely winged and multidentate at the apex.)

Bornmüller (1936) cast doubt on Baumgartner's conclusion that the Sintenis collection (No. 4027), the type of A. macrostylum var. calycocarpum, was conspecific with A. bulbotrichum. Bornmüller claims that this gathering cannot be identified as A. bulbotrichum because the fruit indumentum does not appear to be strongly dimorphic, nor can he identify it as A. macrostylum (A. xanthocarpum). With these two possibilities rejected, he advocates the description of a new species. Duplicates of the type gathering of A. macrostylum var. calycocarpum were examined in various herbaria. Their prominent dimorphic fruit indumentum, persistent sepals/

sepals and densely pubescent styles point to their inclusion, as advocated by Baumgartner, in _A. bulbotrichum_. Why then did Bornmüller think that the fruit indumentum of this gathering was not dimorphic? A clue to this question is provided by one duplicate in the Delessert Herbarium in Geneva. In addition to the typical _A. bulbotrichum_ there are mixed in this gathering fragments of another species which with its homomorphic fruit indumentum and deciduous sepals is referable to _A. minus_! The presence of _A. minus_ mixed with _A. bulbotrichum_ (possibly more abundantly in the original gatherings in the Haussknecht Herbarium in Jena) could account for Bornmüller's view. The mention of persistent sepals and the inference of dimorphic fruit indumentum implied by assigning var. _calycocarpum_ to _A. macrostylum_ (_A. xanthocarpum_), indicates to the present author that the basis of this variety can only be the specimens of _A. bulbotrichum_, which comprise the larger part of the type gathering.

31. __A. trichocarpum__ Dudley & Huber-Morath __sp. nov.__ Pl. 5 Fig. 6, 12-22. Map 13.

Affinis __A. cephaloti__ Boiss., et __A. xanthocarpo__ Boiss. sed a priore racemi elongati (haud globoso-congesti), habitu minus robusto, foliis summum versus decrescentiis haud involucratis, stylo pilis stellatis minoribus et parcioribus differt; a posteriore fructibus minoribus formae diversae et indumento densiore radiis pilorum stellatorum longioribus recedit.

__Planta__ annua, patens, e base multiramosa, (8-) 15-20 (-30) cm. alta et lata, radice principali longa. __Caules__ decumbentes vel ascendentes basi haud ramosi, rubro-purpurei. __Folia__ post anthesin decidua, sessilia vel breviter petiolata, obovata vel oblanceolata, ad basim sensim attenuata, acuta, 10-15 (-20) mm. longa, 2.5-4 (-7) mm. lata, summum versus decrescentia, pilis stellatis parcis vel densis semper basi tuberculatis radiis antrorse suberectis paucibus longis inaequalibus rare ramosis vestita. __Racemus__ 5-10 cm. longus, simplex, cylindricus, erectus, in statu florendi 1-1.5 cm. lato, deinde dense fructiferus apice globoso. __Pedicelli__ rigidi, divaricati vel ascendentes, recurvi, 4-7 mm. longi, indumento dimorpho parco vel denso pilis stellatis radiis longis antrorse suberectis inaequalibus et radiis longissime sinuatis sericeis basi tuberculatis inaequalibus tecti. __Sepala__ subpersistentia, basi angulato-saccata, subcarinata, margine angusta hyalina, ovata, 3.5-4 mm. longa, 1 mm. lata, indumento denso dimorpho pilis stellatis radiis longis parcis suberectis et praesertim apicem versus pilis parcis vel multis longissimis antrorse erectis simplicibus vel bifurcatis basi manifeste tuberculatis/

tuberculatis tecta. Petala obovata, basi cuneata, retusa vel bifida, (4-) 5-6 mm. longa, 1-2 mm. lata. in unguem sensim attenuata, indumento denso solum pilis stellatis radiis crassis parcis rare ramosis tecta. Filamenta longa inaequaliter bilateraliter alatis, 3.5-4.5 (-5) mm. longa, ala una quam altera 2-plo latior dentibus minutis 2-3 supra medium provisa, ala altera apicem versus abrupte contracta vel dentata. Filamenta brevia 3-4 (4.5) mm. longa, appendice 0.8-1 (1.3) mm. lato, in dimidio inferiore connata. Glandulae valdo conspicuae globosae. Ovulae duae per loculum. Stylus subrostratus, basi manifeste dilatatus, 2-3.5 mm. longus, dense pilosus in dimidio inferiore pilis stellatis minutis radiis paucis brevibus divergentibus praeditus, stigmate magno globoso provisus. Silicula duoseminata, pallide flavo-viridia, orbiculata, acuta vel ad basim attenuata, (3.5-) 4-5 (-6.5) mm. longa, 3-4.5 mm. lata, valvis cartilagineis difficiliter separabilibus subcompressis ± aequaliter inflatis indumento denso dimorpho pilis stellatis appressis vel subapressis ramosis radiatis et pilis simplicibus vel bifurcatis (1-) 2-3 mm. longis antrorse ascendentibus sinuatis sericeis basi tuberculatis (tuberculis globosis inflatis (1.5-) 2.5-3 mm. altis!) provisa. Semen fuscum vel subnigrum, 2.5-3.5 mm. longum, 2-2.5 mm. latum, ala 0.05-0.1 mm. lata, valde crenulata. Fl. Mai-Jun., fr. Jun.-Jul.

TURKEY. B6: Prov. Malatya, Darende-Akdağ, c 50 km östlich Darende, Kalk-mergel, 1450-1480 m., 20 Jun. 1949, Huber-Morath 9253 (holo. Hub.-Mor., iso. E). B5: Prov. Yozgat, Akdağmadeni, Aktaş, Jun. 1960, Curtis 124 (E).

There is no doubt that this rare and unusual annual belongs in the species complex of Sect. _Alyssum_ which includes _A. strigosum_, _A. xanthocarpum_, _A. hirsutum_, _A. bulbotrichum_ and _A. cephalotes_. The new species shares with all of these an annual habit and a dimorphic indumentum on the fruit. It may be distinguished from _A. cephalotes_, one of its closest allies, by the elongate fruiting raceme, a more reduced form of growth, uppermost leaves which are not involucrate but are, in fact, smaller than the basal leaves, and the indumentum on the style being composed only of minute stellate hairs. The new species may be separated from _A. xanthocarpum_ by smaller and orbicular fruits with denser indumentum primarily composed of much longer and strongly tuberculate hairs. _A. trichocarpum_ may further be distinguished from all species in the complex by the outwardly arcuate pedicels and the very thick fruit valves which may be separated only with difficulty.

32. A. cephalotes Boiss., Diagn. 3 (1), 34 (1853); Boiss., Fl. Or., 1, 280 (1867).

Syntypes: (Turkey, C2: Prov. Denizli): in pinquibus arenosis montis Cadmi Honaz dağ Asiae minoris, in jugo ad orientum urbis Geyra sitio (orig. G-B, iso. W,K) et in cacumine ad orientem urbis Denisleh (Denizli) supra Khonas (Honaz) (orig. G-B, iso. W,K.) Jun. 1842, Boissier. The type citation covers two collections which were distributed under the one label, "Codmi in Orienti".

Distribution and habitat: Rare alpine endemic to Honaz dağ known only from Boissier's type collections. Map 13.

It is strange that this species has never been found on the well botanized Mt. Cadmus (Honaz dağ) or anywhere else since its discovery by Boissier in 1842. Judging from its type gatherings, A. cephalotes is distinguished from its allies in the annual complex of species (all with dimorphic fruit indumentum) by having extremely reduced and globose racemes surrounded by broad involucrate leaves, and styles densely pubescent with a dimorphic indumentum similar to that on the fruits.

The records of A. cephalotes from Europe (Čelak., in Sitzb. Böhm. Gesell. Wissen., 29, 531:1887; Toel and Rohena in Sitzb. Böhm. Gesell. Wissen., 49, 6:1902; Hayek, Prod. Fl. Pen. Balc., 1, 483:1925) are most certainly incorrect. Bornmüller (1921) states that the Toel and Rohena record represents A. foliosum; however, material labeled by Balkan botanists as A. cephalotes in the Kew Herbarium, London and The Natural History Herbarium, Vienna are definitely identifable as A. strigosum subsp. strigosum.

33. A. repens Baumg., Enum. Stirp. Transs., 2, 237 (1816); Baumg. in Beil. Jahresb. Nied.-Öst. Land.-Lehrers. Wien-Neust., 35, 9 (1908).

Key to infra-specific taxa

1. Stems sprawling, decumbent to ascending, rarely more than 25 cm. long; fruiting racemes up to 10 cm. long; petals deeply bilobed, 3-5 mm. wide; silicules orbicular, deeply emarginate, greenish with sparse indumentum subsp. repens (E,O)
1. Stems erect to ascending, up to 60 cm. long; fruiting racemes up to 30 cm. long; petals retuse, 1-2 (-3) mm. wide; silicules ovate or obovate, obtuse or truncate rarely subemarginate, canescent with dense indumentum subsp. trichostachyum (E,T,O)
   2. Stems stout; silicules 3.5-6 x 4-5 mm.; stellate hairs on lower surface of cauline leaves 0.5-1 mm. diam. var. trichostachyum (E,T,O)
   2. Stems slender; silicules 2.5-3 mm. long and wide; stellate hairs on lower surface of cauline leaves 0.2-0.5 mm. diam. var. stenophyllum (E,T)

subsp. repens. Reichenb., Ic. Fl. Germ. & Helv., 2, t. 19, f. 4273b as A. rochelii & f. 4274c as A. vernale (1837-1838); Degen in Denk. Akad Wissen. Wien, 64, 707 as A. transsilvanicum (1897); Javorka & Csap., Ic. Fl. Hung., pl. 18, f. 1595, t. 212, f. 1595 (1935); Fl. Rep. Pop. Rom., 3, 335, pl. 57, f. 4, 5 (1955).

Syn.: A. decumbens Herb. in Öst. Bot. Wochbl., 5 (1855).

A. montanum L. var. ramosum Heuff. in Verh. Zoo-Bot. Gesell., 8 /

8, 56 (1858).

A. rochelii Andrz. ex Schur Enum. Pl. Trans., 63 (1866)!

A. transsilvanicum Schur, loc. cit.!

A. styriacum Jord. & Fourr., Brev. Pl. Nov., fas. 2, 7 (1868).

A. repens subsp. transsilvanicum (Schur) Nym., Consp. Fl. Eur., 1, 56 (1878)!

A. montanum L. subsp. repens proles eu-repens Baumg., op. cit., 22!

A. montanum subsp. repens proles transsilvanicum (Schur) Baumg., op. cit., 18!

A. montanum subsp. repens proles transsilvanicum f. serpentinicum Baumg., op. cit., 21!

A. trichostachyum var. brachystachyum Bordz. in Fedde Rep. Sp. Nov. 30, 376 (1932)!

Type: (Romania): in calcareo-saxosis nempe post Brasso ibidem in M. Schüler bürge ibidem inter rupium fissuras., Baumgarten (holo. W).

Distribution: E. and S. Europe and Caucasus. Map 14.

As the typical subspecies of A. repens is not known to occur in Turkey, a discussion of its synonymy is postponed to a later date.

A. bulbotrichum, which Baumgartner (1908) allies to A. repens as a "proles", is not a perennial, though indicated as such in its original description. It is a diffuse and spreading annual and is closely related to the species which have a dimorphic fruit indumentum, namely A. hirsutum, A. strigosum, A. xanthocarpum, A. trichocarpum and A. cephalotes.

subsp. trichostachyum (Rupr.) Hayek, Prod. Fl. Pen. Balc., 1, 436 (1925).

var. trichostachyum. Boiss., Fl. Or., 1, 275 as A. repens (1867); Busch in Fl. Cauc. Crit., 3 (4), 573 as A. repens (1909); Fl. Georg., 4, 166 (1948); Grossh., Fl. Kavk., ed. 2, 4, t. 24, f. 7 (1950). Fig. 1B, c.

Syn.: A. trichostachyum Rupr. in Mém. Acad. Sc. Pétersb., 15 (2), ser. 7, 101 & 290 (1869)!

A. montanum L. subsp. repens proles trichostachyum (Rupr.) Baumg., op. cit., 10!

A. repens f. micranthum Busch., op. cit., 575.

A. repens var. albiflorum Busch., op. cit., 578.

A. repens var. oschtenicum Busch, loc. cit.

A. oschtenicum (Busch) Charkev in Not. Syst. Herb. Petrop., 18, 84, (1953).

Syntypes: (Caucasus): In promontorio et reg. subalpina Cauc. occid., 914-1829 m., Meyer 1608 (orig. LE, n.v.); scil. in rupibus calcareis versus rivulum Kassaul 1300-1829 m., 3 Jul. 1829, Meyer 1608 (orig. LE, n.v.); ad Fl Ardon pr. ostium f. Sadon, 1000 m., 21 May, Ruprecht (orig. LE, n.v.); Radscha pr. Slawardsalli m., Frick (orig. LE, n.v. iso. GH, K); in m. Gorsomlia Guriae, Nordmann (orig. LE, n.v., iso. G-B); pr. Tiflis, et in mont. Talysch, 914-1097 m., Meyer (orig. LE, n.v.); e Georgieffsk et e fluv. Kuban, 1817, Steven (orig. H. n.v., iso. G-DC).

Distribution: Balkan peninsula, Crimea, Turkey, Caucasus, Syria, Lebanon and rarely in N. Iran and Transcaspian. Intermediates between subsp. repens /

<u>repens</u> and subsp. <u>trichostachyum</u> occur in Romania as <u>A. transsilvanicum</u>. Map 14.

TURKEY. A2(E): Prov. Istanbul, Constantinople, <u>Coumany</u>. A2(A): Prov. Bursa, Mt. Olympi (Ulu dağ), 200 m., 26 May 1899, <u>Bornmüller</u> 4112; <u>ibid</u>., Bursa-Soğukpinar, 10 km. from Soğukpinar, 500-1000 m., 16 May 1962, <u>Dudley</u> (D. 34748); <u>ibid</u>., Mt. Olympus, <u>Aucher</u> 261. A3: Prov. Bolu, 12 km. N. Bolu, S. of Cağlikdere, 1150 m., 15 Jun. 1957, <u>Kühne</u> 811; A4: Prov. Zonguldak, Balikisik, nr. Yenice, 150 m., 22 Jul. 1962, <u>Davis</u> 37971; Prov. Kastamonu, Kure-Nahas (Küre) nr. Ekilschar (Ekisai?), nr. Taschlik chan (Taşlik- 17½ km. N.W. of Kastamonu), 3 May 1892, <u>Sintenis</u> 3776. A5: Prov. Amasya, Sana Dagh, 15 May 1890, <u>Bornmüller</u> 1943. A7: Prov. Giresun, Balzabandağlari, above Tamdere, 1800 m., 6 Aug. 1952, <u>Davis</u> 20508. A8: Prov. Çoruh, Mürgül, 300 m., 17 Apr. 1960, <u>Stainton et. al</u>. 8199. A9: Prov. Çoruh, dist. Ardanuç, Kordevan dağ (Yalnizçan dağ), 2400 m., 28 Jun. 1957, <u>Davis</u> 30376; Prov. Kars, Ziyaret dağ (Yalnizçan dağ), nr. Ardahan-Artvin, 2200 m., 29 Jun. 1957, <u>Davis</u> 30295; <u>ibid</u>., Yagmurlu dağ, Karaurgan-Sarikamiş, 2350 m., 13 Jun. 1957, <u>Davis</u> 29476. B8: Prov. Erzurum, 1830 m., Jun. 1853, <u>Huet</u>. C5: Prov. Içel, Dombelck pass, Ereğli-Mersin, 1800 m., Jun. 1914, <u>Siehe</u> 326; <u>ibid</u>., Mersin, 1250 m., 28 May 1957, <u>Demiriz</u> 640. Armenia, <u>Szowits</u> 55. Turkey in Europe, 1845, <u>Thirke</u>. Anatolia, <u>Wiedemann</u>.

<u>Habitat</u>: Calcareous or siliceous substrates, stony igneous and limestone slopes, gravelly and grassy banks, volcanic slopes; often in <u>Fagus</u> scrub, <u>Quercus</u> macchie, <u>Pinus sylvestris</u> woods and mixed <u>Cedrus</u> and <u>Abies</u> forests; alt. (150-) 500-2000 (-2400) m. Fl. May-Jun.

Though _A. trichostachyum_, in its typical expression, is well distinguished from the partially sympatric _A. repens_, the occurrence of intermediates (often identified as _A. transsilvanicum_) in the area of overlap, primarily in Romania, indicate that subspecific rank is preferable to full specific recognition. Subspecies _trichostachyum_ replaces subsp. _repens_ in the southern and eastern parts of the specific range.

The types of Busch's infra-specific taxa of _A. repens_ have not been seen, but their descriptions and distributions clearly allow their equation with var. _trichostachyum_.

var. stenophyllum Hal., Consp. Fl. Gr., 1, 94 (1900)!

Syn.: A. virescens Hal., loc. cit.!

A. montanum L. subsp. repens proles trichostachyum f. A.stenophyllum (Hal.) Baumg., op. cit., 14 !

A. montanum subsp. repens proles virescens (Hal.) Baumg., op. cit., 16!

A. montanum subsp. repens proles transsilvanicum (Schur) Baumg. f. macadonicum Baumg., op. cit., 21!

A. repens var. callieri Busch in Fl. Cauc. Crit., 3 (4), 577 (1909)!

A. repens subsp. trichostachyum subf. stenophyllum (Hal.) Hayek, loc. cit.!

A. repens subsp. trichostachyum var. virescens (Hal.) Hayek, loc. cit.!

Lectotype: (Greece): Thessalia, mt. Turnara (in subalpina) pr. Chaliki Pundo, 26 Jun. 1896, Sintenis 794 (orig. W-Hal., iso. W,K,BM,E).

Distribution: Central and N. Greece, N. Anatolia, Caucasus and the Crimea. Map 14.

TURKEY. A3: Prov. Bolu Abant gölü, 11 Jul. 1940, Post; ibid., Hallihan-Mudurnu, Mt. above Mudurnu, 1250 m., 9 Jul. 1962, Davis 37087. A4: Prov. Kastamonu, Ilgaz dağ (nr. Tosya), 200 m., 23 Jun. 1929, Bornmüller 13861; ibid., Küre-Inebolu, 732 m., 7 Jun. 1954, Davis 21598; Prov. Zonguldak, Tefen-Yenice, 50-100 m., 19 Jul. 1962, Davis 37763; ibid., Kel tepe above Yenice, above Sorgun yayla, 1700 m., 20 Jul. 1962, Davis 37890; ibid., Kel Tepe above Karabük, 1950 m., 3 Aug. 1962, Davis 38921; ibid., 800 m., 3 Aug. 1962 Davis 38815.

Habitat /

<u>Habitat</u>: Rocky igneous slopes, S. facing limestone slopes and dry hillsides; alt. (50-) 100-1950 m. Fl. Jul.

The smallest fruits in <u>A. repens</u> prevail in this taxon. Baumgartner (1908) recognised that its erect stems, petal andfruit shape and size allow var. <u>stenophyllum</u> to be placed in closer relationship with subsp. <u>tricho-stachyum</u> (or his "proles") than to subsp. <u>repens</u>. At the same time Halácsy described var. <u>stenophyllum</u>, he established <u>A. virescens</u> which cannot be morphologically separated from the former; in fact, the type localities of these two taxa are virtually identical. The Crimean var. <u>callieri</u> is indistinguishable from the Greek <u>A. virescens</u> and from the type material and many Anatolian gatherings of var. <u>stenophyllum</u>.

The distribution of var. <u>stenophyllum</u> is entirely sympatric with var. <u>trichostachyum</u> but is confined to a much more limited area, primarily in the Euxine territory of N. Anatolia, Lazistan, Caucasus and the Crimea. The small, scattered populations of var. <u>stenophyllum</u> appear to be constant in their morphological expressions.

34. A. wierzbickii Heuff. in Flora, 18 (1), 242 (1835); Reichenb. Ic. Fl. Germ. & Helv., 2, t.20, f.4272b (1837-1838); Heuff. in Verh. Zoo-Bot. Gesell. 8, 58 (1858); Nyár. in Mag. Bot. Lap., 24, t. 1, f.30 (1925); Fl. Rep. Pop. Rom., 3, 328, t. 58, f.1 (1955).

Syn.: A. montanum L. var. magnum Wildt. in Verh. Nat. Ver. Brünn, 44, 258 (1906).

A. repens Baumg. ssp. wierzbickii (Heuff.) Hayek, Prod. Fl. Pen. Balc., 1, 436 (1925)!

A. rostratum Stev. var. argenteum Prodan in Cont. Bul. Bot. Cluj, 1 (17), 4 (1928)!

A. rostratum var. argenteum f. grecescui Prodan, op. cit., 5!

Type: (Romania): rupestribus in montanis Tilfa mare dictis Oraviczam in Banatu, May-Jun., Heuffel (holo. W, iso. K,E).

Distribution and habitat: Rare alpine biennial usually on volcanic rock in Yugoslavia, Romania, Bulgaria, Hungary and Czechoslovakia. Fl. May-Jun.

35. A. calycocarpum Rupr. in Mém. Acad. Sc. Pétersb., 15 (2), ser. 7, 103 & 291 (1869); Busch in Fl. Cauc. Crit., 3 (4), 579 (1909).

Syn.: A. montanum L. var. genuinum Boiss., Fl. Or., 1, 274 (1867), pro parte quoad plantam a Steven lectam!

A. rotundatum Aggenko, Fl. Taur., 1, 40 (1889); ibid., ed. 2, 124, t. 1 (1894).

A. calycocarpum f. rotundatum (Agg.) Busch, op. cit., 580.

A. montanifolium Pau in Trab. Mus. Nat. Cienc. Nat. Madrid, ser. Bot., 14, 15 (1918)!

Syntypes: (Caucasus and Crimea): in Tauriae et Caucasi collibus, Steven (orig. H, n.v., iso. G-DC, orig. synt. A. montanum var. genuinum G-B); e Jaila pr. Nikita, Steven (orig. H, n.v.).

Distribution: Crimea, Caucasus, N. Iran and rarely in Turkish Kurdistan.

TURKEY. C9: Prov. Van, dist. Çakak, Kavussahap dağ, 3200 m., 23 Jul. 1954, Davis 23107.

Habitat: Limestone mountain scree and mountain steppe; alt. up to 3200 m. Fl. Jun.-Jul.

This rare species has often been confused with A. repens subsp. trichostachyum which grows in the same areas of the Crimea and the Caucasus. The persistent sepals, obovate-spathulate and obtuse basal cauline and sterile shoot leaves, dense silvery-white leaf indumentum of appressed stellate hairs, larger floral parts, longer and basally dilated styles (often up to 6 mm. long), very much larger seeds, shorter racemes, /

racemes, usually dwarf stature, and shorter depressed sterile shoots distinguish A. calycocarpum from A. repens subsp. trichostachyum.

A. montanifolium is known to the author by its type description and a photograph kindly sent by the Keeper of the Herbarium, Instituto Botanico Antionino-José Cavahilles, Madrid, Spain. This short description and photograph of the type specimen (Escalera, Iter Persicum, Kouh-Sefid, 3000 m., 1899) compares favourably with other collections of A. calycocarpum from N. Iran and S. Caucasia, and with the only gathering from Turkish Kurdistan (Davis 23107).

36. A. pulvinare Velen. in Sitz. Böhm. Gesell. Wissen., 33 (2), 30 (1889); ibid., Fl. Bulg., 39 (1891); ibid., in Sitz. Böhm. Gesell. Wissen., 37, 8 (1893); ibid., Suppl. Fl. Bulg., 1, 25 (1898); Baumg. in Beil Jahresb. Nied.-Öst. Land.-Lehrers. Wien-Neust., 36, 15 (1909); Hayek, Prod. Fl. Pen. Balc., 1, 431 (1925); Fl. Rep. Pop. Rom., 3, 340, pl. 59, f. 3 (1955).

Type: (Bulgaria): In rupibus aridis calcareous supra vicum Kinjovo, Aug. 1887, Velenovsky (holo. PRC).

Distribution and habitat: Uncommon on calcareous substrates in N. Greece, Bulgaria and Romania.

37. A. pseudo-mouradicum Hausskn. & Bornm. ex Baumg. in Beil. Jahresb. Nied.-Öst. Land.-Lehrers. Wien.-Neust., 36, 6 (1909); Bornm., Symb. ad Fl. Anat., 53 & 54 (1936). Fig. 1A, e; fig. 1B, g, u; fig. 2, h.

Syn: A. pseudo-mouradicum Hausskn. & Bornm. in Verh. Zoo-Bot. Gesell., 48, 552 (1898), nomen nudum!

A. montis-stellae Hausskn. & Bornm. loc. cit., nomen nudum!

A. montis-stellae Hausskn. & Bornm. ex Baumg., op. cit., 8!

Lectotype: (Turkey, A7: Prov. Gümüşane): Armenia Turcica, Gumushane, Darsos Dagh (nr. Sorda) (in prascius alpinis montis), 6 Jun. 1894, Sintenis 5759 (orig. W, iso. G,G-BB,K,BM).

Distribution: Present on a few mountains in Central Anatolia and Armenia. Map 15.

TURKEY. A4: Prov. Zonguldak, Kel tepe above Karabük, 1950 m., 3 Aug. 1962, Davis 38893; Prov. Çankiri, Çankiri, 9 Jun. 1954, Davis 21747. A6: Prov. Tokat/Sivas, Yildiz dağ, Tokat-Sivas, 1900-2500 m., 7 Jun. 1890, Bornmüller 1940 (holo. A. montis-stellae, W?, n.v., iso. G-BB). A7: Prov. Gümüşane, Dranorva in Moaldasdagh (Mağaldas, 7½ km. S.S.E. of Gümüşane), 20-22 Jun. 1894, Sintenis 5930 (orig. synt. W, iso. G,G-BB,K, BM,E); ibid., Agryridagh (nr. Elias dağ), 15 & 20 Jun. 1894, Sintenis 5557 (orig. synt. W?, n.v., iso. E); ibid., Gümüşane, Mt. Brothacolium (?), 9 Jun. 1872, Bourgeau (175) (orig. synt. A. armenum G-B, iso. W); ibid., Karagvelladağ (Karagöl dağ, 30 km. W.S.W. of Gümüşane), 3 Aug. 1894, Sintenis 7314 (orig. synt. W, iso. G-BB). B6: Prov. Adana, Hadjine (Saimbeyli)- Karaklissa, 9 Jul. 1906, Post 223 & 250. Kurdistan, 1840, Strangways pro parte.

Habitat /

Habitat: Montane and mountain steppe, gypsum hills and N. facing rocky limestone slopes; alt. 1900-2500 m., Fl. Jun.-Jul.

On the basis of its oblanceolate and acute leaves, its sprawling habit, and especially its indumentum of large few-rayed but often branched stellate hairs which always appear strigose on the upper parts of the plant, this species is more closely allied to A. erosulum and A. pulvinare than to A. mouradicum. The only noticeable similarity between A. mouradicum and A. pseudo-mouradicum is that their fruits are roughly the same shape, though those of the latter are larger and much more asymmetrically inflated. Baumgartner claimed another similarity - their glabrous fruits - but as pointed out by Bornmüller (1936), though the valves surfaces of the fruits of A. pseudo-mouradicum are always glabrous, the fruits are always furnished with a distinct marginal row of diverent-rayed stellate hairs. This is a very rare feature in Alyssum (the fruit surfaces are usually either pubescent all over or are glabrous), and is diagnostic of A. pseudo-mouradicum.

In addition to its glabrous valve surfaces with a marginal row of stellate hairs, A. pseudo-mouradicum can be distinguished from A. erosulum and A. pulvinare by its larger broadly spathulate and bilobed petals, elongate fruiting racemes, longer styles, cauline leaves decreasing in size upwards, and a sparser over-all indumentum making the plant appear greenish (that of A. erosulum and A. pulvinare is very dense and whitish or gray.).

The type gathering of A. montis-stellae has been examined and is found in no significant features to differ from the Sintenis gatherings of A. pseudo-moradicum. Though Baumgartner maintained these two taxa as separate species, he discussed the possibility that A. montis-stellae might be better considered /

considered as a variety of A. pseudo-mouradicum, and went further by citing the type collection (Bornmüller 1940) of A. montis-stellae under both species! He states in his discussion of A. montis-stellae that he could find no difference between these species except that the stems of A. pseudo-mouradicum appear to be shorter than those of A. montis-stellae, and that the appendages of the short filaments of the latter were short and free, while those of the former were longer and connate to the filaments. Floral dissections of the type material of both binomials and of additional material reveals that their short filament appendages are identical, i.e. small, basal and free. It is interesting to note that Baumgartner claimed the connate short filament appendages were diagnostic for A. pseudo-mouradicum, and that the appendages of A. mouradicum were free. Flowers from every specimen cited in the enumerations of these species have been dissected and the parts mounted; it is apparent that the short filament appendages of A. pseudo-mouradicum are free, those of A. mouradicum are connate.

The binomial pseudo-mouradicum is accepted in preference to montis-stellae which was published at the same time. Baumgartner did not doubt that A. pseudo-mouradicum could be distinguished from other species as he did with A. montis-stellae. Furthermore the epithet pseudo-mouradicum, though slightly misleading by referring to a possible affinity to A. mouradicum, is of less obscure derivation than the epithet montis-stellae which is the Latin equivalent for the Turkish name of the mountain (Yildis dağ- Star mountain), where the type of A. montis-stellae was collected.

From all the specimens cited with the description of A. pseudo-mouradicum, the Sintenis number (5759) is chosen as the lectotype of the species. It is the only original gathering with both mature fruits and flowers; also the only /

only original gathering entirely composed of one taxon in all the herbaria where it has been seen (many duplicates of the other cited specimens have fragments of other species of *Alyssum* mixed with *A. pseudo-mouradicum*).

One of the original syntypes of *A. armenum* (*Bourgeau* from Gümüşane) is to be referred to *A. pseudo-mouradicum*.

38. A. erosulum Gennar & Pestal. in Mem. della Reale Accad. delle Sc. Torino, ser. 2, 16, 248 (1855); Baumg. in Beil. Jahresb. Nied.-Öst. Land.-Lehrers. Wien.-Neust., 36, 10 as A. suffrutescens (1909).

Syn.: A. wulfenianum Bernh. ex Willd. var. suffruticosa Boiss. in Ann. Sc. Nat., ser. 2, 17 152 (1842)!

A. alpestre L. var. minutulum Fenzl in Tchih., Asie Min., Bot. 1 (3), 303 (1860)!

A. suffrutescens Boiss., Fl. Or., 1, 275 (1867)!

A. suffrutescens var. olympicum Boiss., op. cit., 276!

A. wulfenianum var. Boissieri Baumg., loc. cit., pro syn.!

Syntypes: (Turkey, A2(A): Prov. Bursa): in Olympi Bithynici (Ulu dağ) regione alpina humiliori, Clementi (orig., TO, n.v.). (Turkey, C3: Prov. Antalya), in Asiae minoris Adalia (Antalya) prope Bereket dagh (Çalbali dağ), 1846, Pestalozza (orig. TO n.v., iso. G, G-BB).

Distribution: Rare endemic to the Mediterranean region of Anatolia, Map 15.

TURKEY. A2(A): Prov. Bursa, Bithynia Olympo (Ulu dağ), 1835, Aucher 275 (holo. A. wulfenianum var. suffruticosa, G-B, orig. synt. A. suffrutescens var. olympicum, G-B, iso. G,K,BM); ibid., Aucher 75; ibid., Jul. 1874, Pichler 125. B1: Prov. Balikesir, Mt. Ida (Kaz dağ), Ssu-Sjus dagh, 20 Jul. 1883, Sintenis 608. C2: Prov. Antalya, Elmali, Elmali dağ, 9 Jun. 1860, Bourgeau (51) (orig. synt. A. suffrutescens, G-B, iso, G,W,Hub.-Mor.). C3: Prov. Antalya, Çalbali dağ, 2100-2200 m., 14 Jul. 1949, Davis 15303; ibid., Sogut Cumasi yayla, Teke dağ-Çalbali dağ, 1400 m., 13 Jul. 1949, Davis 15240.

Habitat: Alpine, on calcareous scree; alt.1400-2200 m., Fl.Jun.-Jul.

The lax habit, linear, acute and oblanceolate leaves, and the indumentum of long rayed strigose stellate hairs of this species are reminiscent of A. pseudo-mouradicum. By its densely pubescent and smaller fruits with densely pubescent styles, smaller obovate and entire petals, condensed few-fruited racemes, strongly suffruticose stock, denser and grayish over-all indumentum, and cauline leaves which increase in size upwards, A. erosulum can be readily distinguished from A. pseudo-mouradicum.

Though the epithet erosulum (referring to the insect damage of the petals) may be inappropriate, (Boissier, 1867), it is the earliest validly published name of this taxon. The type collections of all the synonyms have been examined and do not differ in any significant features. Boissier considered Clementi's gathering from Mt. Olympus in Bithynia (one of the syntypes of A. erosłum) to represent A. suffrutescens var. olympicum, and referred the other A. erosulum syntype (Pestalazza from Çalbali dağ in S.W. Anatolia) to A. suffrutescens sensu stricto. There are, however, no discernible differences between these two collections.

Fenzl in Tchihatcheff (1860) treats A. tortuosum var. pumilum Clementi (published in the same journal as A. erosulum) as a synonym of A. alpestre L. var. minutulum (lectotype: Clementi from Mt. Olympus, also one of the syntypes of A. erosulum). The inadequate description and inavailability of the type material of A. tortuosum var. pumilum do not permit the present author to accept this view. However, it is certainly possible that the Clementi syntype of A. erosulum and the type of A. tortuosum var. pumilum represent one and the same plant.

The /

The _Sintenis_ specimen from Armenia (No.2628) referred by Baumgartner to _A. suffrutescens_ is correctly identified as _A. ochroleucum_; _A. erosulum_ is confined to some of the highest mountains in Western Anatolia, while _A. ochroleucum_ is a plant of high mountain steppe in the Armenian Highlands and Turkish Kurdistan.

39. A. montanum L., Sp. Pl., 2, 650 (1753); Baumg. in Beil. Jahresb. Nied.-Öst. Land.-Lehrers. Wien.-Neust., 34, 1 (1907).

Key to infra-specific taxa

1. Silicules orbicular or elliptic, ± emarginate, (2.5-) 3-4 x 2.5-3 mm.; fruiting racemes condensed, 5 cm. long, rarely more; styles 2-2.5 mm. long subsp. montanum (E)
   2. Stellate hairs on sepals ± appressed; sterile shoots densely conferted on lignose base; basal cauline leaves obovate-spathulate, obtuse, (4-) 5-10 mm. wide var. montanum (E)
   2. Stellate hairs on sepals with divergent furcate rays at apex; sterile shoots few, arcuate-ascending; basal cauline leaves linear, oblanceolate, acute, 1.5-3 (-4) mm. wide
      3. Cauline leaves bicoloured; indumentum dense of ± minute silvery stellate hairs; pedicels 2-4 mm. long, divergent or ascending var. hymettium (E,T?)
      3. Cauline leaves concolourous; indumentum sparse, greenish of ± coarse stellate hairs; pedicels 5-10 mm. long, spreading to horizontal var. molliusculum (E)
1. Silicules obovate, usually obtuse or subemarginate, (3-) 4-6 x 2.5-4 mm.; fruiting racemes elongated, up to 15 cm. long; styles 2.5-4 mm. long subsp. gmelini (E)

subsp. montanum.

var. montanum Jacq., Fl. Aust., 1, t. 37 (1773); Reichenb., Ic. Fl. Germ. & /

& Helv., 2, pl. 19, f. 4274 (1837-1838); Jordan, Obs. Pl. Nouv., pl. 1, f. F (1846); Busch in Fl. Cauc. Crit., 572 (1909); Nyar. in Mag. Bot. Lap., 24, t. 1, f. 16 (1925); Fl. Poloska, 3, pl. 16, f. d (1927); Fl. Rep. Pop. Rom., 3, pl. 57, f. 2 (1955); Hegi, Ill. Fl. Mitt. Eur. ed. 2, 4 (1), f. 166, 168, T. 125, f. 10 (1960).

Syn.: A. flexicaule Jord., Obs. Pl. Nouv., 12, T. 1, f. E (1846).

A. montanum var. genuinum Boiss., Fl. Or., 1, 274 (1867), pro parte!

A. beugesiacum Jord. & Fourr., Brev. Pl. Nov., fasc. 2, 10 (1868)!

A. brevifolium Jord. et Fourr., op. cit., 11!

A. collicolum Rouy & Fouc., Fl. de Fr., 2, 180 (1895).

A. montanum var. graecum Hal., Consp. Fl. Gr., 1, 95 (1900).

A. montanum subsp. montanum proles eu-montanum Baumg., op. cit. 22!

A. montanum subsp. graecum (Hal.) Hayek, Prod. Fl. Pen. Balc., 1, 433 (1925)!

Type: "Helvetia". LINN No. 828:12. This sheet is determined by Linné as "2 montanum"; he also wrote on the back of this sheet "Alyssum fruticosum Alyssum serpyllifolium Amm. e Sibirica & Horto Upsal. 185". The entry in Linné's Hortus Upsaliensis, 185 (1748) "Habitat forte in Siberia, mihi enim. enata inter plantas ex seminibus Sibiricus" indicates that the A. montanum in the Botanic Garden at Upsalla was grown from seed presumably initially sent to Linné by Amman; it can be safely stated that these seeds were not collected in "Helvetia", but rather from somewhere in Russia, though not necessarily from Siberia as it is understood today. The "Helvetia" /

"Helvetia" of Species Plantarum comes from the reference to Bauhin's Historia Plantarum, 2, 928, t. 929 (1650-1651). There is another specimen of A. montanum in the Linnean herbarium, i.e. No. 828:14. However, it was not determined by Linné as A. montanum, and could not have served as the basis of the 1753 description, as it was not sent to Linné by Allioni until 1757. Linné did, however, recognize this specimen as A. montanum as shown from his writing on the back of this sheet, "Alyssum ramulis suffruticosis diffusis foliis punctatis echinatis", a direct quotation from Hortus Upsaliensis, 185 (1748).

Distribution: Widespread in Central, E. and S. Europe, and occasionally extending into N. Europe and W. Russia.

Habitat: Alpine and subalpine, among gravel and stones.

var. hymettium Boiss., Fl. Or. 1, 274 (1867).

Syn.: A. montanum var. angustifolium Boiss. in Ann. Sc. Nat., ser. 2, 17, 151 (1842), nomen nudum!

A. montanum var. genuinum Boiss., Fl. Or., 1, 274 (1867), pro parte!

A. sprunneri Jord. & Fourr., Brev. Pl. Nov., fasc. 2, 12 (1868)!

A. petrophyllum Boiss. & Heldr. ex Nym., Consp. Fl. Eur., 1, 56 (1878), pro syn.!

A. montanum var. brachyphyllum Hal., Consp. Fl. Gr., 1, 95 (1900)!

A. thessalum Hal. loc. cit.!

A. montanum subsp. montanum proles humile Baumg, op. cit. 7!

A. montanum subsp. montanum proles laxum Baumg., op. cit. 8!

Lectotype /

Lectotype: (Greece): Graeciae monte Hymetto, Aucher 276 (orig. G-B, iso. G,K)

Distribution: Greece and the Aegean Islands.

TURKEY. ?B1: Lesbos (fide Candargy in Bull. Soc. Bot. Fr., 45, 110 as A. montanum: 1898).

Habitat: Rare alpine. Fl. Apr.-Jun.

var. molliusculum Reichenb., Fl. Germ. Exc., 670 (1832); Baumg. in Beil. Jahresb. Nied.-Öst. Land.-Lehrers. Wien.-Neust., 35, 26 as A. reiseri (1908).

Syn.: A. montanum var. crystallinum Reichenb., op. cit., 872.

A. reiseri Velen. in Sitz. Böhm. Gesell. Wissen., 37, 9 (1893)!

A. montanum subsp. montanum proles molliusculum (Reichenb.) Baumg. in Beil. Jahresb. Nied.-Öst. Land.-Lehrers. Wien.-Neust., 34, 15 (1907)!

A. montanum subsp. montanum proles ramosissimum Baumg., op. cit., 12!

A. montanum subsp. montanum proles pagense Baumg., op. cit., 19.

Type: (Yugoslavia): in Dalmatien, Welden (holo. W).

Distribution: Yugoslavia, Bulgaria.

subsp. gmelini (Jord. & Fourr.) Schmid in Hegi, Ill. Fl. Mitt. Eur. 4 (1), 451 (1919); Baumg. in Beil. Jarhresb. Nied.-Öst. Land.-Lehrers. Wien.-Neust., 35, 5 pro species (1908); Javorka & Csap., Ic. Fl. Hung., pl. 212, f. 1594 (1934); Fl. Ukraine, 5, 337, pl. 79 (1953); Fl. Rep. Pop. /

Pop. Rom., 3, pl. 57, f. 3 (1955); Hegi, Ill. Fl. Mitt. Eur., ed. 2, 4 (1), 285, f. 167 as A. montanum var. angustafolium (1960).

Syn.: A. montanum var. angustifolium Heuff. in Verh. Zoo-Bot. Gesell., 8, 57 (1858).

A. montanum var. dubium Heuff., loc. cit.

A. montanum var. commutatum Heuff., loc. cit.

A. gmelini Jord. & Fourr., Brev. Pl. Nov., fasc. 2, 8 (1868)!

A. orophilum Jord. & Four., op. cit., 11!

A. erigens Jord. & Fourr., op. cit. 9!

A. psammeum Jord. & Fourr., loc. cit.

A. collinum Jord. & Fourr., loc. cit.!

A. porphyreticum Jord. & Fourr., loc. cit.!

A. rhodanense Jord. & Fourr., op. cit., 10!

A. xerophilum Jord. & Fourr., loc. cit.!

A. pedemontanum Rupr. in Mém. Acad. Sc. Pétersb., 15 (2), ser. 7, 102 (1869)!

A. preissmanii Hayek in Ost. Bot. Zeit, 51, 301 (1901)!

A. montanum subsp. montanum proles elongatum Baumg. in Beil. Jahresb. Nied.-Ost. Land.-Lehrers. Wien.-Neust., 34, 11 (1907)!

A. montanum subsp. montanum proles pluscanescens Raim. ex Baumg., op. cit., 21!

Type: (West Germany): in arenosis, secus Rheni ripas, Coblentz, ex seminibus Wirtgen (holo. P. n.v., iso. W).

Distribution: Widespread in Central, W., E. and N. Europe.

Habitat: Sandy substrates, usually in lowland areas.

A. montanum is accepted as the lectotype species of the genus. (cf. Hitchcock and Green in the International Botanical Congress, Cambridge (England), Nomenclature, 171:1929 - "The type-species of Alyssum L. is probably A. incanum, but as this is the type of Berteroa DC. which is regarded as a distinct genus, it is not a convenient standard-species. Four species are common to Alysson Tourn. and Alyssum L., namely A. spinosum, A. montanum, A. incanum and A. halimifolium. As A. spinosum and A. halimifolium have been referred to Lobularia, it seems desirable to choose A. montanum as the standard species.". Apart from the reasons given by Hitchcock and Green for their choice of A. montanum as the standard species of Alyssum, and analysis of the description of Alyssum in Genera Plantarum, ed. 5,293 (1754) shows that A. montanum fits the description better than any of the other taxa, in particular reference to the important character of filament teeth which Linnaeus stresses ("filamenta ... denticulo notata" and "Essentialis character consitit in filamentis minoribus denticulato introrsum basi inserto."), thereby excluding, for the most part the other species.

As A. montanum is not known to occur in Turkey, a discussion of its synonymy and infra-specific taxa is postponed to a later date. The European specimens of A. montanum var. genuinum cited by Boissier (Flora Orientalis) are referable to A. montanum subsp. montanum. The Wiedemann gatherings from the Euxine region of N. Anatolia are identifiable as A. repens subsp. trichostachyum; likewise the Boissier and Gaillardot collections from Mt. Cassius in Syria and Lebanon, respectively. The Steven specimen from the Crimea in the Boissier Herbarium under A. montanum var. /

var. genuinum is a fragment from the type collection of A. calycocarpum. A. ochroleucum was considered by Boissier (1867) as a variety of A. montanum, but in the present study this taxon is treated as a distinct species with closer affinity to A. artwinense and A. armenum than to A. montanum.

40. A. armenum Boiss., Fl. Or., 1, 278 (1867); Baumg. in Beil. Jahresb. Nied.-Öst. Land.-Lehrers. Wien.-Neust., 36, 13 (1909) Schischkin, emend desc. in Bull. Mus. Georg., 18 (1922); Grossh., Fl. Kavk, ed. 2, 4, 216 and 307 (1950).

Syn.: A. daghestanicum Rupr. in Mém. Acad. Sc. Petérsb., ser. 7, 15 (2), 104 (1869);

A. tetrastemon Boiss. f. armenum (Boiss.) Buser in Boiss., Suppl. Fl. Or., 52 (1888);

Lectotype: (Turkey, B 10: Prov. Ağri); in Armenia Turcica prope Bayazid (Doğubayazit), Aucher 4093 (not 4095) (orig. G-B, iso. W,K,BM).

Distribution: Armenia, Turkish Kurdistan, Caucasus and rarely extending to N.W. Anatolia. Map 16.

TURKEY. A3: Prov. Bolu, Abant gölü, N.W. of Bolu, 1200 m. 18 May 1958, Markgraf. A5: Prov. Sinop, Ayancik-Zamdan böl, Abbas. B7: Prov. Erzincan, Egin (Kemaliye), Hochadur dagh (part of Sernek dağ nr. Kemerkoep), 15 May 1890, Sintenis 2284; Prov. Tunceli, Munzur dağ above Ovacik, 2600 m., 16 Jul. 1957, Davis 31137; ibid., 2400 m., 18 Jul. 1957, Davis 31345; ibid., 2600 m., 19 Jul. 1957, Davis 31393, pro parte. B8: Prov. Erzurum, Erzurum, Calvert & Zohrab; ibid., Khassankaly (Aşkale), 3 Jul. 1916, Sapozhnikov. B9: Prov. Van, dist. Gevas, Artos dağ, 3658 m., Davis 22883; ibid., dist. Gevas, Artos dağ, 2353 m., 15 Jul. 1954, Davis 22849; ibid., Van, 2840 m., 12 Jun. 1889, Kronenburg 55. B10: Prov. Ağri., Bayarzit (Doğubayazit), Aucher 2099; ibid., Kare-Babu, 16-17 May 1916, Schischkin. Asia Minor, Aucher 251. Kurdistan, 1840, Strangways pro parte. C9: Prov. Van, dist. Çatak, Kavusshap dağ (Şahap dağ),/

(Şahap dağ), 3300 m., 23 Jul. 1954, Davis 23119.

Habitat: A montane and alpine species on limestone slopes and scree, mountain summits and edges of woods; alt. 1200-3658 m. Fl. May-Jul.

Boissier's description of this species was rather inadequate and it was not until this description, Schischkin's emended description and the original specimens of this species in the Boissier Herbarium in Geneva were compared, that the specific limits could be defined with certainty. The description and discussion of A. armenum given by Baumgartner unfortunately is unreliable. He did not have a clear picture of A. ochroleucum or A. armenum and referred a specimen (Sintenis 5615b) of the former to the latter. Though A. ochroleucum and A. armenum somewhat resemble each other in habit and facies, there are a number of striking discontinuities which clearly distinguish them. The wings of the long filaments of A. armenum are unequal in width, usually edentate and abruptly constricted at their apices; those of A. ochroleucum are of equal width and are always two or three-dentate at their apices. The cauline leaves of A. armenum are broadly oblanceolate or obovate and those of the sterile shoots are as large or nearly twice as large as those of the fertile stems. A. ochroleucum possesses very narrow linear-oblanceolate cauline leaves and those of the sterile shoots are usually smaller by half than those of the fertile stems. The densely pubescent styles of A. armenum are in contrast to the glabrous ones of A. ochroleucum. Furthermore, as the specific epithet of A. ochroleucum indicates, its flowers are pale and cream coloured, while those of A. armenum are always flavous.

The type material of A. daghestanicum was kindly sent on loan from the /

the Leningrad Herbarium and agrees in all diagnostic characters with the numerous collections of *A. armenum* from the Caucasus and Turkish Armenia. Both Baumgartner and Schischkin correctly maintained *A. armenum* as distinct from *A. tetrastemon*, a component of Sect. *Gamosepalum*. Some workers (e.g. Boissier, 1867) confused *A. armenum* and *A. muelleri* which grow sympatrically in Caucasia. *A. muelleri* can be easily distinguished by its totally different type of indumentun, i.e. of many-rayed, silvery lepidote or sublepidote scales; that of *A. armenum* is composed of sparser few-rayed stellate hairs.

The *Aucher* 4093 gathering is chosen as the lectotype of *A. armenum* because the material in the Boissier Herbarium is mixed (the *Bourgeau* collection from Gümüşane is correctly referred to *A. pseudo-mouradicum*) and the *Aucher* specimen agrees with Boissier's somewhat fragmentary description. In the type description of *A. armenum* Boissier cited the *Aucher* specimen as No. 4095; however, the specimen of this gathering in Boissier's Herbarium and the duplicates in all the other herbaria are distinctly labelled as No. 4093.

41. A. ochroleucum Boiss. & Huet, Diagn., 3 (5), 36 (1856); Jord. & Fourr., Brev. Pl. Nov., fasc. 2, 12 (1868); Buser in Boiss., Suppl. Fl. Or., 50 (1888).

Syn.: A. montanum L. var. ochroleucum (Boiss. & Huet.) Boiss., Fl. Or., 1, 275 (1867)!

A. montanum L. subsp. montanum proles graecum (Hal.) Baumg. var. ochroleucum Baumg. in Beil. Jahresb. Nied-Öst. Land.-Lehrers. Wieb.-Neust., 34 4 (1907)!

A montanum subsp. montanum proles graecum var. ochroleucum f. simplex Baumg., loc. cit.!

Type: (Turkey, A 8: Prov. Erzurum): in Armenia prope Tortoum (Tortum), (inter Lako, inter Erzeroum et Ispir, 1219-1524 m.) Jun.1853 Huet. (holo. G-B, iso. G,W,K,BM).

Distribution: Endemic to Eastern Turkey and Turkish Kurdistan. Map 16.

TURKEY. A7: Prov. Gümüşane, Ardas (Torul) - Beschlissa, 30 Apr. 1890, Sintenis 2108; ibid., Gümüşane, 2 Jun. 1862, Bourgeau 37; ibid., Aghakoei (nr. Gümüşane), 31 May, 20 Jun. 1894, Sintenis 5615b; ibid., Wang (Venk), 26 May 1894, Sintenis 5615; ibid., Karahissartasch (nr. Venk), 26 Jun. 1894, Sintenis 5615c (holo. f. simplex W, iso. G,G-BB,K, BM). B7: Prov. Erzincan, Bacharsuk on the Euphrates (nr. Avşin, Kemaliye-Kemah), 9 May 1890, Sintenis 2206 (W pro parte, 1 plant of type collection of A. propinquum, 1 plant of A. ochroleucum); Prov. Erzincan/Elaâig, Egin on Euphrates (Kemaliye), Ersschevit dagh, 1889, Sintenis 2628; Prov. Tunceli, Munsur dağ, above Ovacik, 1900 m., 16 Jul. 1957, Davis 31184; ibid., 2700 m., 18 Jul. 1957, Davis 31249. B9; Prov. Van, /

Van, dist. Gevas, Artos dag, 2896 m., 16 Jul. 1954, Davis 22794.

Habitat: Limestone slopes and scree; alt. 1219-2896 m. Fl. Apr.-Jun.

Both Boissier (1867) and Baumgartner (1907) conclude that *A. ochroleucum* (originally described as a distinct species in 1856) was a variant of *A. montanum* meriting only varietal rank. *A. ochroleucum*, however, is only remotely allied to *A. montanum* and appears to be more closely related to *A. armenum* and *A. artwinense*. Its differing floral morphology, flower colour, deciduous sepals, narrow linear-oblanceolate cauline leaves which increase in size upwards, very slender stems and an entirely Anatolian distribution (*A. montanum* is not known to occur in Turkey) distinguish *A. ochroleucum* from *A. montanum*. It is interesting to note that in the Supplement to *Flora Orientalis* (1888), *A. ochroleucum*, as when it was originally described, is again treated as distinct from *A. montanum*.

42. A. artwinense Busch in Fl. Cauc. Crit., 3 (4), 566 (1909); Fl. URSS, 8 345 (1939); Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 11, t. 4, f. 2, Fig. 1 (1949); Grossh., Fl. Kavk. ed. 2, 4, 214 (1950).

Syntypes: (Turkey, A8: Prov. Çoruh): Batum, Artvin, prope Ardanuç, 29 Jun. 1904, Mikhailovski 9; ibid., 15 May 1907, Woronov 536; ibid., on river Çoruh, nr. Çoruh, 2 Jun. 1907, Woronov 535; ibid., Berta, su at Berta, May 1907, Woronov 534 (orig. TBI n.v. or L. n.v.).

Distribution: A rare localized endemic in the extreme N.E. corner of Lazistan. Map 15.

TURKEY. A8: Çoruh, Artvin- Ardanuç, 800 m., 26 Jun. 1957, Davis 30060; ibid., 20 km. S. of Artvin, 730 m., 10 Jul. 1959, Huber-Morath 16230; ibid., Zria (Sirya), on Çoruh river, 9 Jun. 1914, Turkevicz 717; ibid., nr. Ordzhoch on river Çoruh, 9 Jun. 1917, Turkevicz 739; ibid., nr. Chedzor ad Zom, 27 Jul. 1911, Woronov; ibid., nr. Tolgam, 2 Jul. 1911, Vvedensky 4035; Prov. Erzurum, Dist. Ispir, Ispir-Ikizdere, 8 km. N.W. of Ispir, 1200 m., 9 Jul. 1959, Huber-Morath 16229.

Habitat: Steep igneous rock slopes, eruptive stone and river banks; alt. 730-1200 m. Fl. May-Jun.

Originally described in Sect. Odontarrhena and considered by Nyárády as a component of his group "Humiliores" in that section, this species with two ovules in each locule must be referred to Sect. Alyssum. The reason for its application to Sect. Odontarrhena can be attributed to the fact that frequently only one of the ovules in each locule develops into a mature seed; however, the other aborted ovule is always visible, being /

being appressed to the replum.

A. artwinense is a very attractive species sympatric in the N.E. corner of Lazistan with one of its closest allies, *A. armenum*. It can be easily distinguished from its closest relatives, *A. armenum* and *A. ochroleucum*, by its very narrowly linear, ash-coloured leaves, orbicular smaller fruits with a comparatively sparse indumentum which appears punctate, shorter styles, pale lemon coloured petals, and tortuose slender stems.

43. A. moellendorfianum Aschers. ex Beck in Ann. Nat. Hofmus. Wien, 2, 173, t. 2, f. 5-7 (1887).

Syn.: A. montanum L. subsp. montanum proles moellendorfianum (Aschers. ex Beck) Baumg. in Beil. Jahresb. Nied.-Öst. Land.-Lehrers. Wien.-Neust., 34, 20 (1907)!

Type: (Yugoslavia): Herecegovinia, Tesanical, in saxosis calcareis prope Konjica, 500 m., Jun. 1885, Beck 28 (holo. PRC. n.v., iso. K,BM,E).

Distribution and habitat: Rare endemic to Hercegovinia and Bosnia, confined to calcareous substrates; alt. 500 m. Fl. Apr.-May.

44. A. stribrnyi Velen., Fl. Bulg., 640 (1891); ibid., Suppl. Fl. Bulg., 1, 25 (1898); Baumg. in Beil. Jahresb. Nied.-Ost. Land.-Lehrers. Wien.-Neust., 35, 3 (1908); Vandas, Relig. Form., 36 (1909); Hayek, Prod. Fl. Pen. Balc., 1, 435 (1925); Fl. Rep. Pop. Rom., 3, 343, pl. 59, f. 2 (1955). Pl. 6. Fig. 1A, k; fig. 1B, t.

Syn.: A. thracicum Velen., op. cit. 40!

A. midzorense Form. in Verh. Nat. Ver. Brünn, 36, 89 (1897).

A. montanum var. galicicae Form. in Verh. Nat. Ver. Brünn, 37 197 (1898).

A. mildeanum Podop. in Verh. Zoo-Bot. Gesell., 52, 630 (1902)!

A. stribrnyi var. mughetorum Bornm. in Eng. Bot. Jahrb., 59, 353 (1924).

A. galicicae (Form.) Hayek, op. cit., 436.

Syntypes: (Bulgaria): in rupestribus calidis calcareis supra Stanimaka, Stříbrný (orig. PRC, iso. W,G,K,BM).

Distribution: Extremely disjunct, including Romania, Bulgaria, N. Greece and Turkey-in-Europe. In Asiatic Turkey from S. Turkey (Antalya) eastwards to the Amanus and the Anti-Taurus. Also present in Syria and Lebanon. Map 16.

TURKEY. A1(E): ?Prov. Tekirdağ, Tekir, Jun. 1907, Stříbrný. A2(E): Prov. Istanbul, Istanbul-Terkos gölü, Karaburun-Tahlisiye, E. side of Terkos gölü, 50-60 m., 8 May 1962, Dudley (D. 34558); ibid., E. side of Terkos gölü, 50-60 m., 8 May 1962, Dudley (D. 34568). C3: Prov. Antalya, nr. Antalya, Jul. 1961, Atay T/50. C6: Prov. Adana, dist. Osmaniye, Yarpuz-Yağlipinar, 1300-1450 m., 27 May 1956, Huber-Morath 13737 /

13737; Prov. Hatay, dist. Belen, Amanus, Karlik tepe above Soguk Oluk, 1400 m., 24 Apr. 1957, Davis 27111; ibid., Kay-Pok-Dagh (nr. Kotschbel dağ, N. of Iskenderun), 20 Sept. 1887, Post 34; ibid., 13 Jun. 1884, Post; Prov. Gaziantep/Maraş, Aintab (Gaziantep) - Marash (Maraş), Artrichakoi nr. Uffodschakly (Ahir dağ?), 914-1524 m., 12 Jul. 1865, Haussknecht (orig. synt. A. praecox, G-B, iso. K). C7: Prov. Adiyaman, Nimrud dağ, nr. Kjachta (Kâhta), distr. Marumet-ül-Asis (Urfa-Malatya), 1600-2250 m., 12 Jul. 1910, Handel-Mazzetti 2107. D6: Prov. Hatay, Cassius, (Akra dağ), May-Jul. 1846, Boissier; ibid., 9 Jun. 1884, Post; ibid., 1219-1667 m., Haradjian 3154.

Habitat: Very variable, sand dunes, sandy road banks; in Turkey, Syria and Lebanon most often in Quercus macchie and Pinus nigra woods; alt. sea level-914 (-1300-2250) m. Fl. May-Jun.

The type descriptions of all the synonyms have been compared with the abundant material of A. stribrnyi from the Balkans and Anatolia. The minor differences which appear to exist (at least in the descriptions) do not merit the establishment of specific or even infra-specific taxa. The type collections of A. mildeanum, A. thracicum and A. stribrnyi borrowed from Prag (PRC) are all conspecific, and have no apparent diagnostic characters which could be used to separate them. The type description of A. mildeanum states that the major diagnostic character separating it from A. stribrnyi is the gradually attenuate and edentate condition of the wings of the long filaments. However, in approximately ten flowers examined from the type of A. mildeanum, the long filaments were all dentate in a manner similar to A. stribrnyi.

Though /

Though A. thracicum was published at the same time as A. stribrnyi, and is possibly a more convenient name, the latter binomial is chosen as the correct one referring to this species because its description is very much more complete and exacting in detail than the description of A. thracicum. Without reference to the type material of A. thracicum, it would be impossible merely by reading the description to distinguish it from A. montanum or A. pulvinare.

This species was collected in 1962 for the first time in Turkey-in-Europe (Dudley : D. 34558 & D. 34568). It is doubtful if the Stříbrný collection from Tekir is in fact the Tekirdağ in Turkey-in-Europe; probably it is somewhere in Bulgaria near Stanimaka (most of his collections from Tekirdağ were labelled as coming from Rhodosto, the old name for Tekirdağ). A. stribrnyi had been collected a number of times before in Asiatic Turkey, Syria and Lebanon, but the identification of these specimens has long been in doubt. Most of these gatherings were labelled as A. montanum, which is not known to grow anywhere east of the Bosphorous. One of the original syntypes of A. praecox (Haussknecht; Gaziantep-Maraş) must be referred to A. stribrnyi. It is interesting that Handel-Mazzaetti determined his gathering of this taxon (No. 2107) as "A. stribrnyi ?".

The reasons for the extremely disjunct distribution of this species is not known, but it could be hypothesised that the present Asiatic stations represent points of survival of a once more widespread species. Possibly more intensive collecting will reveal more stations in Western and Mediterranean Anatolia.

45. A. idaeum Boiss. & Heldr., Diagn. 2 (8), 35 (1849); Boiss., Fl. Or. 1, 277 (1867); Raulin, Desc. Phys. Crete, 708, Atlas t. 5 (1869); Hal., Consp. Fl. Gr., 1, 96 (1900); Baumg. in Beil. Jahresb. Bied.-Ost. Land.-Lehrers. Wien.-Neust., 35, 44 (1908); Hayek, Prod. Fl. Pen. Balc. 1, 431 (1925); Rech. fil., Fl Aegeae, 223 (1943).

Syn.: A. curetum Gandog. in Bull. Soc. Bot. Fr., 64, 121 (1917).

A. idaeum var. curetum (Gandog.) Hayek, loc. cit.

Type: (Crete): ad saxa cacuminum montis Idae, 1829 m., rarum, May 1846, Heldreich (holo..G-B, iso. W, GH).

Distribution: Rare endemic found only on Crete.

Habitat: Alpine, on calcareous rocks and scree; alt. 1829-2300 m. Fl. May-Jun.

A. curetum is said to differ from A. idaeum in having larger leaves which are more densely lepidote (not less densely lepidote as indicated by Hayek and Rechinger), larger yellow petals and ovate fruit with shorter styles. The original Gandoger collection of A. curetum has been seen (G) and can be identified with no difficulty as A. idaeum. The differences which Gandoger pointed out are not significant when the whole pattern of variation for the species is considered.

A single specimen (BM) of A. idaeum has minutely lepodote fruits, but as this condition occurs on only one specimen out of many collected from Crete, fromal recognition does not seem justifiable.

A collection of A. idaeum in the Edinburgh Herbarium is labelled as coming from the island of Andros (Cyclades). This is most probably an error. /

error. In Crete this alpine species grows at a minimum altitude of 1829 meters, while the highest point on Andros is only 1000 m. (A sheet of Viola fragran labelled in the same handwriting as coming from Andros, confirms the error: this species is generally considered as endemic to alpine Crete.)

Baumgartner considered the Baldacci 154 collection from Lassiti in Crete to represent A. idaeum. However, this gathering is the type of A. lassiticum, a very distinct species more closely allied to A. sphacioticum than to A. idaeum.

46. A. mouradicum Boiss. & Bal., Diagn., 3 (6), 16 (1859); Boiss., Fl. Or., 1, 277 (1867); Baumg. in Beil. Jahresb. Nied.-Øst. Land.-Lehrers. Vien.-Neust., 36, 5 (1909). Fig. 1A, m.

Type: (Turkey, B2: Prov. Kütahya): in regione alpina montis Mouraddagh (Murat dağ) Phrygiae, 2400 m., 27 Jun. 1857, Balansa (373) (holo. G-B, iso. G).

Distribution: Rare but widely distributed in Anatolia from Murat dağ in the Phrygian steppe to the Cilician Tauras. This species is also present in Lebanon. Map 17.

TURKEY. B2: Prov. Kütahya, Murat dağ, above Gedis, above Kesit Söğüt, 1900 m., 5 Jul. 1962, Davis 36792. C4: Prov. Konya, Jelibel dağ, Karaman-Ermenak, 2020 m., 10 Jun. 1948, Huber-Morath 8213 pro parte. C5: Prov. Içel, Kagiraki, (nr. Külek), 700 m., 1895, Siehe 95 & 42; ibid., Kysil depe nr. Bulgar Maaden, 2700 m., Jun. 1912, Siehe 250 pro parte; ibid., Bulgar dağ, 1895, Siehe 450 pro parte; Namrun, 16 Apr. 1933, Balls 186; ibid., Goelek (Külek), 1000 m., 7 Apr. 1934, Balls 684; Prov. Adana, Zeytun, Kuru dağ (nr. Adana), 1667 m., 10 May 1934, Balls 1030.

Habitat: Igneous slopes, limestone scree and chalk slopes of S. and S.E. exposure; often in association with Pinus brutia; in Lebanon found in Cedrus forest; alt. (700-) 1000-2700 m. Fl. Apr.-Jun.

The differences distinguishing this species from A. praecox are detailed in the discussion of that species. Baumgartner did not recognise the distinctness of these species due to the lack of sufficient satisfactory/

satisfactory material, and suggested that A. mouradicum be regarded as a form of A. praecox.

The Aucher specimen (No.75) from Ulu dağ near Bursa cited in Flora Orientalis (1867) as A. mouradicum is correctly identified as A. erosulum (A. suffrutescens) with densely pubescent ovaries, and linear acute leaves with an indumentum of large few-rayed stellate hairs. No specimens of A. mouradicum have been seen from Ulu dağ, one of the classical localities of A. erosulum.

P. H. Davis in 1962, recollected A. mouradicum for the first time since the original Balansa gathering, from the type locality (Murat dağ), though numerous collections are known from the Cilician Taurus and the Cedrus forest in Lebanon (e.g. Blanche, Peyron, Zerny and Meinertzhagen).

47. A. handelii Hayek in Beih. Bot. Centralb., 65, 279 (1929).

Syn.: ?A. olympicum Hal., Consp. Fl. Gr., 1, 91 (1900).

Syntypes: (Greece): Thessalia Olympo, in lockeren Felsschutt des höchsten Rückens (in glarea mobili summi, subst. calceo), 2600-2800 m., 15-19 Jul. 1927, Handel-Mazzetti (orig. W, iso. G,G-BB); Schutt ober der Mikri Kazania, 2000-2800 m., (subst. calc., 16 Jul. 1928), Dibowski (orig. W).

Distribution and habitat: Rare alpine endemic on the calcareous rocks and screes of Mt. Olympus in Greece; alt. 2000-2800 m. Fl. Jul.

The type material of A. olympicum (Bornmüller and Sintenis 1154) could not be traced in the Halácsy Herbarium in Vienna. Though A. olympicum was described as pertaining to Sect. Odontarrhena, most of its description appears to fit the material of A. handelii and was collected from the same mountain in Thessaly to which A. handelii apparently is endemic. However, until such time as the type material of A. olympicum is found, the epithet A. handelii is best retained.

48. A. aurantiacum Boiss., Fl. Or., 1, 276 (1867); Baumg. in Beil. Jahresb. Nied-Öst.-Land., Lehrers. Wien-Neust., 35, 42 (1908). Fig.2,e.

Type: (Turkey, C2: Prov. Antalyz): in regione alpina montis Akdagh Lyciae, 5 Jul. 1860, Bourgeau 20 (holo. G-B, iso. G,W,K,E,)

Distribution: Endemic to W. and S.W. Anatolia. Map 19.

TURKEY. C1: Prov. Aydin, Mesogosis (Aydin dağ) above Thralles (Aydin), Jun. 1842, Boissier. C3: Prov. Isparta, dist. Sütcüler, Dedegol dağ nr. Cirque Anica 2200 m., 2 Aug. 1949, Davis 15995; ibid., above Oruz Gazi yayla, 2 Aug. 1949, 2200 m., Davis 16044; Prov. Antalya, Tahtali dağ above Kemer, 2200 - 2300 m., 16 Aug. 1947, Davis 14192; ibid., 2300m., 10 Jul. 1949, Davis 15054; Beidagh (Bey dağ), 8 Jul. 1883, Pichler 51. Lycia, Forbes 112.

Habitat: Alpine, mountain screes and cold N. slopes; alt. 2200-2300 m. Fl. Jul.-Aug.

This species and A. argyrophyllum are partially sympatric, but are easily distinguished from one another. The smaller, much more pubescent fruits, the retuse and glabrous petals with entire claw margins, the short, basally connate short filament appendages, and the much smaller and narrower, densely disposed (almost imbricated) oblanceolate leaves are characters diagnostic for A. aurantiacum. Boissier first identified the type collection of A. aurantiacum as A. lepidotum, but later realized that they were specifically distinct. A. aurantiacum has smaller fruits with much longer styles, and longer stems which are sprawling or decumbent. The stems of A. lepidotum are densely conferted, seldom more than 5 cm. long. In addition, the apparently strigose indumentum on the sepals and pedicels, caused by the long divergent peripheral rays of large lepidote scales, does not occur in A. aurantiacum.

49. A. argyrophyllum Schott & Ky. in Öst. Bot. Wochbl. 7 (29), 229 (1857); Boiss., Fl. Or., 1, 278 (1867); Baumg. in Beil. Jahresb. Nied.-Öst.Land.-Lehrers. Wien.-Neust., 35, 39 (1908).

Syn: A. wulfenianum Bernh. ex Willd. var. argyrophyllum (Schott & Ky.) Fenzl in Tchihat., Asie Min., Bot. 1 (3), 310 (1860), pro parte!

Syntypes: (Turkey, C5: Prov. Içel): in Tauro Ciliciae, ad fodinas Bulgar-Magara (Bolkar dağ) (Metdesis and Koschan), 2134-2286 m., (2743-3048 m.) Jul. 1853, Kotschy 161, 229, 124a, 182 (orig. W, iso. G, G-B, K).

Distribution: Endemic to Anatolia in the Lycian and Cilician Taurus. Map 18.

TURKEY. C2: Prov. Antalya, Elmali, 1200 m., 19 Apr. 1936, Tengwall 363. C3: Prov. Antalya, Bozburn dağ, above Tozlu Çukur yayla, 1900-2110 m., 25 Jul. 1949, Davis 15632. C4: Prov. Içel, dist Anamur, Çamurlu yayla-Oluçak, Emenak-Anamur, 18 Aug. 1949, Davis 16293. C5: Prov. Içel, Boulgar-Maden, Jul., Aug. 1855, Balansa 425 (169); ibid., Kysil depe, Bulgar Maden, 2700 m., Jul. 1912, Siehe 250 pro parte; ibid., Gumsgelik pass, 1 mile N. of Mersin, Jul. 1909, Siehe 240 pro parte; ibid., Bulgar dagh, 1895, Siehe 450 pro parte; ibid., Namrun, Gysel dere, 560-1700 m., Apr. 1895, Siehe 169.

Habitat: Mountain screes; alt. (560-) 1900-3048 m. Fl. Apr.-Jul.

On the basis of its spathulate-obovate, often orbicular leaves, always lepidote indumentum, and sprawling nodose stems, this species is most /

most closely allied to A. idaeum from Crete and A. handelii from Mt. Olympus in Thessaly. A. argyrophyllum may be distinguished with ease from A. idaeum by its much larger, densely pubescent fruits, and broadly spathulate petals which are constricted at the middle and furnished with wide denticulate claws; from A. handelii it may be separated by its smaller assymetrically inflated fruits, wingless seeds and longer styles. A. argyrophyllum can be distinguished from its closest Anatolian relative A. praecox and A. mouradicum by having larger densely pubescent fruits, condensed few-fruited racemes, and a more saxatile decumbent habit.

Baumgartner recognized the resemblance in facies of A. argyrophyllum, A. idaeum, A. sphacioticum, A. cuneifolium, A. ovirense, etc. and hypothesized that though now readily distinguished as distinct species, they all had a common ancestor which is now extinct. This precursor species, he continues, migrated from its point of origin (somewhere in Central or Eastern Europe) and colonized the southern part of Europe and Mediterranean Anatolia. During this colonization, the populations became isolated from one another on high mountains; this altidudinal and geographical isolation being at present expressed by these readily distinguished vicariant species of alpine and restricted distributions. Though this is an interesting hypothesis which may be correct, no available evidence appears to support it. It would be expected that if such an evolutionary method were correct, morphological specialization would follow the route of migration (Babcock, 1947). However, no presently existing taxon appears to be more highly specialized in all characters than any other.

50. A. praecox Boiss. & Bal. in Boiss., Fl. Or., 1, 275 (1867).

Key to varieties

Flowers yellow; growing on calcareous or igneous substrates praecox (T)

Flowers white; growing in saline habitats albiflorum (T)

var. praecox. Baumg in Beil. Jahresb. Nied.-Öst. Land.-Lehreres. Wien.-Neust., 36, 3 (1909); Bornm., Symb. ad Fl. Anat., 53 (1936); Dudley in Notes Roy. Bot. Gd. Ed., 24 (2), 160 f. 3B (1962).

Syn.: A. pseudo-montanum Hausskn. & Bornm. in Mitt. Thür. Ver., n.f., 10, 4 (1904-1905), pro syn.!

Lectotype: (Turkey, C5: Prov. Içel): Tauro Cilicico circa Gülek boghas (Külek boğ) (Coteau calc. entour ad le village de Gullek-Boghas ad 10 lieues du N. Taurus), 26 Jun. 1855, Balansa (orig. G-B, iso. G, E).

Distribution: Endemic to Anatolia in the Cilician Taurus, Amanus, Anti-Taurus, Turkish Kurdistan and the Armenian Highlands. Map 17.

TURKEY. A6: Prov. Amasya, Ak dağ, 1600-1900 m., 9 Jul. 1889, Bornmüller 1512; ibid., 23 May 1890, Bornmüller 1942; ibid., mt. Sanadağ, 1500-1600 m., 15 May 1890, Bornmüller 1944. A9: Prov. Kars/Çoruh, Ziyaret dağ (Yalnizçan dağ) Ardahan-Artvin, 2300 m., 29 Jun. 1957, Davis 30273. B2: Prov. Denizli, Honaz dağ, 1700 m., 3 Jun. 1938, Huber-Morath 5436. B5: Prov. Kayseri, Bakir dağ at Akoluk yayla above Kisge, 2000 m., 29 Jun. 1952, Davis 19450; ibid., Tschosch dagh (?) nr. Bakhyra (Bakir dağ), Mt. Kassan Oughlu - Gürdmse /

Gurumse (Gürümse nr. Feke), 1680 m., 15 May 1859, Kotschy 95 (orig. synt. G-B, iso. G-BB, K, BM). B7: Prov. Tunceli, foot of Munzur dağ, above Ovacik, 2600 m., 19 Jul. 1957, Davis 31393 pro parte; Prov. Malatya, Kuhe dağ, Malatya-Pütürge, 34 km. from Malatya, 1730 m., 15 Jun. 1949, Huber-Morath 9472. B9: Prov. Biltis, Kars dağ nr. Kotum, 2210 m., 28 Jun. 1954, Davis 22299; Prov. Van, Gevas, Artos dağ, 2896 m., 14 Jul. 1954, Davis 22727; Prov. Van/Biltis, Mt. 10 km. S.E. of Pelli, 2591 m., 8 Jul. 1954, Davis 22549. C5: Prov. Içel, Mt. nr. Findikpinar, (N. of Mersin), 1900 m., Siehe 144. C6: Prov. Hatay, Mt. Amanus, 1906, Haradjian 383; ibid., nr. Düldül 1524-2134 m., Jul. 1908. Haradjian 2383; Prov. Maraş, Allischer dagh (Ahir dağ), 17 Aug. 1865, Haussknecht.

Habitat: Montane and alpine of rocky igneous and limestone slopes and nr. melting snow; alt. 1500-2600 m. Fl. Jun.-Jul.

The habit, fruit and leaf shape, and indumentum of this species resembles that of A. mouradicum. These similarities caused Baumgartner to doubt the discontinuities of the two taxa. However, examination of more material than Baumgartner had at his disposal proves that they are separate species, though closely allied. Baumgartner claims that many intermediates occur between these two species, but the present author has seen no specimens, though the two species frequently occur in the same locality, which could not be certainly identified as one or the other. The always pubescent and usually larger fruits, pubescent styles, winged seeds, larger petals with entire claw margins, nearly twice as long/

long appendages of the short filament, long filaments with wings of unequal width, and cauline leaves which increase in size upwards, are some of the distinguishing characters of A. praecox.

It is impossible to say whether all of Rechinger's (1959) records of A. praecox from Lebanon should be referred to that species or to A. mouradicum. The photographs of Samuelsson No.6012 appear to have sparsely pubescent fruits and styles, in which case this specimen should be referr d to A. praecox, but this pubescent appearance may be a photographic artifact. A duplicate of Samuelsson No.2275, also cited by Rechinger, has been examined (W) and because of its entirely glabrous fruits and styles, and wingless seeds, can be identified as A. mouradicum.

The Balansa gathering from the Cilician Gate is chosen as the lectotype of A. praecox because it has never been confused with any other taxon. The flowering Kotschy collection (No.95), though correctly referred to A. praecox, was originally determined by Kotschy and by Boissier as A. montanum. Busch (1909) cited this Kotschy number in his enumeration of A. montanum specimens, not realising that it was a syntype of A. praecox. The Haussknecht specimen with densely pubescent fruits was also cited as a syntype of A. praecox by Boissier, but it does not fit his description of A. praecox and is correctly referred to A. stribrnyi.

var. <u>albiflorum</u> Dudley, <u>var. nov.</u> Map 17.

A typo floribus albis et habitu halophilo differt.

TURKEY. B5: Prov. Kirşehir, Sifegöl, nr. Mucur, salt marsh in zone nearest lake, in stiff clay, leaves succulent, flowers white, 17 Jun. 1954, <u>Davis</u> 21795 (holo E, iso. K, BM).

This local and extremely halophytic low altitude race which formed a large population in the clay zone nearest the small salt lake, differs from the high altidude typical variety in possessing white flowers, a feature originally noted on the label. However, flower colour does not serve to distinguish these varieties in the dried and mounted state.

51. A. densistellatum Dudley in Notes Roy. Bot. Gd. Ed., 24 (2), 160, f.3A (1962); Hal., Suppl. Consp. Fl. Gr., 1, 9 as A. praecox (1908); ibid., 2, 12 as A. praecox (1912); Hayek, Prod. Fl. Pen. Balc., 1 435 as A. praecox (1925); Rech. fil., Fl. Aegaea, 224 as A. praecox (1943); Rech. fil. in Engl. Bot. Jahrb., 80 (3), 329 as A. praecox (1961).

Syn.: A. praeco auct. graec., non Boiss. & Bal.!

Type: (Greece): Euboea, prope Limni, 18 Apr. 1902, Leonis 55 (holo. W-Hal.).

Distribution and habitat: Endemic to Euboea on serpentine substrate; alt. 300-700 m. Fl. Mar. - May.

52. A. lepidotum Boiss., Diagn., 1 (1), 73 (1842); Fenzl in Tchih., Asie Min., Bot. 1, (3), 307, Atlas pl. 17 (1860); Boiss., Fl. Or., 1, 276 (1867); Baumg. in Beil. Jahreb. Nied.-Öst. Land. Lehrers. Wien. - Neust., 36, 21 (1909). Fig. 1B, f,l.

Lectotype: (Turkey, C2: Prov. Denizli): Cadmus (Honaz dağ), supra Gheyra (Geira), Jun. 1842, Boissier (orig. G-B. iso. G,W,K,BM).

Distribution: Very disjunct, rare endemic to S.W. and Central Anatolia and Armenia. Map 18.

TURKEY. B7; Prov. Erzincan, Erzincan-Sivas, 27 km. W.N.W. of Erzincan, nr. Refahiya, 1600 m., 7 Sept. 1957, Rechinger 15169. B8/9: Prov. Van/Bingöl, Kardustorum, Schirwan nr. Karuy, 1219 m., 5 Oct. 1859, Kotschy 746. C1: Prov. Aydin, Mesogosis (Aydin Dağ), above Thralles (Aydin), Jun. 1842, Boissier. C2: Prov. Muğla, Muglah (Muğla,) 1832 Aucher 252 (not 299; orig. synt. G-B, iso.K) ibid., Motch (Muğla), 1833, Montbret; Prov. Aydin/Denizli, Baba dağ, 2200-2300 m., 24 Aug. 1950, Davis 18391a. C3: Prov. Antalya, Ghei dagh (Geyik dağ), Jul. 1845, Heldreich. Galatia, Mandjulik-Deliktach (?), 1849, Tchihatcheff 683 (fide Fenzl, loc. cit.).

Habitat: Limestone scree and mountain steppe; alt. 1219-2300 m. Fl. Jun.-Jul.

By its conferted habit and small linear leaves A. lepidotum resembles A. propinquum which occurs in the same general area in S.W. Anatolia and again in Armenia. The broadly spathulate, retuse and deep yellow petals which are furnished with widely dilated denticulate claw margins, the very short styles, the densely foliate stems, and the white dense /

dense fruit indumentum composed of small lepidote hairs distinguish *A. lepidotum* from *A. propinquum*. The petals of the latter are narrow, obovate, entire and pale cream; its styles are very long, up to 5 mm. long; its stems, though conferted, are laxly foliate, and its fruits indumentum is sparse and composed of large punctate lepidote scales.

Boissier's specimen from Honaz dağ is chosen as the lectotype of *A. lepidotum* in preference to *Aucher*'s collection from Muğla because, though in *Flora Orientalis* (1867) Boissier corrected the number of *Aucher's* gathering to read No. 252, he had referred to it in the original description of *A. lepidotum* as No. 299. *Aucher's* No.252 had also been previously described by Boissier in Ann. Sc. Nat., ser. *17*, 152 (1842) as *A. atlanticum* var. *calycibus hispido lanatis*. Furthermore, the *Boissier* gathering is provided with mature fruits as well as flowers, whereas the *Aucher* collection only has flowers.

A. lepidotum is indeed very rare and has only been collected once since 1833 from near the type locality (*Davis* 18291a). Its distribution is rather anomolous, occurring on limestone scree in S.W. Anatolia and again in Armenia on mountain steppe, the localities being separated by a matter of approximately 900 km.

53. A. lassiticum Hal., Suppl. Consp. Fl. Gr., 10 (1908); Hayek, Prod. Fl. Pen. Balc., 1 432 (1925); Rech. fil. Fl. Aegaea, 223 (1943).

Type: (Crete): in rupestribus mt. Lazari, distr. Mirabello (Phiotokastrios), 1 Jun., Jul. 1899, Baldacci 154 (holo. W-Hal., iso. G-BB, W, GH, K, BM). The type citation covers two collections, that of 1 Jun. from dist. Mirabello, and that of Jul. from dist. Phiotokastrios.

Distribution and habitat: Rare endemic found only Crete.

54. A. sphaciotioum Boiss. & Heldr., Diagn., 2 (8), 35 (1849); Boiss., Fl. Or. 1 276 (1867); Raulin, Desc. Phys. Crete, 707 (1869); Hal., Consp. Fl. Gr, 1, 96 (1900); Baumg. Beil. Jahresb. Nied.-Öst. Land.-Lehrers. Wien.-Neust., 35, 45 (1908); Hayek, Prod. Fl. Pen Balc. 432 (1925); Rech., fil. Fl. Aegaea, 223 (1943).

Type: (Crete): in Monte Stravapodia cacumine excelso jugi Sphciotici, raum, (1981 m.), 10 Jul. 1846, Heldreich (1509) (holo.G-B., iso. K, W-Hal.)

Distribution and Habitat: Rare Alpine endemic of calcareous rocks and scree in Crete; alt. 1981-2300 m.Fl. Jun.-Jul.

55. A. propinquum Baumg. in Beil. Jahresb. Nied.-Öst. Land.-Lehrers. Wien.-Neust., 36, 22 (1909); Bornm., Symb. Fl. ad Anat., 54 (1936), amend. desc.

Type: (Turkey, B7: Prov. Erzincan): Bacharsuck am Euphrat (Bacharsuk nr. Avşsin, Kemaliye-Kemah), 9 May 1890, Sintenis 2206 (holo. W ?. iso. W pro parte, 1 plant of A. ochroleucum & 1 plant representing the type collection of A. propinquum).

Distribution: Rare endemic known from the type collection from E. Anatolia, one collection from S.W. Anatolia and two collectionsfrom the Cilician Taurus. Map 19.

TURKEY. C2: Prov. Muğla, Sandras dağ, 2200-2300 m., 23 Jul. 1947, Davis 13537. C5: Prov. Adana, Ala dağ, Yazipinar, 2400-2800 m., May 1961, Stern; ibid., Ala dağ, Çemustal, 2000 m., May 1961, Schiechtl.

Habitat: Alpine on screes and gypsum rock; alt. 2000-2800 m. Fl. May-Jul.

The original material used to circumscribe this species has not been seen. An attempt was made to find it in the Natural History Museum in Vienna, where most of Baumgartner's Alyssum types are retained, but to no avail. Baumgartner states that the type collection is labelled as A. lepidotum; however, the only specimen available from the Sintenis type gathering (W) is not so labelled and, in fact, is composed of discordant elements, i.e. one plant of A. ochroleucum and one plant which exactly matches the description of A. propinquum. As Bornmüller cites the type specimen of A. propinquum(labelled A. lepidotum) and gives for it an amended description of the leaves, it is presumed that he examined this/

this material either in Berlin or in the Haussknecht Herbarium now in Jena.

Recent collections of this species from the Cilician Taurus have helped to fill in the large gap in its distribution. It is possible that eventually A. lepidotum, which has a very similar disjunct distribution, will also be found in the Cilician or Anti-Taurus.

56. A. lanceolatum Baumg. in Jahresb. Kaiser Franz Josef- Land.-Gymn. Oberrealsch., Baden bei Wien, 48, 11 (1911); Czern. in Fedde Rep. Sp. Nov., 27, 272 as A. iranicum (1930); Rech. fil. in Ann. Nat. Mus. Wien, 51, 380 as A. iranicum (1941).

Syn.: A. iranicum Czern. in Not. Syst. Herb. Hort. Bot. Rep. Ross., 5, 34 (1924) - non Hausskn. ex Baumg!

A. czernjakowskae Rech. fil. in Phyton, 3, 54 (1951), nomen novum!

A. shahrudum Parsa, Fl. Iran, 1, 730 (1951), nomen novum!

A. persicum auct. pers., non Boissier!

A. muelleri auct. pers., non Boissier & Buhse!

Type: (Iran): Turkemenien, Mt. Kular bei Gaudan (Kopet dagh), 2134 m., 28 Apr., 30 May 1898, Litwinow 569 (holo. W, iso. G, K, E).

Distribution and Habitat: Rare montane species on serpentine and calcareous rocks in N. Iran and Afghanistan; alt. (1000-) 1700-3000 (-3900)m. Fl. Apr.-Jun.

At the same time that Baumgartner (1911) described this species he published the description of A. iranicum Hausskn. ex Baumg. A. lanceolatum was based on a Litwinow gathering (No.569) from Kopet-Dagh in Iran, and A. iranicum was based on eight syntypes collected by Strauss in Iran between the years 1897 and 1904, all of which were designated (in exsicc.) by Haussknecht as "A. iranicum".

The later homonym, A. iranicum Czern. (1924), used the Litwinow No.569 as one of its syntypes. Though Rechinger (1951) realised that A. iranicum /

A. iranicum Czern. could not be applied because of the earlier A. iranicum Hausskn. ex Baumg., he did not appreciate that the one of the syntypes of A. iranicum and the holotype of A. lanceolatum were identical, and supplied the binomial A. czernjakowskae to refer to Czerniakowska's species. Parsa supplied yet another nomen novum (A. shahudrum) for A. iranicum Czern. The other Litwinow numbers (570 and 571) cited for A. iranicum Czern. have been seen in various herbaria (G,W) and fall into the range of A. lanceolatum Baumg.

In the absence of any material of A. persicum, other than Aucher's type gathering, it is preferable to maintain A. persicum and A. lanceolatum as distinct species. The abundant material of A. lanceolatum, especially the recent Hedge and Wendelbo collections from Afghanistan (1962) cannot be equated with A. persicum. The final decision of whether these two taxa are really distinct species will have to be delayed until additional collections from Central Iran can be evaluated and compared with the material known as A. lanceolatum.

57. A. persicum Boiss. in Ann. Sc. Nat., ser. 2, 17, 152 (1842); Boiss., Fl. Or., 1, 279 (1867); Baumg. in Jahresb. Kaiser Franz Josef-Land.-Gymn. Oberrealsch., Baden bei Wien, 48, 15 (1911).

Type: (Iran): Ispahan (Isfahan), Aucher 4089 (holo. G-B, iso. G, W, K, BM).

Distribution: Known only by the type collection from Central Iran.

58. A. muelleri Boiss. & Buhse in Nouv. Mém. Soc. Nat. Mosc., 12, 12 (1860); Bois., Fl. Or., 1, 279 (1867); Busch in Fl. Cauc. Crit., 3 (4), 582 (1909); Baumg. in Jahresb. Kaiser Franz Josef-Land.- Gymn. Oberrealsch., Baden bei Wien, 48, 13 (1911); Grossh., Fl. Kavk, ed. 2, 4, 216, t.24, f.8 (1950).

Syn.: A. hajastanum Avet. in Izvestia Akad. Nauk. Arm. SSR, 14 (11), 93, f.1 (1961).

Syntypes: (Russian Armenia): in den Vorbergen des Kisildagh bei Gamarlu in der Nähe von Eriwan, 21 Apr. 1847, Buhse 93/1 (orig. LE, photo. E, iso. G-B). (Iran): Gebirge bei Jesd (Deh ballo) 24 Apr. 1849, Buhse 1358 (orig. G-B, iso. K).

Distribution and habitat: Alpine and montane species on mountain screes in Russian Armenia, Caucasus, Aserbaijan and N. Iran; alt. 1981-2800 m. Fl. Apr.-May.

Specimens of this species have never been seen from Anatolia, though recorded by Boissier (1867), Busch (1909), Baumgartner (1911) and Grossheim (1950). All of the records of A. muelleri from Anatolia (e.g. Boissier- Aucher 251) can be referred to A. armenum. The easiest character to distinguish A. muelleri from A. armenum is the distinctive indumentum of each. The silvery indumentum of A. muelleri is primarily composed of appressed many-rayed lepidote or sublepidote hairs; that of A. armenum is greenish or at the most greyish and composed of few-rayed, though often branched, stellate hairs which often appear strigose on the pedicels.

A. /

A. muelleri is usually a coarser more robust plant with smaller floral parts and fruits than _A. armenum_. The petals of _A. armenum_ are retuse, glabrous and flavous; those of _A. muelleri_ are entire, densely pubescent and pale cream. Another difference is the widely spreading, horizontal or deflexed pedicels of _A. armenum_; those of _A. muelleri_ are strictly ascending, though sometimes divergent.

In addition to the _Aucher_ specimen, Boissier cites a _Szowits_ gathering from "Anatolia"; however, the label on this material in the Boissier Herbarium in Geneva clearly indicates that this collection was made in Azerbaidjan not from Turkish Armenia. The _Bunge_ collections from Mt. Elbrus and Prov. Khorassan in Iran do not represent _A. muelleri_ (as Boissier claims) but _A. lanceolatum_.

The excellent illustrations accompanying the description of _A. hajastanum_ permit this binomial to be referred to _A. muelleri_. Numerous specimens of _A. muelleri_ (E,K) collected from near the type locality of _A. hajastanum_ cannot be separated from it because of the continuity of their variation.

59. A. iranicum Hausskn. ex Baumg. in Jahresb. Kaiser Franz Josepf-Land.-Gymn. Oberrealsch., Baden bei Wien, 48, 9 (1911); Bornm. in Beih. Bot. Centralb., 27, 303 (1910).

Syn.: A. dimorphosepalum Eig in Pal. Journ. Bot., Jer. ser, 4, 171 (1948)!

A. lanigerum DC. var. nana Parsa, Fl. Ir., 1, 721 (1951)!

Syntypes: (Iran): Sultanabad ad Montes Karagan, Kuh Guliowa (in declivitibus montis Kuh-i-Guliawa) 28 Apr. 1902, Strauss (orig. B, n.v.) ibid., Kuh Noksch Kemer (Kuh Nogreh Kemer-Tschal, in monte Nogreh Kemer), 20-25 May, 1892, Strauss (orig. B n.v., iso. W, JE, G-BB); ibid., in montibus Tefresch, 1897, Strauss (orig. B., n.v.). Kermauschah (Kermanschah), in Mt. Changuschdschica (Kharguschdschica), 1 Apr. 1903, Strauss (orig. B., n.v.), ibid., ad Dscheffenabad (inter Newawend et Burudschird), 7 Apr. 1903, Strauss (orig. B., n.v.); ibid., ad Saleh (Sahne), 23 Apr. 1903, Strauss (orig. B.,n.v.); ibid., mt. Kuh Tarikha (in montibus Kuh-i-Tarikha), 11 Apr. 1904, Strauss (orig. B n.v., iso.W); ibid., ad rupes pr. Bisitius (ad Bisitun), 24 Jul. 1903, Strauss (orig. B, n.v.).

Distribution: Syria, Jordan, Israel, N.Iraq, N.Iran, and Afghanistan.

Habitat: An Irano-Turanian species, found in Artêmisia steppe, elevated plateaus, dry hills, bare chalk hills, gravelly banks, and mountain screes; alt. (610-) 1000-3048 (-3658) m. Fl. Mar.-Jun.

Before the type material of A. dimorphosepalum was examined, the author entertained the possibility that this taxon was a component of Sect. Gamosepalum; the specific epithet dimorphosepalum refers to one of the major diagnostics of that section. However, the type material of A. dimorphosepalum kindly loaned by Professor Zohary, Department of Botany, Hebrew University, Jerusalem, Israel, though resembling some species of Sect. Gamosepalum in certain features (i.e. having whitish flowers like those of A. tetrastemon, A. lepidoto-stellatum and A. paphlagonicum) has no other characters diagnostic for Sect. Gamosepalum. A. dimorphosepalum conveniently agrees with the numerous gatherings of A. iranicum in morphology and distribution and must therefore be reduced to synonymy.

The sepals of A. dimorphosepalum, contrary to the specific epithet and description, are not truly dimorphic as they are in all components of Sect. Gamosepalum. That some of the calyces on some (but not all) of the type collections of A. dimorphosepalum appear to be composed of unequal sepals, is an artifact caused by the withering of the floral parts before the plants were collected. The plants possessing these withered sepals were obviously growing in a very scorched environment. Additional collections from Syria and the Transjordan (Davis 5578, 6104a, 5696 and 9532) have normally developed and homomorphic sepals.

Parsa applied the name A. lanigerum var. nana, following suggestion by Turrill (1930), to two gatherings of this species collected by Gillett-Smith in Iran. Though very widespread in Iran, A. lanigerum is a component of Sect. Odontarrhena. The plants comprising A. lanigerum var. nana are depauperate compared to the more robust plants from Syria and Lebanon, but are clearly comparable to those specimens of A. iranicum which Haussknecht collected from the same general area in Iran and labelled (in exsicc.)"A.elymaiticum"

60. A. aizoides Boiss. in Ann. Sc. Nat., ser. 2, 17, 153 (1842); Boiss., Fl. Or., 1, 277 (1867). Fig. 1A, 1; fig. 1B, m.

Type: (Turkey, B7: Prov. Erzincan); Armenia (Monte Olympo-Keşiş dağ), Aucher 271 (holo. G-B, iso. G, K, BM).

Distribution: Endemic to Turkey from the high mountains of the Pontus, from Central Anatolia, the Anti-Taurus and the Cilician Taurus. Map 19.

TURKEY. A7: Prov. Giresun, Eribel, high pass S. of Tamdere, 2350 m., 7 Jul. 1958, Huber-Morath 14809; ibid., Sebinkarahisar-Giresun, 2100 m., 24 Jun. 1960. Stainton et. al. 5832. B4: Prov. Konya, Kulukessa (Kurthasanli), 1000 m., 1853, Tchihatcheff 305 (fide Fenzl in Tchih., Asie Min., Bot. 1 (3), 314: 1860). B6: Prov. Kayseri, Pinarbasi, 2000 m., 26 May 1960, Stainton et. al. 5166: ibid., Bakir dağ above Akoluk yayla above Kisge, 2700 m., 29 Jun. 1952, Davis 19654: Prov. Maraş, dist. Çardak, Berit dağ, 2900 m., 26 Jul. 1952, Davis 20328: ibid., dist. Göksun, Binboğa dağ, on Isik dağ, 2300-2600 m., 28 Aug. 1947, Davis 1435a; & 14354b. C4: Prov. Antalya, E. side of Geyik dağ, 2286-2338 m., 3 Aug. 1947, Davis 14547; ibid., Ghei dagh (Geyik dağ), 1829 m., 1845, Heldreich. C5: Prov. Içel, Taurus above Mersin, Siehe 352. Cappadocia, 1834, Montbret 2347.

Habitat: Alpine on exposed and windy summit ridges, rocky limestone slopes and igneous rocks; alt. 1829-2900 m., Fl. May-Jun.

This species belongs to the complex of species including A. bornmuelleri, A. caespitosum, A. iranicum, A. doerfleri and A. taygeteum which morphologically link Sect. Alyssum to Sect. Gamosepalum (cf. The Taxonomic /

Taxonomic Position of the Sect. Gamosepalum, p.200). A. aizoides is often confused with the partially sympatric A. bornmuelleri. In addition to the characters stated in the key distinguishing these two species, several other diagnostics are of value, especially for flowering material. The appendages of the short filaments of A. aizoides are broader and longer (up to 1 mm. long and 0.7 mm. wide), and are usually bidentate. The appendages on the short filaments of A. bornmuelleri are very narrow, always acute and only c. 0.5 mm. long. The stellate hairs on the often entire petals of A. aizoides are short-rayed and appressed; those on the always bilobed or retuse petals of A. bornmuelleri are at least twice as large and have spreading or suberect rays causing the lemina of the petals to appear substrigose. The dimorphic indumentum on the sepals and pedicels of A. bornmuelleri is generally more strongly developed with denser and longer furcate rays. The pedicels (mature or immature) of A. aizoides are all approximately the same length, but the lowermost ones of A. bornmuelleri are 2 to 3 times longer than the upper ones.

The Sintenis (No. 323) record of A. aizoides (Baumgartner, 1909; Bornmüller, 1936) is the type of A. harputicum sp. nov. in Sect. Gamosepalum.

61. A. bornmuelleri Hausskn. ex Degen in Øst. Bot. Zeit., 48, 108 (1898); Baumg. in Beil. Jahresb. Nied.-Øst. Land.-Lehrers. Wien.-Neust., 36, 27 (1909); Bornm., Symb. ad Fl. Anat., 54, t. 2 (1936).

Syn.: A. bornmuelleri Hausskn. in Øst. Bot. Zeit, 40, 211 & 393 (1890), nomen nudum!

A. drabaeforme Hausskn. op. cit., 393 (1890), nomen nudum!

A. drabiformis Hausskn. & Bornm. in Bornm., op. cit., 55!

Lectotype: (Turkey, B6: Prov. Sivas): Pontus ditionis Siwas in monte Tschamlu-bel. (Çamlibel dağ), 1700 m., 31 May 1890, Bornmüller 1698 (orig. JE, n.v., iso. W, G-BB, BM).

Distribution: Endemic to the Central and N. Irano-Turanian region in Anatolia. Map 18.

TURKEY. A5: Prov. Amasya, Sana dağ (nr. Amasya), 1500-1600 m., 14-18 May 1890, Bornmüller 1945 (orig. synt. JE, n.v., iso. W, G, G-BB, K, BM); ibid., Akdagh nr. Amasya, 1850-1900 m., 9 & 17 Aug. 1889, Bornmüller 1505 (orig. synt. JE, n.v., iso. W, G-B, K, BM). B6: Prov. Sivas, Ak dagh nr. Karababa dağ, 2700 m., 1-2 Aug. 1889, Bornmüller 1504 (orig. synt. & holo. A. drabiformis JE, n.v., iso. W, G); ibid., Tschepni (Çepni), 2300 m., Jun. 1911, Siehe 423; ibid., Gürün- Sivas, 1 km. N. of Gürün, 1350 m., 28 Jun. 1950, Huber-Morath 11971.

Habitat: Marl and limestone scree and calcareous steppe; alt. 1500-2700 m. Fl. May.-Jun.

In its habit this species resembles A. caespitosum, but the latter may be distinguished easily by its densely pubescent petal claws (not lamina), homomorphic sepal indumentum of lepidote scales, and an over-all indumentum of silvery lepidote-peltate scales with very short peripheral rays (as Fig. 1A, m). The hairs of A. bornmuelleri, though lepidote, are always provided with long peripheral rays (as Fig. 1A, l).

The habit and facies of A. bornmuelleri is also similar to that of A. doerfleri from Greece and Yugoslavia. The differences separating these species is summarised in the following table.

A. bornmuelleri	A. doerfleri
petals 5-7 mm. long	petals 8-10 mm. long
sepals 3-4.5 mm. long, ovate, with wide hyaline margins (0.4-0.6 mm.)	sepals 5-7 mm. long, lanceolate, with narrow hyaline margins (0.1-0.3 mm.)
long filaments 3.5-4 mm. long	long filaments 6-8 mm. long
short filaments 3-3.5 mm. long, with short appendages (c.0.5 mm.)	short filaments 5-6 mm. long, with long appendages (c.2-3 mm.)
pedicels longer than sepals	pedicels shorter than sepals
upper cauline leaves not strongly involucrate, 6-8 x 0.5-1 mm.	upper cauline leaves prominently involucrate, 10-20 x 1-2 mm.

One of the syntypes of A. bornmuelleri (Bornmüller 1504) is also the type of A. drabiformis. This specimen does not appear to differ from any of the other syntype gatherings of A. bornmuelleri.

Bornmüller 1698 was chosen as the lectotype for this species because it is the only gathering among the original syntypes which has mature fruits as well as flowers, and has never been confused with any other taxon as is the case with Bornmüller 1504.

Schulz /

Schulz (1927) contended that the seeds of A. bornmuelleri do not produce a layer of mucilage in the presence of water, a process which prevails in most other species of Sect. Alyssum (also Sect. Meniocus, Sect. Psilonema and Sect. Gamosepalum). He claimed that instead of the expected mucilage formation, the seed surface was minutely papillose, and that the narrow wings on the seeds of A. bornmuelleri were also papillose-toothed. This minutely papillose condition of the seeds is not unexpected and is obvious in most Alyssa, including Sect. Odontarrhena. The present author has examined seeds of several recent gatherings as well as of the syntype collections of A. bornmuelleri for mucilage production. All of the mature seeds not over 10 years of age produced a copious layer of mucilage when immersed in water. Those seeds which were 10 years of age or older exuded little or no mucilage, as was the case in most of the syntype material. The seeds of a duplicate specimen of Siehe 423, the collection which Schulz investigated, did not produce any mucilage. It is suggested that the amount of mucilage produced is directly proportional to the age of the collections and also the state of maturity of the seeds. Most of the seeds examined from Siehe 423 were in fact immature and could never have germinated. It was often observed in the course of mucilage production, that the viscuous substance was exuded from the seed surface in linear chains, and caused the seeds, before the chains had coalesced, to appear ciliate. A comparable appearance is seen by the growth of Saprolegnia on an insect body.

62. __A. taygeteum__ Heldr., __in sched.__ Herb. Graec. Normale (1897) __Heldreich__ 1405; Hal. in Verh. Zoo-Bot. Gesell., __48__, 703 (1898); Hal., Consp. Fl. Gr., __1__, 96 (1900); Baumg. in Beil. Jahresb. Nied.-Öst. Land.-Lehrers. Wien.-Neust., __36__, 31, (1909); Hayek, Prod. Fl. Pen. Balc. __1__, 431 (1925).

__Type__: (Greece): Mt. Taygeteus, in summo cacumine Hagios Elias, 2134 m., Aug. 1897, __Heldreich__ 1405 (holo. W-Hal., iso. G, G-BB).

__Distribution and Habitat__: Rare montane species known only from the type location in the Peloponnese; alt. 2134. Fl.Jun.-Aug.

63. A. doerfleri Degen in Denk. Acad. Wissen. Wien, 64, 708, t.2, f.5d-f (1897); Degen in Öst. Bot. Zeit., 48, 105 (1898); Baumg. in Beil. Jahresb. Nied.-Öst. Land.-Lehrers. Wien.-Neust., 36, 29 (1909); Hayek, Prod. Fl. Pen. Balc., 1, 431 (1925); Schulz in Nat. Pflanzenf., 17b, f. 299 (1936).

Type: (Yugoslavia): in rupium fissuris regionis altin. alt. montis Kossov. prope Zborska Macedoniae centralis, 25 Jun. 1893, Dörfler 48 (holo. BP n.v., iso. W-Hal., W,G-BB,K,BM).

Distribution and habitat: Endemic to a few mountains in N.Greece and S.Yugoslavia. Fl. Jun.

64. A. caespitosum Baumg. in Beil. Jahresb. Nied.-Öst. Land.-Lehrers. Wien.-Neust., 36, 26 (1909).

Type: (Turkey, B5: Prov. Niğde): Cappadocia, Utsch Kapu-Dagh (Melendiz dağ), über Niğde, 1300-1400 m., 4-6 Jun. 1898, Siehe 73 (holo. W?, iso. W, G, G-BB, BM).

Distribution: Endemic to E. and Central Anatolia. Map 19.

TURKEY. B5: Prov. Kayseri, Erdschias dagh (Erciyas dağ), May 1902, Zedebour. B6: Prov. Sivas, Gürün, 1400 m., 28 May 1960, Stainton et.al. 5227; ibid., 1219 m., 19 Jun. 1954, Davis 21952; ibid., Gürün- Sivas high pass at Behramcah, 34 km. N. of Gürün, 1 km. from Bördülik, 1750 m., 28 Jun. 1953, Huber-Morath 11972. C5: Prov. Adana, Ala dağ, to Emlital, 1000-1500 m., May 1961, Schiechtl.

Habitat: Limestone steppe and eroded calcareous shale; alt. 1000-1750 m. Fl. May-Jun.

The Taxonomic Position of the Sect. Gamosepalum, p.200 and Tables No. 5, 6 and 7 point out that this species in Sect. Alyssum most closely approaches, in its morphology, Sect. Gamosepalum. A. caespitosum can be thought of as the taxonomic link between Sect. Alyssum and Sect. Gamosepalum.

(4) SECT. GAMOSEPALUM

(a) Series Gamosepalum

65. A. tetrastemon Boiss. in Ann. Sc. Nat., Ser. 2, 17, 153 (1842); Boiss., Fl. Or., 1, 278 (1867).

Syn.: A. tetrastemon var. cappadocica Boiss. in Ann. Sc. Nat., ser. 2, 17, 153 (1842) - non var. cappadocicum Boiss., Fl. Or., 1, 278 (1867)!

Type: (Turkey, C5: Prov. Adana ?): Cilicia, Akdagh, (nr. Pozanti ?), 1837, Aucher 279 (holo. G-B, iso. G,K).

Distribution: Turkish endemic from the Cilician Taurus and Central Anatolia, Map 21.

TURKEY. B5: Prov. Yozgat, Yozgat, Jun. 1960, Curtis 112. B6: Prov. Sivas, Sivas-Kayseri, Gemerek, 1400 m., 23 May 1960, Stainton et al. 5099. C4: Prov. Konya, Ermenak. 1400 m., Jul. 1872, Peyronin ?; Prov. Antalya, Taurus Mts., Ghei Dagh (Geyik dağ,) 1829 m., 8 Jul. 1848, Heldreich 1036. C5: Prov. Adana, Cilicia, Akdagh (nr. Pozanti), Aucher 270 (holo. var. cappadocica 1842, G-B, iso. W,K,). Turkey, subalpine Anatolia, Jun. 1852, Nöe 1063.

Habitat: Fallow fields, steppe, alpine scree: alt. 1400 - 1829 m. Fl. May - Jun.

Boissier initially indicated that this species possessed an aspect similar to that of A. atlanticum Desf.; however, a closer affinity is found within the natural species complex of Sect. Gamosepalum. The features distinguishing this species from its closest ally, A. lepidoto-stellatum are complete concrescence of the wings of the long filaments, larger sepals and petals, dimorphic indumentum on the inner surface of the sepals, and the larger leaves with an over-all sparser indumentum. With remarkable insight, Boissier (1867) observed that the facies of A. tetrastemon resembled that of Ptilotrichum canescens. The allignment of Ptilotrichum to Alyssum is expanded earlier in this study (p.18) where Ptilotrichum canescens is regarded as a component of Alyssum Sect. Alyssum.

Judging from Boissier's description, A. tetrastemon was the first taxon in Alyssum in which fusion of the long filaments was observed. This feature was denied later by Buser (1888 as A. armenum f. tetrastemon), Degen (1898) and Baumgartner (1911:5), but in all cases these authors examined material other than A. tetrastemon. The cohering long filaments, a character of major diagnostic value in all members of Series Gamosepalum, are consistently present in this species.

A. tetrastemon var. cappadocicum (1842) was based on a different Aucher number (270) but was probably collected at the same time and locality as the type of A. tetrastemon, Aucher 279. It is conceivable that Boissier misread the numerials when he first examined the material, and in fact later crossed out the 0 and replaced it with a 9. There is no doubt that the two Aucher collections in the Boissier herbarium are conspecific. The record of A. tetrastemon (endemic entirely in Antolia) from Iran (Parsa, 1951) refers to the same species considered by Degen (1898), i.e. A. iranicum in Sect. Alyssum.

Baumgartner (1911) correctly referred A. tetrastemon var. latifolium (Boissier, 1867) to A. baumgartnerianum, a species in Series Libra with predominately lepidote indumentum and free filaments.

66. A. lepidoto-stellatum (Hausskn. & Bornm.) Dudley, comb. nov.; Schulz in Notizbl. Bot. Gart. Mus. Berlin-Dahlem, 10 (91), 109 as Gamosepalum (1927); Bornm.; Symb. ad Fl. Anat., 58 as Gamosepalum (1936).

Syn.: Gamosepalum lepidoto-stellatum Hausskn. & Bornm. in Mitt. Thür. Bot. Ver., 11, 73 (1897)!

Gamosepalum confine Hausskn., op. cit., 74!

Ptilotrichum lepidoto-stellatum Hausskn. & Bornm. in Bornm., loc. cit., pro syn.!

Plant perennial. Indumentum on cauline leaves of copiously branched stellate hairs, c. 0.5 mm. diam. Fruiting racemes condensed, 1.8-4 cm. long. Pedicels ± horizontal, 2.5-5 mm. long, c. 1 mm. distant, appearing substrigose towards sepals with heteromorphic indumentum similar to that on sepals. Sepals not inflated in fruit, 2.5-3.5 x 1-1.5 (-2) mm., with a tuft of slightly tuberculate, simple or 2-3-furcate hairs (0.3-1 mm. long) at apex, and appressed stellate hairs overall. Petals retuse, sparsely pubescent. Long filaments (2.5-) 3-4 mm. long, connate for at least 3/4 their length, free apices 0.5-1 mm. long. Short filaments 2.5-3 mm. long, with basal appendages 0.5 mm. long. Styles 1.5-2 mm. long. Silicules 3-3.5 (-4) x 2-3 (-3.5) mm., obtuse or truncate, with lepidote hairs 0.2-0.3 mm. diam., valves unequally inflated.

Type: (Turkey, A/B 6: Prov. Sivas): in Ponto Australi in declivibus apricis inter Siwas et Mt. Yyldisdagh (Yildis dağ), 1300 /

1300-1400 m., 6 Jun. 1890, Bornmüller 1671 (holo. JE n.v., iso. G, G-BB, K, BM).

Distribution: Turkish endemic from the central and S. steppe areas. Map 21.

TURKEY. B6: Prov. Sivas, 15 km. S. of Sivas, Şarkişla-Kayseri, 15 Jun. 1939, Reese; ibid., Gürün, 1400 m., 28 May 1960, Stainton et.al. 5226; Prov. Maraş/Malatya, Elbistan-Darende, 13 Jul. 1906, Post 91; Prov. Malatya/Sivas, Gürün - Darende, 1524 m., 19 Jun. 1954, Davis 21861. B7: Prov. Erzincan, at Chama on the Euphrates, 1890, Sintenis 2161 (iso. Gamosepalum confine, K).

Habitat: Steppe and calcareous hills; alt. 1300-1524 m. Fl. May-Jun.

This species is regarded as the type species of Sect. Gamosepalum and its typical series. The reasons for recognising Gamosepalum as a section within Alyssum rather than as a distinct genus are explained in the section entitled The Taxonomic Position of Sect. Gamosepalum, p.

This species is easily separated from A. paphlagonicum, with which it has sometimes been confused, by its merely retuse and sparsely pubescent petals, shorter styles, more spreading usually horizontal pedicels, and few-fruited condensed raceme. Considering the morphological expressions as a whole. A. lepidoto-stellatum is more dwarf and caespitose when contrasted with the erect, luxuriant and coarse appearance of most specimens of A. paphlagonicum.

Both species are endemic to Anatolia and overlap in part of their ranges; A. lepidoto-stellatum appears better represented in the Eastern and South-Eastern steppe regions, whereas A. paphlagonicum exhibits a more /

more westerly and northerly distribution pattern, extending from some steppic enclaves in the Euxine region of North-Central Anatolia to as far east as Prov. Gümüşane (Sintenis 3125 and Balls 1552).

Schulz (1930) correctly reduced Gamosepalum confine (based on Sintenis 2161) to synonymy under A. lepidoto-stellatum. This collection matches A. lepidoto-stellatum on all characters except the petals which are nearly as large as the largest found in A. paphlagonicum, c. 6 mm. long.

67. A. paphlagonicum (Hausskn.) Dudley, comb. nov.; Schulz in Notizbl. Bot. Gart. Mus. Berlin-Dahlem, 10 (91), 109 as Gamosepalum (1927); Bornm., Symb. ad Fl. Anat., 59 as Gamosepalum (1936).

Syn.: Gamosepalum paphlagonicum Hausskn. in Mitt. Thür. Bot. Ver., 11, 74 (1897)!

Gamosepalum alyssoides Hausskn., op. cit., 75, pro parte quoad plantam Sipikordagh a Sintenis lectam!

Plant perennial. Indumentum on cauline leaves of sparingly branched stellate hairs, 0.5-1 mm. diam. Fruiting racemes elongated, (2-) 5-7 cm. long. Pedicels ascending or spreading, (4-) 7-9 mm. long, 2-5 mm. distant, appearing strigose overall with heteromorphic indumentum similar to that on sepals. Sepals inflated in fruit, 3.5-5 x 1.5-3 mm., with heteromorphic indumentum overall of strongly tuberculate, simple or 2-3-furcate hairs (0.5-1.5 mm. long), and appressed stellate hairs, hyaline margins 0.2-0.3 (-0.4) mm. wide. Petals bilobed, densely pubescent. Long filaments 3.5-5 mm. long, connate for at least ½ their lengths, free apices 1-2 mm. long. Short filaments 3-3.5 mm. long, with basal appendages 1 mm. long. Styles 3 mm. long. Silicules 3.5-4.5 (-5) x 3-4 mm., emarginate or truncate, with lepidote hairs 0.4-0.5 mm. diam., valves ± equally inflated.

Type: (Turkey, A4/5: Prov. Kastamonu): Paphlagoniae, dist. Kastambuli, in montosis supra Kissiltscha (Kisilia-Kisilça) pr. Tossia, 24 May, 1892, Sintenis 3865 (holo. JE n.v., iso. G-BB, K, BM).

Distribution: Endemic to the Central and N.E.Anatolia. Map 20.

TURKEY. /

TURKEY. A4: Prov. Çankiri, at Çankiri in the valley of Čakmakli-dere, 800-900 m. 6-16 May, 2 Jul., 1929, Bornmüller 13789. A7: Prov. Gümüşane, Sipikor-Köse, 1372 m., 26 Jun. 1934, Balls 1552. B6: Prov. Kayseri, Pinarbaşi-Pasarviran, 15 km. W. of Pinarbasi, 1540 m., 22 Jun. 1951, Huber-Morath 10989; Prov. Sivas, 30 km. S. of Sivas, Ulaş-Malatya, 17 Jun. 1939, Reese. B7: Prov. Erzincan, Sipikordağ, 29 Jul. 1890, Sintenis 3125 (orig. synt. Gamosepalum alyssoides, JE, n.v. iso. K). N.W. of Tuz Gölü, 15 May 1954, Birand 226.

Habitat: Vineyards, serpentine and non-calcareous scree, and Artemisia steppe; alt. 800-1372 m. Fl. May-Jun.

This species is partially sympatric with A. lepidoto-stellatum and in addition to the differential characters cited in the discussion of that species possesses several other features which may be conveniently used. The sepals of A. paphlagonicum show a tendency to be subinflated and are separable with difficulty at maturity. Those of A. lepidoto-stellatum do not illustrate any obvious inflation and are easily separated at maturity. As indicated in Tables No.5 and 6 the inflation tendency places A. paphlagonicum at a higher specialisation level than A. lepidoto-stellatum. The over-all indumentum of A. paphlagonicum is composed of larger and coarser stellate hairs, and the floral parts are, on the average, larger than those of A. lepidoto-stellatum; however, on individual specimens (Huber-Morath 10989) the range of variation is too great to allow these species to be safely distinguished on these quantitative characters.

A. paphlagonicum /

A. paphlagonicum appears to have an edaphic preference for serpentine or igneous rubble, whereas *A. lepidoto-stellatum* is confined almost entirely to calcareous soils.

One of the specimens from Prov. Gümüşane (*Balls* 1552) has a note on the label to the effect that the flowers are sweet-scented. It is not known if this feature is shared by *A. lepidoto-stellatum*.

68. A. thymops (Huber-Morath & Reese) Dudley, comb. nov.

Syn.: Ptilotrichum thymops Huber-Morath & Reese in Fedde, Rep. Sp. Nov., 52, 40 (1943)!

Type: (Turkey, C5: Prov. Nigde): Cappadocien, Steppe bei Bor, Vilajet Nigde, 10 Jun. 1937, Reese (holo. Hub.-Mor.).

Distribution: An Irano-Turanian species endemic to Central Anatolia.

TURKEY. B4: Prov. Ankara, 45 km. S. of Ankara, road to Bâlâ, Beynam ormani, 19 May 1960, Karamanoğlu; ibid., 50 km. S.E. of Ankara, Beynam Ormani, 1500 m., 2 May 1958, Markgraf 10535a; Prov. Konya, Cihanbeyli-Kulu, 9 km. S. of Kulu, 980 m., 1 Jun. 1956, Huber-Morath 13725. C5: Prov. Nigde, Nigde-Ulukişla, high pass 45 km. from Nigde, 1560 m., 10 Jun. 1953, Huber-Morath 12816.

Habitat: Steppe, wheat fields, eruptive stone; in association with Pinus nigra; alt. 980-1560 m. Fl. Jun.

As Boissier (1867) noted, a similarity exists in the habit and facies of Ptilotrichum canescens and Alyssum tetrastemon; likewise, Huber-Morath makes a similar observation regarding Ptilotrichum purpureum from Spain and his new taxon, P. thymops. It is interesting that both workers chose species of "Ptilotrichum" which can now be referred to Alyssum Sect. Alyssum (cf. p 18 and Synopsis of the Genus Alyssum, p. 181). The major feature of entire petals which Huber-Morath uses to assign his new species to Ptilotrichum rather than to Gamosepalum (bilobed petals, fide Haussknecht: 1897) is only of differential value between species and cannot be used with any surety to separate Alyssum from "Ptilotrichum" or Gamosepalum at generic levels.

Huber-Morath /

Huber-Morath correctly points out that Ptilotrichum thymops is closer morphologically to Gamosepalum lepidoto-stellatum than any oriental species of "Ptilotrichum", but that the connate sepals and long filaments of the Gamosepalum were not found in Ptilotrichum thymops. Examination of the original material revealed that the fusion of the long filaments, the "pseudo-connation" of the sepals and an indumentum of few-rayed stellate hairs (not lepidote as indicated by Huber-Morath) were consistent in A. thymops. These features ally it directly to the complex in Sect. Gamosepalum (Series Gamosepalum) containing A. tetrastemon, A. lepidoto-stellatum, and A. paphlagonicum.

A. thymops, which is partially sympatric in the Central Anatolian steppe with two of its closest allies, A. tetrastemon and A. paphlagonicum, may be distinguished from these by the weakly dimorphic and sparse short-rayed hairs on the sepals, the obovate, glabrous and pale cream petals, and the very narrow linear-oblanceolate leaves, the uppermost not involucrate. The narrow wings of the long filaments of A. thymops led Huber-Morath to describe "stamina non alata"..."; however, these wings, - narrower than in any other species in Sect. Gamosepalum - are of further distinguishing value.

It may be observed in Tables No. 5 and No. 6 that A. thymops is the most specialized representative of Series Gamosepalum and holds a comparable position of advancement to A. corningii in Series Libra.

(4) SECT. GAMOSEPALUM

(b) Series Libra

69. A. baumgartnerianum Bornm. ex Baumg. in Jahresb. Kaiser Franz Josef-Land.-Gymn. Oberrealsch., Baden bei Wien, 48, 16 (1911); Bornm. in Beih. Bot. Centralb., 31, 186, t. 1, f. 1 (1914); Bouloumoy, Fl. Lib. & Syria, pl. 38, t. 14 as A. tetrastemon (1930).

Syn.: A. tetrastemon Boiss. var. latifolium Boiss., Fl. Or., 1, 278 (1867)!

A. lepidotum sensu Post, Fl. Syr., Pal & Sin., 1, 85 (1932), non Boiss.!

Lectotype: (Lebanon): Libanon, Dschebel Barûk, ad nives, 2100 m., 15 Jun. 1910, Bornmüller 11405 (orig. W, iso. G, K, BM, E).

Distribution: S. Anatolia, Syria, Lebanon, Israel and Iran. Map 21.

TURKEY. C3: Prov. Antalya, Berket dagh (Çalbali dağ) 1846, Pestalozza. C4: Prov. Konya, Jelibel dağ, Karaman-Ermenak, 2020 m., 10 Jun. 1948, Huber-Morath 8213 pro parte. C5: Prov. Adana, distr. Karaisali, N.W. of Pozanti, Koça, Çukur yaylasi 1750 m., 29 Jun. 1959, Huber-Morath 16226. C6: Prov. Urfa, Asir Gedizi, Burijik (Birecik), 1524 m., 7 Jun. 1934, Balls 1313; Prov. Hatay, Amanus dağ, 1300-1400 m., 27 May 1956, Birand 119. D6: Prov. Hatay, Mt. Cassius (Akra dağ), Jun. 1846, Boissier.

Habitat: Limestone scree, subalpine regions and pastures; often in Pinus nigra woods; alt. 1300-2100 m. Fl. May-Jun.

Designated as the type species of Series Libra, A. baumgartnerianum possesses the important features defining that natural complex. It may be/

be distinguished from A. sulphereum, thought to be closely related and with which it is contiguous, by the obtuse, obovate or spathulate cauline leaves which are prominently involucrate, usually entire petals, wider hyaline sepal margins and always densely pubescent styles.

Bornmüller claims (in Baumgartner) that no relationship exists between this species and A. tetrastemon. This concept is rejected by Baumgartner and the present author. Beaumgartner hints, however, that the high alpine A. baumgartnerianum might be considered as an "ecological vicariant" of the montane or steppic A. tetrastemon, similar to the relationship between A. ovirense Kerner and A. wulfenianum Bernh. ex Willd. in Eastern Europe. It is obvious that though A. baumgartnerianum and A. tetrastemon are both included in Sect. Gamosepalum, they represent different morphological trends (for example: fused long filaments and an indumentum of few-rayed stellate hairs of the latter, versus free but adjacent and often overlapping long filaments, and an indumentum of many-rayed lepidote or sublepidote hairs of the former) which may be expressed as natural groups or series with the other components of the section.

The reduction of A. tetrastemon var. latifolium to synonymy by Baumgartner is justified by comparison of one of the specimens of this variety (Roth) from the Boissier Herbarium at Geneva with the type collection of A. baumgartnerianum. It is necessary to point out that the records of A. montanum (Boissier, 1867; from Mt. Cassius: Post, 1896), A. lepidotum (Post, 1896 and 1932) and A. suffrutescens (Tristram, 1884) are all referable as A. baumgartnerianum.

The occurrence of A. baumgartnerianum in Anatolia has not been previously/

previously recorded, but the comparison of the material cited with the type collection of this species indicates that they are conspecific. Prof. Zohary has assured the author that this species forms large and colourful populations on alpine screes in Palestine and Lebanon.

One collection from Anatolia (Huber-Morath 16226) is indicated on the label as having white flowers. This observation probably stems from the fact that upon drying the yellow flowers of many *Alyssum* fade to a whitish or creamy tone.

70. A. corningii Dudley, sp. nov. Pl. 7. Fig. 1B, v. Map 21.

Syn.: A. tetrastemon Boiss. var. cappadocicum Boiss., Fl. Or., 1, 278 (1867), non var. cappadocica Boiss. (1842)!

A. tetrastemon sensu Baumg. in Jahresb. Kaiser Franz Josef-Land.-Gymn. Oberrealsch., Baden bei Wien, 48, 5 (1911), non Boiss. (1842)!

Affinis A. tetrastemon Boiss. sed habitu diverso, indumento ex toto fere monomorpho pilis stellatis paucis radiatis brevibus, foliis haud involucratis, racemi elongati multifructi differt.

Herba perennis, suberecta vel patens, basi multiramosa et suffruticosa, 7-12 cm. alta, 5-10 (-15) cm. lata. Planta ex toto indumento cinereo-cano e pilis stellatis densis punctatis semper stipitatis interdum manifeste basi tuberculatis 0.2-0.4 mm. latis radiis brevibus vel longis 5-10-radiatis crassiusculis suberectis (rare appressis) inaequalibus multiramosis (haud lepidotis) composito. Caules floriferi ascendentes vel erecti, 2-7 (-12) cm. longi. Surculi steriles dense foliati, basi caulium floriferorum conferti, 1-3 cm. longi. Folia caulium floriferorum linearia, oblonga vel oblanceolata, acuta, sensim in petiolum attenuata, 6-10 mm. longa, 1.5-2 (-2.5) mm. lata; superiora longiora et latiora, ad marginem saepe subhirsuta, non involucrata. Folia caulium sterilium lineari-oblanceolata, acuta vel rare obtusa, aciculiformia, subsulcata, 6-10 mm. longa, 0.5-1 (1.5) mm. lata, pilis stellatis quam eis foliorum caulium floriferorum densioribus et minioribus. Racemus simplex, brevibus, saepe confertus, rare subumbelliformis, post anthesin elongatus, saepe corymbosus ramulis aequalibus /

aequalibus, 1.8-2 (-2.5) cm. longus. Pedicelli erecto-patentes, stricti, rigidi, subrecurvi, 3-6 mm. longi, pilis stellatis furcatis et suberectis sicut sepala obsiti. Sepala basi subsaccata, lanceolata vel ovata, acuta, 3-3.5 mm. longa, 1-1.5 mm. lata, obscure pseudoconnata ob pilis intertextis cohaerentia, facile separabilia, extus indumento pilis stellatis appressis et rare apicem versus pilis furcatis basi tuberculatis radiis delicatissimis simuatis inaequalibus sericeis sparse vel dense provisa, intus pilis stellatis radiis delicatulis inaequalibus sericeis obsita. Petala in sicco pallida, late spatulata, retusa vel subretusa, 4.5-5.5 mm. longa, 1-1.5 mm. lata, infra constrictionem medianam ungue alato (ala denticulata 0.4-0.6 mm. lata) munita, nervo mediano unguis pilis stellatis parcis radiis haud ramosis proviso. Filamenta longa 3-4 mm. longa, libra, contigua, bilateraliter anguste marginata, superne sensim contracta, basi vel etiam ad medium rare conniventia sed facile separabilia pilis stellatis parcis minutis provisa. Filamenta brevia (2.8-) 3-3.5 mm. longa, basi dente brevissimo 0.2-0.3 mm. longo provisa. Ovulae duae per loculum. Stylus rostratus vel subrostratus, 1.5-2.5 (-3) mm. longus, in dimidio inferiore pilis stellatis minutis multiradiatis parce vel dense provisus. Silicula uniseminata vel rare duoseminata, orbicularis, ovata, truncata vel subemarginata, 3.5-4 mm. longa, 2.5-3.5 mm. lata, valvis cartilagineis aequaliter vel inaequaliter inflatis indumento cano dense vestitis. Semen immaturum non alatum. Fl. et fr. Jun.

TURKEY. C4: Prov. Konya, Konya to Sultanhani on new road, 18 miles from Konya, 1050 m., in new enclosed forestry plantation, steppic habitat /

habitat, pale lemon yellow flowers, rare, 16 Jun. 1962, Dudley (D. 35911) (holo. E). B4: Prov. Ankara, Giarrkale (?) bei Haymana, Berge Steppe, Kotte 1165 (K). B5: Prov. Niğde, Tuff bei Niğde, 1100 m., 4 Jun. 1898, Siehe 60 (W, K, BM, G-B, B). C4: Prov. Konya, Steppen bei Divle (Karaman - Ereğli), 1300 m., Jun. 1906, Siehe 241 (E); ibid., Sarayönü, civari Step yol Kenari, May 1943, Birand (ANK as A. tetrastemon). C5: Prov. Adana, Partie supérieure de la Vallée du Kamechly-Tchai (Kamışli), 1490-1500 m., 16 Jun. 1856, Balansa 493 (holo. var. cappadocicum (1867, G-B, iso. G, GH).

Habitat: Entirely confined to the Central Anatolian steppe; alt. 1050-1500 m.

A. corningii was first distinguished by Boissier (1867) as A. tetrastemon var. cappadocicum and differentiated from the typical A. tetrastemon by possessing "... pili omnes lepidoti et caules saepe ramulosi", contrasted to "basi suffrutescens lepidotum et insuper breviter tomentoso-hirtum, caulibus humilibus...". This name is pre-dated by Boissier's (1842) A. tetrastemon var. cappadocica which was based on different material and is obviously a synonym of A. tetrastemon sensu stricto.

The indumentum of A. corningii is for the most part monomorphic and appressed, and lepidote in the lower portions of the plant. That of A. tetrastemon is dimorphic and distinctly hirsute and tomentose especially on the sepals, pedicels, and upper stems and leaves. Baumgartner (1911:6) stated that the indumentum difference did not justify the formation of a new species. However, examination of all available

available material indicates that the indumentum character is of considerable differential value when combined with the other numerous and consistent diagnostic characters.

In addition to the characters detailed by Boissier, A. corningii (Series Libra) may be separated from A. tetrastemon (Series Gamosepalum), the taxon with which it is most easily confused, by the closely adjacent but free long filaments (rarely coherent at the extreme base); the narrower cauline leaves which are not involucrate; and the many-fruited, elongate racemes.

Baumgartner (1911:5 as A. tetrastemon) indicated that from his point of view the recognition of A. tetrastemon var. cappadocicum sensu 1867 as a variety or species was unwarranted. This was a definite departure from his views regarding A. montanum (1907), and it would appear that he did not examine the floral structure of both species, in particular the filaments. In fact, he had only one collection of A. corningii (Siehe 60) at his disposal. The deviating morphological characters distinguishing A. corningii from A. tetrastemon are consistent in all the populations and gatherings which this author has examined, and are of significant merit necessitating the establishment of a new binomial.

The distribution and general ecology of A. corningii and A. tetrastemon do not appear to be mutually exclusive, though they have never been found growing together. Both species probably represent branches from a Gamosepaloid ancestor within the perennials of Sect. Alyssum and close to A. iranicum, A. aizoides, A. bornmuelleri, A. doerfleri, A. taygeteum and A. caespitosum.

The /

The specific epithet of this new taxon honours a friend and benefactor, The Honorable Erastus Corning II of Albany, New York, whose support and interest made the author's investigations of Alyssum at Edinburgh a reality.

71. A. sulphureum Dudley & Huber-Morath, sp. nov. Pl. 8 & 9. Fig. 5, 13-26. Map 21.

Syn.: ? Gamosepalum alyssoides Hausskn. in Mitt. Thür. Bot. Ver., 11, 75 (1897), pro parte quoad plantam Sindschar a Reuter lectam. Gamosepalum paphlagonicum sensu Bornm., Symb., ad Fl. Anat., 59 (1936), pro parte quoad plantam Mesopotamiam a Handel-Mazzetti lectam, non Hausskn.

Affinis A. bornmuelleri Hausskn. ex Degen (Sect. Alyssum), A. aizoidi Boiss. (Sect. Alyssum) et A. harputico Dudley (Sect. Gamosepalum), sed ab omnibus speciebus habitu diverso, sepalis angustioribus margine membranaceo, appendice filamentorum brevium multo breviore differt; insuper a primo forma squamorum lepidotorum, petalis retusis vel bilobatis recedit; a secundo filamentis longis edentatis, unguibus petalorum pilis stellatis provisis divergit; a tertio indumento diverso, petalis majoribus, pilis stellatis forma foliorum distinguitur.

Herba perennis, suffruticosa, dense caespitosa, pusilla, multiramosa, sed ad basim efolitata, (50) 10-20 cm. alta. Planta ex toto indumento denso appresso cinereo-argenteo squamis minute punctatis lepidotis (0.2-) 0.3-0.5 mm. diam. vestita, sed superne et in marginibus (rare in paginis ambobus) foliorum superiorum indumento ut in sepalis dimorpho obsita, pedicellis et sepalis pilis stellatis radiis longis sericeo-villosis vestitis. Caules floriferi erecto-ascendentes, parce foliati, (2.5-) 8-10 cm. longi. Surculi steriles numerosi, densissime conferti, patentes, dense foliati, 1.2-5 cm. longi. Folia caulium floriferorum lineari-oblanceolata, sessilia, acuta, (5-) 10-15 mm. longa, 1.5-2 (2.5) /

(2.5) mm. lata, ascendentes, superiora sensim increscentia, post anthesin decidua; summa involucrata. Folia caulium sterilium oblanceolata vel subspatulate, acuta, (2-) 6-10 mm. longa, 1.5-2 mm. lata. Corymbi umbelliformes capitato-rotundati, congesti, 1.5-2 cm. longi et lati, floribus 5-15. Pedicelli in statu fructifero 3-4.5 (-6) mm. longi, crassi, rigidi, ascendentes vel subhorizontales, indumento dimorpho eo sepalorum simili dense obtecti. Sepala subpersistentia, apice cucullata, inaequalia, acuta, pseudoconnata, (3.5-) 4.5-5.5 mm. longa, (1.5-) 2-3 mm. lata, margine hyalina angusta, 0.1-0.2 mm. lata squamis lepidotis tecta in dimidio inferiore intertextio connata, extus squamis lepidotis minute punctatis argentis 0.3-0.4 mm. diam. apicem versus indumento dimorpho e pilis stellatis basi tuberculatis sericeo-villosis radiis inaequalibus longis paucis vel numerosis 0.5-1 mm. longis squamis lepidotis composito, intus indumento dimorpho parce vel dense obtecta e pilis stellatis radiis sericeis valde inaequalibus duobus longis antrorse appressis et pilis stellatis radiis aequalibus brevibus composito. Petala sulphurea, late spatulata, retusa vel bilobata, (5.5-) 6-8 mm. longa, 2.5-3 mm. lata; unguis ad medium constrictus alis latis membranaceis saepe integris, nervo mediano pilis stellatis sublepidotis radiis paucis vel multis suberectis dense vel sparse obsito. Filamenta longà 4.5-5.5 (-6) mm. longa, libra, non connata sed verum contigua, edentata, anguste bilateraliter alata, ad basim sensim dilatata. Filamenta brevia 3-4.5 mm. longa, haud alata vel angustissime alata ad basin appendice brevissima minuta praedita. Antherae auriculatae, apice acùtae, 1 mm. longae. Stylus in statu fructifero, /

fructifero, tenuis ad basin dilatatus, (2-) 3-3.5 (-4) mm. longus, glaber vel in dimidio inferiore pilis stellatis radiis suberectis obsitus. Ovulae duae per loculum. Silicula uniseminata, rare duoseminata, orbicularis vel obovata, truncata vel obstusa, (4-) 5-5.5 (-6) mm. longa, 3.5-4.5 mm. lata, valvis cartilagineis manifeste inaequaliter inflatis indumento denso argenteo e squamis appressis minute punctatis lepidotis vel sublepidotis multiradiatis 0.3-0.5 mm. diam. composito obsitis. Semen pallide brunneum, in aqua manifeste limosum, 3.5-4 mm. longum, 3 mm. latum, ala angusta (0.05-) 0.1-0.2 mm. lata. Fl. Jun., fr. Jul.

TURKEY. B6: Prov. Malatya, Kalkmergelhügel östlich ob Darende, 1000-1050 m., 28 Jun. 1953, Huber-Morath 11969 (holo. Hub.-Mor., iso. E.) B6: Prov. Malatya, Mergelhügel, 2 km. westlich ob Darende, an der Strasse nach Gürün, 1090 m., 28 Jun. 1953, Huber-Morath 11970 (Hub.-Mor.); ibid., Mergelhügel nördlich ob dem Dorf Darende, 950-980 m., 20 Jun. 1949, Huber-Morath 9252 (Hub.-Mor.); ibid., Entre Derindeh et Kavak Aghatch (Akçadag), 14 Jun. 1906, Post 52 (G-B.V.D. Post, as A. argyrophyllum). C9: Prov. Hakâri, mons Bestabije (Beytüşşebap) prope Hos, Amadia (Imfiya) - Sattak (Çatak), 1650 m., 27 Jul. 1910, Hándel 1264 (BRA, as Gamosepalum alyssoides).

NORTHERN SYRIA: Desert nr. Harbat Antar, 3 May, 1900, Post (BM, as Ptilotrichum lepidoto-stellatum).

NORTHERN IRAQ: Kalk Hangen bei Dorfruine Ghara (Bir Garan) in Dschebel Abd'elasis (Debel-Abdul Aziz), 600 m., Handel Mazzetti (W, as Gamosepalum alyssoides).

Habitat: Limestone and marl ledges , steppe hillsides and scree; alt. 600-1650 m.

The/

The closest ally to this new species within Sect. Gamosepalum is probably A. harputicum. A. sulphureum may be easily separated from it by the caespitose, dense cushion-forming habit, broader and shorter leaves, smaller lepidote scales with longer peripheral rays on the sterile shoot leaves and fruits, larger and usually bilobed petals, and the narrower membranous sepal margins. In addition, the stellate hairs on the upper cauline leaves, pedicels and sepals often appear strigose with long, unequal and spreading rays. This form of indumentum is shared with A. bornmuelleri and A. aizoides in Sect. Alyssum, from which A. sulphureum may be separated by the same characters which distinguish it from A. harputicum. The edentate long filaments and presence of indumentum on the petals are also of differential value in separating the new species from A. aizoides.

Considerable difficulty was experienced in placing A. sulphureum in the correct section due to this superficial resemblance to some species in Sect. Alyssum. The problem was clarified by observation of the dimorphic sepals which are adherent, at least basally, because of interlocking hairs, the copious indumentum on the inner surface of the sepals, and the edentate contiguous, but free, long filaments of A. sulphureum. The difficulty in sectional placement indicates that Sect. Gamosepalum is probably directly derived from Sect. Alyssum.

Haussknecht (1897) was bewildered by this resemblance of Gamosepalum to Alyssum and discussed it at length when he proposed the binomial Gamosepalum alyssoides for a Reuter collection from Sindjar in North Iraq. This collection (not seen) and that of Handel-Mazzetti (Handel-Mazzetti: /

(Handel-Mazzetti: 1913 and Bornmüller: 1936) certainly represent <u>A. sulphureum</u>. This view is supported by the fact that <u>A. sulphureum</u> is one of the two species in Sect. <u>Gamosepalum</u> (the other being <u>A. baumgartnerianum</u>) with an Anatolian and extra-Anatolian distribution; specimens having been seen from N. Syria and as far east as Turkish Kurdistan.

The specific epithet <u>alyssoides</u> applied by Haussknecht in <u>Gamosepalum</u> may not be used for this new taxon; <u>Clypeola alyssoides</u> L. (1753) was transferred to <u>Alyssum</u> by Linnaeus in 1759.

72. A. harputicum Dudley, sp. nov. Pl. 10. Fig. 5, 1-12. Map 20.

Syn.: A. aizoides sensu Baumg. in Jahresb. Nied.-Ost. Land.-Lehrers. Wien.-Neust., 36, 24 (1909) et sensu Bornm., Symb. ad Fl. Anat. 54 (1936) - non Boiss.!

Affinis A. lycaonico Schulz sed squamis lepidotis duplo minoribus, caulibus longioribus ascendentibus, foliis surculorum sterilium angustioribus, sepalis haud inflatis minoribus, petalis minoribus indumento parciore differt.

Herba perennis e basi ramosa suffruticosa. Planta ex toto squamis appressis desciformibus albo-lepidotis punctatis 0.2-0.3 mm. latis dense vestita. Caules floriferi erecti vel arcuato-ascendentes, 5-11 cm. longi. Surculi steriles numerosi eoque caespitosi, fastigiati, ascendentes, 1-4 cm. longi, dense foliati. Folia caulina sessilia, acuta; inferiora obovato-oblanceolata, c. 4 mm. longa, 1-1.5 mm. lata; mediana linearia vel lineari-cuneata, c. 10 mm. longa, 0.5-1 mm. lata. Folia surculorum sterilium lineari-oblanceolata, 5-10 mm. longa, 0.5-1 mm. lata. Corymbi simplices vel pauci-ramosi, congesti, rotundati, 1.3-1.5 (-2) cm. lati, foliis caulinis summis subinvolucrati. Pedicelli sub-anthesi patentes vel erecti, c. 5 mm. longi. Sepala persistentia, pseudoconnata, subcarinata, subinaequalitia, apice cucullata, acuta, 2.5-4 mm. longa, 1-1.5 mm. lata, margine hyalina squamis tecta, in dimidio inferiore ob indumento intertexto cohaerentia, extus dense lepidota, intus pilis radiis valde inaequalibus duobus longis antrorse appressis et pilis stellatis radiis aequalibus brevibus vestita. Petala lutea, obovata vel spatulata, 5-5.5 mm. longa, 2 mm. lata, apice integra vel leviter retusa, unguis /

unguis margine hyalina in parte superiore dilatata, 0.2-0.3 mm. lata, pilis stellatis paucis obsitus. Filamenta longa c. 4 mm. longa, libra, sed verum contigua, edentula, bilateraliter membranaceo-marginata, superne sensim contracta. Filamenta brevia 3-3.5 mm. longa, basi appendice brevissima praedita. Antherae 0.8-1 mm. longae. Ovarium orbiculare, 2 mm. longum, 1.5 mm. latum, dense lepidoto-squamatum, apice emarginatum. Glandulae nectariferae prominentes, globosae. Stylus in statu florendi 2.5-3 mm. longus ad basin dense lepidotus stigmate globoso capitato provisus. Ovulae duae per loculum, non marginatae. Fructus ignotus. Fl. Mai.

Type: Turkey, B7: Prov. Elâzig, Armenia Turcica, Kharput (Harput) in summo monte Kisil Depe, 10 May 1889, Sintenis 323 (holo. G, iso. G-BB, W,K, all as A. aizoides).

A. harputicum most closely resembles A. lycaonicum which is, however, widely separated from it geographically. The diagnostic characters separating these two are easily observed. A. lycaonicum has large and extremely inflated sepals enclosing the ovary or fruit (presumably of dispersal value); whereas those of A. harputicum are persistent but considerably smaller and never inflated. The petals and lepidote scales of both species are similar in form, but those of A. harputicum are always smaller. The narrow, almost needle-like, involute leaves of A. harputicum are unique in Sect. Gamosepalum. Similar leaves, however, are possessed by A. pinifolium (Sect. Odontarrhena Subsect. Samarifera), thereby providing an example of convergence in morphologically and taxonomically widely separated taxa.

Baumgartner /

Baumgartner (1909:24) erroneously thought the type collection of _A. harputicum_ represented _A. aizoides_ in Sect. _Alyssum_. Unfortunately he did not examine any additional material and did not know _A. aizoides sensu stricto,_ but rather relied on Stapf's determination. Bornmüller (1936) repeated this error but stated "_folia linearia_", accordingly widening the specific limits of _A. aizoides_. _A. harputicum_ is morphologically so distinct that it should never be confused with any other species, even its closest ally.

73. A. niveum Dudley, sp. nov. P.11. Map 20.

Affinis A. harputico Dudley sed habitu valde diverso, foliis latioribus, petalis longioribus et squamis lepidotis maioribus differt.

Herba perennis, caespitosa, conferta, 3 cm. alta, 5 cm. lata, radice principali longa. Planta ex toto indumento manifeste albo-argenteo squamis lepidotis multiradiatis appressis disciformibus manifeste punctatis (0.1 -) 0.2-0.5 (0.7) mm. diam. dense vestita. Folia imbricata, summum versus increscentia, sessilia, acuta, squamis lepidotis 0.4-0.5 mm. diam. dense obtecta; superiora involucrata, linearia, oblanceolata vel spatulata, 10-15 mm. longa, 2-3 mm. lata; inferiora lanceolata vel obovata, 7-10 mm. longa, 2-2.5 mm. lata. Corymbi simplices, conferti, umbelliformes, 1-2 cm. lati et longi, floribus 8-15. Pedicelli in statu florendi subhorizontales vel divergentes, interdum deflexi, 3-4 mm. longi, indumento denso squamis lepidotis 0.4-0.5 mm. diam. tecti. Sepala lanceolata vel elliptica, obtusa vel subacuta, basi subsaccato-angulata, leviter dimorpha, pseudo-connata sed facile separata, in dimidio inferiore ob indumento intertexto cohaerentia, persistentia, (3-) 3.5-4.5 mm. longa, (1.5-) 2.5-3 mm. lata, margine hyalina 0.2-0.3 mm. lata, extus indumento denso squamis lepidotis 0.2-0.3 mm. diam. provisa, intus pilis stellatis appressis multiradiatis sublepidotis parce vel copiose munita. Petala spatulata, retusa vel sub-retusa, rare integra, flava, 6.5-7 mm. longa, 3-3.5 mm. lata, in ungue sensim attenuata vel ad medium constricta margine unguis saepe denticulata, squamis lepidotis 0.1-0.3 mm. latis in ungue (rare in lamina) obsita. Filamenta longa, libra sed verum contigua, interdum omnino conniventia, angustissime bilateraliter alata, ad basim leviter dilatata, edentata, 3.5-4mm. longa. Filamenta brevia 2.5-3 mm. longa, ad basim leviter dilatata, basi appendice brevissimo provisa. Antherae 1 mm. longae, apice obtusae vel subacutae, connectivo prolongato 0.2-0.3 mm. longo. Glandulae minutae, globosae, lobatae. Ovulae duae per loculum, ut videtur solum una vel duae maturantes. Stylus in statu florendi 2-2.5 (-3) mm. longus, rigidus, ad basim dilatatus, in dimidio inferiore (rare ex toto) squamis lepidotis densis provisus, stigmate magno globoso provisus. Ovarium orbiculato-ovatum, apice emarginatum, 1.5-2.5 mm. longum, 1-2 mm. latum, indumento denso albo squamis lepidotis 0.4-0.5 mm. diam. provisum. Fructus ignotus. Fl. May.

Type: Turkey. B3: Prov. Eskişehir, distr. Sivrihisar, nordöstlich von Yaka Pinar, Steppe auf Kalk, 18 May 1941. Romieux (holo. Hub.-Mor.).

A detailed comparison of the species in Sect. Gamosepalum shows that A. niveum, a steppe plant of very limited range, is morphologically closest to A. harputicum. A. niveum deviates by its extremely reduced habit but with a long tap root (A. harputicum having a net root system), wider leaves and larger lepidote scales. The petals may also be utilised to distinguish these species: A. niveum has very large, usually retuse petals with the wings of the claw frequently denticulate; A. harputicum has smaller and entire petals and entire claw wings.

Unfortunately the species is only known from the type collection of one plant, but the numerous morphological discontinuities which distinguish it from the other species in Sect. Gamosepalum make specific rank necessary. As the author failed to re-discover this species in an area near the type locality, it may be assumed that A. niveum is extremely rare.

This species may be regarded as a stage in the same cul de sac evolutionary sequence (Series Libra of Sect. Gamosepalum) as A. harputicum and which culminates with A. lycaonicum.

74. A. lycaonicum (Schulz) Dudley, comb. nov.; Bornm., Symb. ad Fl. Anat., 58 as Gamosepalum (1936).

Syn.: Gamosepalum lycaonicum Schulz in Notizbl. Bot. Gart. Mus. Berlin-Dahlem, 10, (91), 110 (1927)!

Type: (Turkey, B3, Prov. Konya): Wilajet Konia, Steppe bei Korasch (Koraşi) in Lykaonien, 1400 m., Jun. 1906, Siehe 274 (holo. B n.v., iso. BM).

Distribution: Rare Anatolian endemic, confined to the Konya steppe. Map 20.

TURKEY. C4: Prov. Konya, Karaman-Mut, 7 km. S. of Karaman, 14 Jun. 1950, Reese. C5: Prov. Konya, Ereğli, 1900 (1906), Siehe.

Habitat: Dry steppe; alt. 1400 m. Fl. Jun.

The morphological discontinuities which define the limits of this species are of such significance that confusion with any other species should not ensue. The homomorphic indumentum of very large disciform lepidote scales (up to 2 mm. in diam.), the extremely inflated and enveloping calyx, the erect and tall growth and the non-involucrate cauline leaves which decrease in size upwards are sufficient to clearly distinguish this species from its closest allies in Series Libra, namely A. harputicum and A. niveum. The distribution of these species is completely allopatric.

This was the first formally described Gamosepalum with prominent yellow petals, the feature of whitish petals not being useful to define the genus (Schulz). However, A. baumgartnerianum (described as an Alyssum, Bornmüller ex Baumgartner; 1911), which is designated by the present /

present author as the type species of Series Libra, also has yellow petals.

Of all the species in Series Libra, A. lycaonicum has the largest floral parts and the largest lepidote scales. It is concluded from Table No. 6 that this species represents one of the most specialized members in the section.

(5) SECT. ODONTARRHENA

(i) Subsect. Odontarrhena

75. A. corsicum Duby in DC., Fl. Gall., ed. 2, 1, 34 (1828); Fiori & Paol., Ic. Fl. Ital., 1, 165, f. 1440 (1899); Nyár. in Bul. Grăd. Bot. Cluj, 7, 125, t. 3, f. 50, 51, t. 5, f. 77, t. 8, f. 101, f. 10, t. 10, f. 127, 128 (1927); Huber-Morath in Fedde Rep. Sp. Nov., 52, 194 (1943); Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 85 (1949); Contandr., Recher. Fl. End. Corse (Thèses Faculté Sc. Montpell.), 135 (1962). Pl. 12. Fig. 1A, j; fig. 2, i.

Syn.: A. bertolonii Lois., Nouv. Not., 28 (1827), non Desv.!

Syntypes: (Corsica): in Corsica circa Bastia (orig. synt. G-DC, iso. G-BB, GH, K, E).

Distribution: Native to S.W. Anatolia, but naturalized in Corsica. There is one record from Crete (Mt. Ida, 1949 m., Boissier; fide Fenzl in Tchih., Asie Min., Bot. 1 (3), 311 as A. elatum: 1860). Map 29.

TURKEY. B1: Prov. Izmir, Dereköy (nr. Bergama), 60 m., 1849, Tchihatcheff 327 (fide Fenzl, loc. cit.). B2: Prov. Kütahya, Tavşanli-Inégöl, 7 km. from Tavşanli, 800-900 m., 23 Jun. 1962, Dudley (D. 36148). C2: Prov. Burdur, Yeşilova-Denizli, Salda Gölü, 1100 m., 1 Jun. 1962, Dudley (D. 35305b); ibid. high pass S. of Dirmil, 1380 m., 29 Jul. 1948, Huber-Morath 9265; ibid., Kizilhisar-Yeşilova, 68 km. to Denizli, 1000 m., 16 Jun. 1954, Huber-Morath 12826; ibid. Korkuteli-Teffeni, 52 km. from Korkuteli, 1100 m., 31 May 1962, Dudley (D. 35282); Prov. Muğla, Marmaris- Datça, nr. Hisarönü, 10-20 km. from Marmaris, 5-60 m., 6 Jun. 1962, Dudley (D. 35406); ibid., Muğla-Marmaris, 36 km. to Muğla,

20 /

20 m., 19 Jun. 1954, Huber-Morath 12827; ibid., Mugla-Fethiye, 10 km. from Mugla, 590 m., 29 May 1962, Dudley (D. 35131); ibid., 57 km. S.E. of Mugla, 21 Jun. 1954, Huber-Morath 12828; ibid., Sandras dag, above Agla, 1219 m., 23 Jul. 1947, Davis 13618; Prov. Denizli, ibid., Çukur köy, from Denizli to Honaz dag, 1100 m., 30 Jun. 1935, Reese; ibid., Denizli-Acipayam, Honaz dag, 32 km. from Acipayam, 1220 m., 10 Jun. 1954, Huber-Morath 12825; ibid., Cadmi (Honaz dag), Gheyra, 1842, Boissier (orig. synt. A. elatum, G-B). C3: Prov. Antalya, Gagae (nr. Kumluca), Forbes 43. Caria, 1843 Pinard (orig. synt. A. elatum, G-B; iso. W, G, K).

Habitat: Forming large populations in disturbed and ruderal areas, neglected fields, limestone and conglomerate cliffs, infrequently on serpentine and mica-schist substrates; sometimes in Pinus brutia woods and Quercus macchie; alt. (sea level-) 100-1380 m. Fl. May-Jul.

A. corsicum is a member of a complex within the typical subsection of Sect. Odontarrhena. All the species included in this complex are fruticose perennials with glabrous or glaucous or rarely papillose fruits and bicolored or concolorous spathulate-obovate or obcuneate sterile shoot leaves. The closest Anatolian ally within this group is A. masmenaeum, from which A. corsicum differs by having considerably smaller orbicular or obovate fruits, shorter styles, larger and more widely branched corymbs, and an intensely silvery indumentum on the sterile shoot leaves composed of stellate hairs with many, long and branched rays (that of A. masmenaeum is of dull appearance formed from small lepidote scales).

Boissier /

Boissier (1849 and 1867) unfortunately included this species in _A. elatum_. When the original material of _A. elatum_ was examined, it was evident that three taxa were involved; _A. corsicum_ (_Pinard_ and _Boissier_ from Caria and Cadmus); _A. gioenanum_ (_Kotschy_ 41); and _A. elatum_ (_Heldreich_ from Tcherali). Because of this confusion it was necessary to assign a lectotype (Heldreich's specimen) _A. elatum_, thereby permitting the other specimens to be treated under their correct epithets. The obvious characters of _A. elatum_ not shared by _A. corsicum_ are the crenulate wing on the fruit, equally compressed fruit valves, and the fragile reflexed pedicels. The habit and stature of the two are similar, but _A. corsicum_ flowers and sets fruit approximately a month earlier than _A. elatum_.

The reasons for Boissier's error are not clear. It is thought, however, that he was unwilling to assign the epithet _A. corsicum_ to any plant found in Anatolia, yet the fact that he initially labelled the _Pinard_ collection as _A. corsicum_ var. _orientale_, _ined_. reveals that he recognized a definite similarity to the Corsican plants.

For many years European botanists, including Nyárády (1927), contended that this species was a Corsican endemic. Evidence elucidated by Huber-Morath (_loc. cit._) and Contandriopoulos (_loc. cit._) make it clear that _A. corsicum_ is actually (as a native) endemic to Western Anatolia and has become naturalised in Corsica. _A. corsicum_ is abundant in extremely localised areas in the Valley of Fango on Corsica. Huber-Morath maintains that the occurrence of this species in Corsica (close to the old shipping port of Bastia), though of long naturalised duration, cannot be interpreted as/

as a relicism. The wide distribution in Western Anatolia and the localised distribution in Corsica lead to the conclusion that A. corsicum as an adventive in Corsica has not been able to extend beyond the area where it first became established. In Anatolia the conditions for extension are more suitable; the author discovered this species as far north as Prov. Kütahya (Dudley D.36148) and south east into Lycia (Dudley D.35382), accordingly extending the range far beyond that indicated by Huber-Morath. In some areas of Caria, A. corsicum is sympatric with A. caricum of Subsect. Samarifera, but is more widespread. A. caricum completely replaces A. corsicum on serpentine outcrops and in montane or alpine areas.

The chromosome complement of A. corsicum is 2n=16 (Contandriopoulos). This number and chromosome configuration which she illustrates are not unexpected in Alyssum.

In conversation Huber-Morath has hypothesised that A. corsicum was probably introduced into Corsica (hence described as an endemic) in shipments of grain from Anatolia. Very large populations - appearing as acres of golden yellow when in flower - attain the best development on the lowland calcareous areas in the Caria which once may have produced grain for exportation, but is now, for the most part, abandoned to Alyssum corsicum. A similar example is pointed out by Contandriopoulos, Cerastium illyricum Ard. (C. comatum Desv.) is a native plant of the Balkans, Western Anatolia and Crete. Recently it has been discovered in very localised populations near a sea port on Corsica. The Cretan records of A. corsicum (Fenzl in Tchih., 1860 as A. elatum) and Cerastium illyricum /

illyricum are probably due also to importation of the seeds in shipments of grain. _Diplotaxis assurgens_ (Delille) Grodr., until recently known only from Port Juvenal near Montpellier on the south coast of France, furnishes a similar example. Jahandiez (1922) records this taxon as occurring abundantly in Morocco and Contandriopoulos claims that this Moroccan endemic was introduced to Port Juvenal in wool shipments.

An interesting use of _A. corsicum_ was observed just outside Múgla. The inhabitants were collecting large bundles of flowering _A. corsicum_ which, they explained, would be used to feed goats and to make a "herb tea".

76. A. masmenaeum Boiss., Diagn., 3 (5), 36 (1856); Boiss., Fl. Or., 1, 270 (1867); Nyár. in Anal. Acad. Rep. Pop. Rom. Sect. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 86, t.1, f.4, t.6, f.14,15 (1949).

Syn.: A. kotschyanum Boiss., loc. cit. - pro syn.!

Type: (Turkey, C5: Prov. Adana): in regione montana superiori montis Masmeneudagh (Cappadocia, à 25 lieues SSO de Césarée) 8 Aug., 7 Sept. 1855, Balansa 430 (175) (holo. G-B, iso. G-BB, W, K, BM, OXF).

Distribution: A rare endemic known from only a few mountains in W. and S.W. Anatolia and Anti-Taurus. Map 23.

TURKEY. B1: Prov. Izmir, Nif dag, 6 Jun. 1881, Luschan (fide Stapf, Fl. Lycien, Carien, Mesopot., 17: 1885). C2: Prov. Muğla, Sandras dağ, above Ağla, 1219 m., 22 Jul. 1947, Davis 13562; ibid., 2200 m., 23 Jul. 1947, Davis 13538; ibid., 1219 m., 22 Jul. 1947, Davis 13617. C5: Prov. Adana, Antitaurus, Masmutli dagh (Aladağ), 2000 m., Jul. 1913, Siehe 578; ibid., N. of Soğukolik, Ala dağ, 1800 m., 23 Aug. 1958, Markgraf 1122.

Habitat: Confined to serpentine rocks and frequently associated with Pinus nigra; alt. 1219-2200 m. Fl. Jul-Aug.

Boissier allies this species to A. callichroum (A. constellatum var. confertum), differing from it by its larger fruits and narrowly winged seeds. An examination of all the species in Sect. Odontarrhena reveals a more obvious affinity with A. troodi from Cyprus. Both species have concolorous leaves with an indumentum of lepidote scales. The obtuse or truncate fruits of A. masmenaeum are considerably smaller than the acute or attenuate ones of A. troodi. A convenient distinguishing /

distinguishing character is the non-involucrate cauline leaves which decrease in size upwards in A. masmenaeum; the cauline leaves of A. troodi increase significantly in size upwards, the uppermost being conspicuously involucrate and suborbicular or spathulate. Coupled with the involucrate leaves of A. troodi is the fact that the fruiting corymbs are condensed and subumbellate, while those of A. masmenaeum are widely branched and open.

Usually A. masmenaeum is a much larger plant than A. troodi; however, one gathering (Davis 13538) from Sandras dağ shows that the stature of the plant may be reduced at high altitudes, and is almost identical, in this respect, with some of the larger speciments of A. troodi.

The relationship of A. masmenaeum to A. corsicum is discussed under the latter species.

It is unfortunate that the type material of A. troodi var. continentis was destroyed at Berlin. The conclusion that Schulz's variety is probably applicable to this species stems from a comparison of the varietal description with the description and specimens of A. masmenaeum. The classical localities for both taxa are identical.

A. masmenaeum has a disjunct alpine distribution, a feature explained by a definite preference for serpentine outcrops. Its presence in the Anti-Taurus (Masmeneu = Masmutli dağ), the type locality, and then again on Sandras dağ in South West Anatolia (c. 800 km. away) is related to the similarity in the petrological composition of these mountains, at least towards the summits. Further collections from the mountains lying between these two will probably show that A. masmenaeum occurs on those of serpentine composition, but not on those composed of calcareous rocks.

77. A. syriacum Nyár. in Bul. Grad. Bot. Cluj. 18, f. 2 (1938); Nyár in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 86, t. 2, f. 6 (1949); Gombault in Mém. Soc. Bot. Fr., 33, 5 (1952).

Type: (Syria or Turkey, C6: Prov. Hatay): Syria, Aucher 268 (holo. FL. n.v., iso. G-BB, G, K, BM, OXF).

Distribution: Syria ? and the Amanus of Turkey. Map 27.

TURKEY. C6: Prov. Hatay, Elma dağ (Amanus), Dubertret; ibid., Amanus, Dubertret (fide Gombault, loc. cit.)

Nyarady (1949) roughly indicated a relative relationship of this species to A. corsicum, A. masmenaeum and A. libanoticum. The cauline and sterile shoot leaves of A. syriacum are bicolored and similar in shape, while those of the above-mentioned taxa are of different shape and concolorous, or if bicolored are oblanceolate and the plant is biennial (A. libanoticum). In over-all facies A. syriacum resembles A. discolor but the morphological discontinuities of shorter stature and inflorescences, smaller leaves and larger flowers clearly distinguish the former. The long filament wings of A. syriacum are connate for $\frac{1}{2}$-$\frac{3}{4}$ the length of the filament and have a free apex of only 0.3-0.5 mm.; those of A. discolor are connate only at the base and are furnished with a relatively long free apex (1-1.5 mm.).

As the only material seen of A. syriacum, the type collection, was in the flowering state, no comparison of the fruits could be made, but the immature ovaries of this species do not show any tendency to be rugose or stipitate as is the case of A. discolor.

None /

None of the specimens cited by Gombault were seen. It is known from other Aucher collections that much of the area he incorporated in "Syria" now belongs within the Turkish boundary. From this fact and the collections he has seen, Gombault presumes that A. syriacum is an alpine or montane endemic to the Amanus which has never been found in Syria.

78. A. troodi Boiss. in Buser, Suppl. Fl. Or., 49 (1888); Huter in Øst. Bot. Zeit., 34, 260 (1904); Holmboe, Studies on the Veg. of Cyprus, 89, f. 24 (1914); Schulz in Fedde Rep. Sp. Nov., 33, 183 (1933); Nyár. in Anal. Acad. Rep. Pop. Rom. Secț. Ştiințe Geol. Geog. Biol., ser. A, mem. 3, 1, 10, t. 5, f. 1, 2 (1949).

Syn.: A. coriaceum Nyár. in Bul. Grăd. Bot. Cluj, 9, 46, pl. 31, t. 4, f. 67, 68, t. 6, f. 55, t. 8, f. 72-74 (1929)!

Type: (Cyprus): in monte Troodos Cypri (Mt. Podromo, Toodos), 17 Jun. 1880, Sintenis & Rigo 844 (holo. G-B, iso. G, W, W-Hal., GH, K, BM).

Distribution: Endemic to the Troodos mountains of Cyprus.

Habitat: Serpentine acree, stony slopes and dry hillsides mostly of N. exposure; alt. (305-) 1500-2000 m. Fl. Apr.-Jul.

When Nyárády described A. coriaceum he had not seen any type material of A. troodi, but he admitted that they were probably very closely related. After examining material of A. troodi, he concluded in 1949 (a view upheld here) that A. coriaceum was conspecific with that species, and that being the earlier binomial, A. troodi must be applied.

79. A. discolor Dudley & Huber-Morath, sp. nov. Pl. 13 & 14. Fig. 8, 1-11. Map 23.

Affinis A. syriaco. Nyár., A. libanotico Nyár. et A. chondrogyno Burtt, sed ab omnibus speciebus habitu altiore et magis diffuso, inflorescentia maiore ramis longioribus divergentibus provisa, foliis maioribus petiolatis longioribus, et fructibus late ellipticis vel obovatis coriaceis rugosis glabris basi longe attenuatis stipitatis differt; in super a primo appendice diversa filamentae longae recedit; a secundo inflorescentia magno (haud subconferto) divergit; a tertio (cui probabiliter magis affinis) forma et amplitudine fructuum distinguitur.

Planta perennis, pulchra, erecta, suffruticosa, supra basin multiramosa, ramis tenuibus subflexuosis. Caules floriferi erecti, 25-40 cm. longi, parce foliati, basi flavescenti-rubri, pilis stellatis parcis multiradiatis radiis brevibus inaequalibus tecti. Surculi steriles erecti, e basi lignosi caulium floriferorum ascendentes, basi efoliati, 5-10 cm. longi, supra medium laxe foliati, indumento denso cano obtecti. Folia conspicue bicolorata; pagina superior atrovirens pilis stellatis punctatis minutis appressis multiradiatis sparsis vestita; pagina inferior indumento denso albo-cano e pilis stellatis 15-20 radiatis tenuibus delicatulis appressis punctatis 0.2-0.3 (0.4) mm. diam. composito vestita. Folia caulium floriferorum divergentes rare subhorizontales, superne sensim decrescentia; inferior obovata, spatulata, obtusa, (15-) 20-35 mm. longa, (4-) 6-8 mm. lata, petiolis 5-10 mm. longis; superiora oblanceolata vel anguste obovata, breviter petiolata (7-) 8-10 (-15) mm. longa, 1-2 mm. lata; summa sub-bracteata, oblanceolata, acuta, 8-10 (-15) /

(-15) mm. longa, 1-1.5 mm. lata. Folia caulium sterilium stricte divergentia interdum deflexa, obovata, spatulata, obtusa, 1-20 mm. longa, 3-5 (-6) mm. lata, petiolis 4-8 mm. longis. Corymbi 7-15 (-18) cm. alti et lati, e ramis multis divergentibus vel stricte ascendentibus 3-5 (-8) cm. longis compositi; inflorescentiae ultimae subumbelliformes vel in statu fructifero elongatae. Pedicelli tenues saepe filiformes, divergentes, 4-6.5 mm. longi, pilis stellatis appressis punctatis minutis multidadiatis valde parce muniti. Sepala membranacea, manifeste nervosis, lanceolata vel anguste ovata, basi subsaccata, obtusa, 3 mm. longa, 1 mm. lata, indumento pilis stellatis paucissimis appressis vel subappressis punctatis minutis brevibus paucis vel multis c. 0.2 mm. diam. radiis saepe ramosis. Petala obovata, clavata, integra vel emarginata vel subemarginata, 3.5-4 mm. longa, 1 mm. lata, glabra. Filamenta longa 3-4 mm. long, haud alata, appendice unidentata 1-1.5 mm. longa, basi connata. Filamenta brevia 2-2.5 (-3) mm. longa, appendice libra lineari-lanceolata acuta vel minute bi-tri-dentata 1.5-2 mm. longa. Antherae 0.8-1 mm. longae, auriculatae, apice acutae vel subobtusae. Ovarium 1-1.5 mm. longum, 0.5-0.7 mm. latum, oblongo-ellipticum, acutum, glabrum. Glandulae inconspicuae, minutae. Ovula una per loculum. Stylus erectus, tenuis, 2-2.5 (3) mm. longus, glaber, stigmate magno capitato 0.2-0.3 mm. diam. provisus. Silicula late elliptica vel obovata (rare orbiculata) (5.5-) 6-6.5 mm. longa, (2.7-) 3-4 mm. lata, basi longissime attenuata, stipite (0.5-) 1-1.5 mm. longo, valvis coriaceis aequaliter inflatis glabris manifeste rugosis prominenter nervosis. Semen immaturum ut videtur anguste alatum. Fl. Apr.-Mai, fr. /

fr. Mai-Jun.

TURKEY. C3: Prov. Antalya, Bucht von Adrasan an Südfuss des Tahtali dağ (as "Çalbali dağ) zwischen Çirali und Finike, Macchie auf Kalk, 0-300 m., 27 Mai 1950, Huber-Morath 11755 (holo. Hub.-Mor., iso. E). C2: Prov. Muğla, Marmaris, 30 m., Pinetum brutiae on serpentine, 24 Mar. 1956, Davis 25246 (E); ibid., Hisarönü, Marmaris-Datça, 80-100 m., saxatile on dry sandstone rocks, uncommon, 6 Jun. 1962, Dudley (D. 35410) (E); ibid., Muğla-Marmaris, 5 km. from Marmaris on descent from high pass, 150-200 m., common, saxatile forming dense thick clumps on limestone cliffs and scree, 5 Jun. 1962, Dudley (D. 35391)(E); ibid., hills on south side of Marmaris village, 100 m., common forming dense clumps under Pinus brutia and Smilax, 7 Jun. 1962, Dudley (D. 35458) (E).

Habitat: Rare endemic on serpentine, limestone and sandstone cliffs and scree; often associated with Pinus brutia and Smilax; alt. 0-300 m.

A. discolor comes within the complex of species including A. corsicum, A. masmenaeum, A. syriacum, A. troodi, A. libanoticum and A. chondrogynum, all of which have glabrous or papillose or glaucous fruits (never with an indumentum of stellate hairs) and usually broadly spathulate or obcuneate, often bicolored sterile shoot leaves.

The new species differs from its allies, A. syriacum, A. libanoticum and A. chondrogynum, by being a more spreading plant larger in all its parts, and by the broadly elliptic or obovate, rugose, basally long-attenuate and stipitate fruits. Furthermore, A. discolor may be separated from A. syriacum by the long basally connate appendage of the

long /

long filaments; from A. libanoticum by the many-branched corymb, the shape of the leaves and the life form (A. libanoticum being a biennial with oblanceolate leaves); and from A. chondrogynum, to which it may be most closely related, by the shape and size of its fruits and the lack of any indumentum on the fruits (the fruits of A. chondrogynum being orbicular or obcordate with papillae on the valve surfaces).

Recent collections (Dudley D. 35410) possess broadly elliptic and somewhat larger fruits than the obovate ones of the type material (Fig. 8, 1 & 2). However, in all other characters, including those of the fruit, the new material corresponds completely with that of Huber-Morath. The fact that the fruits of one recent collection (Dudley D. 35458) match exactly those of the type collection, indicates that the fruit shape, especially, of this species issubject to marked fluctuation, even between populations in close proximity.

This beautiful chameaphyte is endemic to only a few localities in S.W. Anatolia and exhibits a preference for calcareous situations and low altitudes. One gathering (Davis 25246) indicates "serpentine", but it is notable that these specimens are poorly developed and somewhat depauperated compared to populations from calcareous substrates. Most of the plants which the author examined in the field formed large woody saxatile clumps on limestone cliffs near the sea or on calcareous rubble with Pinus brutia.

80. A. libanoticum Nyár. in Bul. Grád. Bot. Cluj, 18, 83, f.1 (1938); Nyár. in Anal. Acad. Rep. Pop. Rom. Secț. Științe Geol. Geog. Biol., ser. A, mem. 3, 1, 86 (1949).

Type: (Lebanon): Libanon, 1896, Tanus, Botros (holo. JE).

Distribution and habitat: Lebanon. An addition to the type collection, Davis 5964 indicates that this species may grow on cliffs at an altitude of 457 meters and flowers in July.

81. A. smolikanum Nyár. in Bul. Grád. Bot. Cluj, 9, 43 t. 4, f. 70, 71, t. 54, t. 7 f. 69-71, t. 9, f. 71, pl. 30, f. 2,3 (1929); Nyár. in Anal. Acad. Rep. Pop. Rom. Sect. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 92, t. 6, f. 7 (1949).

Syn.: A. smolikanum f. typicum Nyár. in Fedde Rep. Sp. Nov., 27, 393 (1930)!

A. smolikanum f. glabrum Nyár., op. cit., 394.

A. balkanicum Nyár. f. depressum Nyár., op. cit., 394 & 395.

Syntypes: (Greece): in summis saxosis Smolika distr. Konitza, 18 Jul. 1896, Baldacci 206 (orig. BP. n.v., iso. W-Hal, Wu, BM, K). (Albania). Maja Ranns, serpentin, 1400 m., 4 Jun. 1913, Košanin (orig. BELGU, n.v.).

Distribution and habitat: Confined to serpentine in N.W. Greece and Albania; alt. 2000-2338 m. Fl. Jun.-Aug.

This is another species to be included in the complex containing A. corsicum, A. masmenaeum, A. syriacum, A. troodi, A. discolor, A. chondrogynum, A. oxycarpum, A. libanoticum and A. bertolonii Desv.; they all possess a fruticose habit, usually glabrous or glaucous or papillose fruits and obovate-spathulate leaves of the sterile shoots.

Nyárády indicated in the description of this species that the immature fruits had sparsely dispersed stellate hairs. Examination of the type gathering and additional material reveals that this feature is by no means consistent on individual plants or populations. Usually the sparse indumentum, when present, is deciduous, causing the mature fruits to appear entirely glabrous, a situation accounting for A. smolikanum var. glabrum. The /

The forms of A. smolikanum which Nyárády later treated as varieties (1949) do not represent constant patterns of variation, and are accordingly reduced to synonmy.

A. kosaninum var. obovatifolium and A. balkanicum f. depressum (1949 as variety) were described from the same general restricted area near Lurja in Albania as A. smolikanum f. glabrum. The photographs, illustrations and descriptions of these taxa indicate to the present author that the differential characters are not consistent with the limits of A. bertolonii subsp. scutarinum Nyár. (A.balkanicum f. elatum Nyar. and A. kosaninum var. typicum Nyár.) and are best treated as synonyms of A. smolikanum sensu lat.

82. A. chondrogynum Burtt in Kew Bull., 101, pl.4 (1949). Fig. 1A, a.

Type: (Cyprus): Limassol district above Yeśasa, 600 m., 10 Apr.1941, Davis 3083 (holo. K, iso. E,G-BB, W, Hub.-Mor.).

Distribution and habitat: Endemic to the Limassol district of Cyprus on open chalf hillsides, serpentine scree, Dhali formation; often associated with Pinus brutia; alt. 305-610 m. Fl. Mar.-Apr.

83. A. oxycarpum Boiss. & Bal., Diagn. 3 (5), 35 (1856); Boiss., Fl. Or., 1, 269 (1867); Nyar. in Anal. Acad. Rep. Pop. Rom. Sect. Stiinte Geol. Geog. Biol., ser. A, mem. 3, $\frac{1}{m}$, 10, t. 4, f.1, t.5, f.3, 4 (1949).

Syn: A. sulcatifrons Nyár. in Bul. Grád. Bot. Cluj, 9, 47, pl. 32, t.4, f. 65,66, t.6, f. 56, t.8, f. 75 (1929)!

Type: (Turkey, C5: Prov. Adana): in regione alpina inferiori montis Masmeneudagh inter Taurum et urbem Caesaream (à 25 lieues au SSO de Césarée), 8 Aug. 1855, Balansa 427 (167) (holo. G-B, iso. G, W, GH, K, BM, OXF).

Distribution: Rare Anatolian endemic found mainly from the Anti-Taurus and the Amanus. Map 23.

TURKEY: Prov. Izmir, Nif Dagh (Lydia), Luschan, (holo. A. sulcatifrons, UW). C5: Prov. Adana, Masmutli dagh (Ala dağ), 1800 m., Jul. 1906, Siehe 160. C6: Prov. Hatay, Amanus Mts, forest road from Erzin, 1200 m., 14 Oct. 1957, Kühne 1418.

Habitat: Montane in woods, stoney slopes and cliffs; alt. 1200-1800 m. Fl. Jul.-Aug.

The leaf shape and concolorous dullish gray indumentum of this species is reminiscent of A. masmenaeum with which it is sympatric in the Anti-Taurus. A. oxycarpum may be distinguished from that species by its reduced growth, smaller leaves, narrower fruits, usually longer styles, wingless seeds and an indumentum of smaller sublepidote hairs (those of A. masmenaeum being prominently lepidote).

A European member of this group in Subsect. Odontarrhena, A. smolikanum /

kanum, has a similar growth form, broadly spathulate-suborbicular prominently involucrate bicoloured leaves, winged seeds, and occasionally a sparse indumentum on the immature fruits - all characters which clearly separate it from our Anatolian species.

The type material of A. sulcatifrons Nyár, does not have sufficient correlated morphological discontinuities to enable it to be separated from A. oxycarpum Boiss. & Bal. The cauline leaves of Nyárády's taxon appear to increase in size upwards, but are not prominently involucrate. This feature is not shared by the type or authentic material of A. oxycarpum and as it is not reinforced by any diagnostic characters, the recognition of a distinct species is unwarranted. The Luschan record (6 Jun. 1881) of A. masmenaeum from Nif dag (published by Stapf, 1886) is probably based on the type specimen of A. sulcatifrons. However, the original sheet (UW) of this species is not furnished with any data regarding the date of collection.

The very disjunct distribution of A.oxycarpum resembles that of A. masmenaeum and is probably attributable to a similar preference for serpentine substrates.

84. <u>A. davisianum</u> Dudley, <u>sp. nov.</u> Fig. 4, 14-22. Map 23.

Affinis <u>A. siberico</u> Willd. sed in omnibus partibus minore, fructibus glabris, foliis angustoribus, indumento foliorum pauciore dissimili differt.

<u>Planta</u> perennis, caespitosa, 4-10 cm. alta et lata, in sicco lutescens, e basi multi-ramosa aphylla, lignosa, rubra cicatrice prominenti foliorum, ex toto indumento virescenti vel cinereo, e pilis stellatis appressis punctatis 4-6 radiatis radiis ramosis aequalibus 0.3-0.6 mm. diam. composito. <u>Caules floriferi</u> tenue, ascendentes vel erecti, 4-8 cm. longi, parce foliati, ad basin efoliati, pilis stellatis radiis ± longis ramosis sparse vel dense tecti. <u>Surculi steriles</u> apici dense foliati, e basi lignose caulium floriferorum ascendentes, basi efoliati, 1-2.5 cm. longi. <u>Fölia caulium floriferorum</u> oblanceolata, obtusa vel subacuta, descrescentia summum versus, post anthesim decidua, involucrata, subplicata-sulcata, flavo-virescentia, 7-10 mm. longa, 1-2 mm. lata. <u>Folia surculorum sterilium</u> lineari-oblanceolata vel spatulata; inferora superioribus longiora, 5-8 mm. longa, 1-1.5 mm. lata; superiora dense imbricata, 3-5 mm. longa, 0.5-1 mm. lata. <u>Corymbi</u> ramosi, parviflori, c. 2-5 cm. longi et lati, ramulis stricte ascendentibus vel patentibus, corymbis secundariis subumbelliformibus. <u>Pedicelli</u> tenue, rigidi, divergentes vel horizontales, rare deflexi, inter se 1-2 mm. distantes, 3-4 mm. longi, pilis stellatis appressis vel subappressis parce vel copiose provisi. <u>Sepala</u> decidua, membranacea, ad apicem carinata, cucullata, ovata obtusa, 1-1.5 mm. longa, 0.5-0.8 mm. lata, anguste hyalino-marginata, pilis stellatis sparsissimis provisa. <u>Petala</u> in sicco aurea, obovata, integra vel /

vel retusa, in unguem sensim attenuata, glabra vel solum in ungue pilis stellatis provisa, 2 mm. longa, 0.5-0.7 mm. lata. Filamenta longa c. 1 mm. longa, recruva; appendix bidentata vel acuta, indimidio inferiore ad filamentum connata, apice libra, 0.3-0.5 mm. longa. Filamenta brevia 0.5-1 mm. longa, recurva; appendix libra, lanceolata, filamentum subaequans, apice bidentata vel acuta, 0.2-0.3 mm. lata. Antherae minutae 0.3-0.6 mm. longae. Ovarium orbiculatum, emarginatum, 0.5-0.7 mm. longum et latum, glabrum sed minute papillosum, translucens, subflavo-viride. Glandulae nectariferae conspicuae, globosae. Ovula una per loculum. Stylus glaber, tenuis, rigidus, 0.5-1 mm. longus, stigmate leviter dilatato provisus. Silicula ut videtur uniseminata, orbiculata, emarginata, 2-3 mm. longa et lata, valvis membranaceis prominenter nervosis glabris laevigatis valde inaequaliter inflatis. Semen immaturum non alatum. Fl. Jun.-Jul. Chamaephyte.

TURKEY. B2: Prov. Kütahya, Murat dağ, above Gediz, above Kesit Söğüt, 1900 m., rocky igneous slopes, flowers bright yellow, 5 Jul. 1962, Davis 36799 (holo. E); ibid., Murat dağ, above Gediz, between Kesit Söğüt and Hamam, 1400 m., on metamorphic rocks, 5 Jul. 1962, Davis 36872 (E).

A. davisianum does not appear to be closely allied to any known species in Sect. Odontarrhena, although it resembles A. sibiricum in the orbicular and extremely asymetrically inflated fruit which has an S-shaped configuration in cross-section. It differs strongly from that species and its closest allies, A. borzaeanum and A. caliacrae, in the reduced cushion-forming habit, the prominent lignose base with copious and raised leaf scars, the much shorter /

shorter and fewer-fruited corymb, smaller and always glabrous fruit, smaller and linear leaves, indumentum composed of few-rayed, minute and appressed stellate hairs, and the yellowish-green aspect of the plant.

Furthermore, it is possible to assume that A. davisianum, being a restricted endemic, has a preference for igneous or metamorphic substrates; whereas A. sibiricum is an extremely widespread and polymorphic taxon usually found in calcareous situations.

This new species is named in honour of the collector, Dr. P.H. Davis, whose energy and careful attention as the author's supervisor has always been inspiring.

85. A. fallacinum Hausskn. in Mitt. Thür. Bot. Ver., n.f., 3-4, 114 (1893); Hal., Consp. Fl. Gr., 1, 92 (1900); Nyár. in Mag. Bot. Lap., 24, t. 1, f. 27 as A. baldaccii (1925); Nyár. in Notizbl. Bot. Gart. Mus. Berlin-Dahlem, 11, 634, f. 12, No. 3-6 (1932); Rech. fil. in Öst. Bot. Zeit., 84, 138 as A. baldaccii (1935); Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 82 & 105 as A. baldaccii (1949).

Syn.: A. baldaccii Vierh. ex Nyár. in Bul. Grad. Bot. Cluj, 7, 123, pl. 12, t. 3, f. 54-56, t. 5, f. 76, t. 8, f. 98-100, t. 10, f. 125, 126 (1927)!

Type: (Greece): inter parentes inter Tschungeri et Malakasi, Jul. 1885, Haussknecht (holo. JE, iso. W).

Distribution and habitat: Confined to serpentine in Greece and Crete. Fl. Jun.

There has been considerable doubt about the relationship of this species from the time it was first described. Haussknecht indicated that it was a hybrid between A. chlorocarpum Hausskn. (a minor variant of A. murale Waldst. & Kit.) and A. heldreichii Hausskn. Halácsy thought of it as a hybrid between A. chalcidicum Janka, another minor variant of A. murale, and A. heldreichii. He had reduced A. chlorocarpum to a synonym of A. chalcidicum. Nyárády (1927) followed Halácsy's view but maintained A. chlorocarpum at specific rank. He entertained the possibility that A. fallacinum might be a hybrid between A. chlorocarpum and A. orphanides Nyár., yet another minor variant of A. murale. At the same time (1927) he/

he described a new taxon from Crete as A. baldaccii and indicated that it had leaves and a growth form similar to A. chalcidicum.

In 1930 Nyárády definitely states that A. fallacinum is not to be regarded as a hybrid, but rather is a form (not in the nomenclatural sense) of A. heldreichii with ..."teratologisch veränderten Früchten"... He claims that A. fallacinum is identical in all characters to A. heldreichii except the fruit; there being two types, a minor proportion which may be classified as typical A. heldreichii, and a larger proportion which are smaller, oblanceolate-elliptic, attenuate to the base and obtuse at the apex. In the second type the fruits have an elevated centre similar to that found in A. heldreichii and are covered with a thick indumentum and show a great similarity to those of A. chalcidicum. A fallacinum could not have had a hybrid origin (he continues) from A. chalcidicum because the latter does not occur in the Pindus where A. fallacinum was first discovered; nor could he visualize a close relationship with A. chlorocarpum. His argument states that the more numerous type of fruit show a pronounced deformity which is caused by the lack of seed production. In conclusion he casts doubt on his argument by pointing out that he had examined specimens of A. heldreichii in which normally developed and typical fruits nevertheless have undeveloped and atrophied seeds.

It is possible that the collection(s) of A. fallacinum which Nyárády examined in the Haussknecht herbarium were mixed, i.e. that fragments of A. heldreichii were placed inadvertently with the more copious material of A. fallacinum. This is a plausible explanation, as the type gatherings of/

of both species were collected in the same general area and probably on the same day. Furthermore, he indicates a thick indumentum on the atypical but more numerous fruits of this collection. On all the specimens of A. heldreichii that the present author has examined, the fruits are glabrous or rarely with a very sparse indumentum which more often than not is deciduous at maturity. The presence of pubescence on the fruits of A. heldreichii is a situation similar to that of A. smolikanum, and is not a constant character for any given plant or population.

What is the reason for the infertility of the commoner type of fruits? It can be claimed to be due either to hybrid sterility, a suggestion of little promise, or to the fact that the two species in a mixed collection have a different flowering time so that the seeds would mature at different times. The inference is that the infertile fruits are a reflection of immaturity. Furthermore, why should A. heldreichii sensu stricto have typical, normally developed fruits and undeveloped seeds, while the fruits of A. fallacinum are deformed in a similar circumstance.

Now let us refer back to A. baldaccii. The description, original material and subsequent Greek gatherings (Rechinger, one cited by Nyárády in 1949) of this species (never with any fruits typical of A. heldreichii) compare favourably with the description and type material of A. fallacinum. The fruit shape and size, and the accompanying thick indumentum and floral parts are identical. This resemblance indicates that the binomials A. baldaccii (which is not a strict Cretan endemic) /

endemic) and A. fallacinum apply to the same taxon.

The crux of the problem does not lie in individual character expressions but rather in character correlations and the aggregation of species into natural groups which give some idea of present affinities. It cannot be denied that A. fallacinum superficially resembles A. heldreichii in habit and leaf shape, but it may be conveniently distinguished from the latter - apart from fruit shape and size by the thick fruit indumentum of stellate hairs with branched rays, rigid and spreading pedicels, usually densely pubescent petals, stout and basally dilated styles, and the wide multi-denticulate wing on the long filaments which is connate to the filaments for its entire length. By virtue of the equally compressed fruit valves, pendulous fruits with prominent venation which appear flattened in cross-section though often undulate, fragile and sigmoid pedicels, and above all the crenulate membranous wing on the fruits, A. heldreichii is established as a component of Sect. Odontarrhena Subsect. Compressa Series Crenulata. The fruit valves of A. fallacinum are strongly unequally inflated causing the inconspicuously veined, smooth margined fruit on rigid and divergent pedicels to appear strongly S-shaped in cross-section (indicated by Nyárády for A. baldaccii), thereby indicating inclusion in Subsect. Odontarrhena.

Though individual plants from large interconnected populations recently collected in the Pindus (Davis in 1962) could be identified as A. chalcidicum, A. chlorocarpum, A. orphanides and A. murale sensu stricto, the author agrees with Nyarady that A. fallacinum is not the result of hybridization between any of these taxa. Also, none of the specimens of A. heldreichii/

A. heldreichii collected at the same time have fruit characters which are equatable to those of A. fallacinum. It is understood then, that though A. fallacinum belongs to the same section as all of the taxa mentioned above, it is only remotely related. The binomial A. baldaccii antidates A. fallacinum and must be considered a synonym.

86. A. penjwinensis Dudley in Notes Roy. Bot. Gd. Ed., 24 (2), 162, pl. 7 & f. 4 (1962).

Syn.: A. rhodopense Form. subsp. duristellatum Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 77 (1949)!

Type: (Iraq); dist. Sulaimaniya (Kurdistan), in ditione pagi Penjwin in montibus denudatis, 1400-1600 m., serpentino, 19-20 Jun. 1957, Rechinger fil. 10446 (holo. W, iso. E).

Distribution: Confined to N. Iraq.

Habitat: Montane and on serpentine, igneous and metamorphic scree and rock often associated with Rhus and Quercus libanoticum and Astragalus; alt. 1400-2600 m. Fl. 1400-2600 m. Fl. Apr.-Jun.

87. <u>A. constellatum</u> Boiss. in Ann. Sc. Nat., ser. 4, <u>2</u>, 244 (1854); Fenzl in Tchih., Asie Min., Bot. <u>1</u> (3), 304 (1860); Boiss., Fl. Or., <u>1</u>, 270 (1867); Bouloumoy, Fl. Lib., Syr., t.27, f.38 (1930).

<u>Syn</u>: <u>A. constellatum</u> var. <u>lepidotum</u> Post, Fl. Syr., Pal. & Sinai, ed. 1, 83 (1896)!

<u>Type</u>: (Turkey, C5: Prov. Adana): prope Kizil dagh (Kizil dağ, E. of Külek, nr. Pozanti and Ak dağ) 1800 m., 1853, <u>Tchihatcheff</u> 682 (holo. G-B).

<u>Distribution</u>: The Lycian and Cilician Taurus, the Anti-Taurus and the Amanus of Anatolia, Turkish Kurdistan and N. Iraq. Map 23.

TURKEY: Prov. Van, Warah-dağ (Erek dağ) nr. Van, 2500 m., 25 Jun. 1899, <u>Kronenburg</u> 161. C2: Prov. Burdur; Tefenni-Yeşilova, 9 miles from Tefenni, 1100 m., 1 Jun. 1962, <u>Dudley</u> (D.35284); <u>ibid.</u>, Korkuteli-Tefenni, 52 km. from Korkuteli, 1100 m., 31 May 1962, <u>Dudley</u> (D.35281). C5: Prov. Hatay, Tolos dagh (Amanus dağ), above Arsus, 1219 m., 4 Jul. 1868, <u>Kotschy</u> 203 (orig. synt. <u>A. eriophyllum</u> G-B, iso. G-BB, W); <u>ibid.</u>, Mt. Keserlik above Arsus, 914 m., Jul. 1862, <u>Kotschy</u> 179. C6: Prov. Hatay, Khotschbel dağ (N. of Iskenderun), 11 Sept. 1884, <u>Post</u> 30 (holo. <u>A. constellatum var. lepidotum</u> G-BB iso. BM) <u>ibid.</u>, Soukluk (3 km. W. of Belen), 15 Aug. 1929, <u>Dinsmore</u> 20363 <u>pro parte</u>; <u>ibid.</u>, Soguk Oluk, 700 m., 16 Jun. 1953, <u>Lindberg</u> 12830; Prov. Maraş, Akher dagh (Ahir dağ), 1529 m., Jul. 1907, <u>Haradjian</u> 1600.

<u>Habitat</u>: Mountain steppe and neglected fields; alt. 700-1829 (-2500) m. Fl. Jun.-Jul.

This species has occasionally been confused with A. condensatum with which it is sympatric. The generally smaller and densely pubescent fruits, cushion-forming, decumbent or procumbent and caespitose habit, conferted sterile shoots, smaller linear-oblanceolate or obovate and acute leaves, and compact sparingly branched inflorescences distinguish the latter from A. constellatum.

Post states that his var. lepidotum differs from the typical form of A. constellatum by having smaller and more densely pubescent leaves. The holotype of this variety, determined by Post's handwriting has, if anything, larger leaves than most material of A. constellatum collected in the Amanus. As is the case with A. virgatum var. mutabile (a synonym of A. cypricum), larger leaves, larger fruits and more robust stems can probably be attributed to a shaded environment. Though the indumentum on the lower surfaces of the sterile shoot leaves of var. lepidotum is slightly denser than expected, the indumentum density is quite variable over the entire species range, but generally increases in density with altitude. A considerable variability prevails in fruit size and shape of this species, ranging from large narrowly elliptic and acute (Post 30; Dudley: D. 35284) to smaller obovate and obtuse or slightly emarginate (Kotschy 203 and 179). However, this variation is not constant in any given population or on many individual plants. There is, moreover, a tendency for the fruits to decrease in size at high altitudes.

The only specimen referred to A. constellatum in Flora Orientalis which actually represents that species is Tchihatcheff's from Kisil dağ in the Cilician Taurus. The Kotschy exsiccata (41 and 83) from the Cilician Gates have the diagnostics of A. giosnanum in Subsect. Compressa, which/

which is distinguished from A. constellatum by having compressed fruits with narrow crenulate margins, pubescent petals, dense silvery indumentum on the leaves of the sterile shoots, and widely winged seeds (the seed wing of A. constellatum is usually two times narrower). The Haussknecht gathering from Ssofdagh in the Amanus, also referred to A. constellatum by Nyárády (1949), on the basis of its floral structure and its dense, white concolorous indumentum of sublepidote hairs on the sterile shoot leaves should be referred to as A. murale subsp. murale var. haradjianii.

Though collected originally in the Cilician Taurus and many times since in the Anti-Taurus and the Amanus, A. constellatum has a very disjunct distribution. It was found for the first time in S.W. Anatolia by the author in 1962. In this area the very large populations were confined to an area of less than 50 square miles. The Turkish Kurdistan and N. Iraq populations appear to be similarily limited in extent.

88. A. callichroum Boiss. & Bal., Diagn., 3 (5), 34 (1856); Boiss., Fl. Or., 1, 270 (1867); Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 88, t. 1, f. 3, t. 6, f. 10, 11 (1949); Burtt in Kew Bull., 101 as A. rhodopense subsp. armeniacum (1949).

Syn.: A. constellatum Boiss. var. confertum Boiss., loc. cit.!
Odontarrhena bourgaei Jord. & Fourr., Brev. Pl. Nov., fasc. 2, 4 (1868)!
A. rhodopense Form. subsp. armeniacum Nyár. in Bul. Grád. Bot. Cluj, 8, 156 (1928)!
A. rhodopense subsp. bourgaei (Jord. & Fourr.) Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 77 (1949)!

Type: (Turkey, C5: Prov. Adana); in regione montana superiori montis Masmeneudagh (nr. Ala dağ) inter Taurum et Urbem Caesaream (à 25 lieues du SSO Césarée), Aug., 7 Sept. 1857, Balansa 432 (holo. G-B, also holo. A. constellatum var. confertum, iso. G, W, K, BM, B).

Distribution: Endemic to Anatolia from the Cilician Taurus, the Amanus and eastwards into the Armenian Highlands. Map 24.

TURKEY. A8: Prov. Gümüşane, Berdak-Baibout (Bayburt), 10 Jul. 1862, Bourgeau 38 (holo. Odont. bourgaei P, n.v., iso. W, K). A9: Prov. Erzurum, Horasan-Karaurgan, 1650 m., 7 Jul. 1957, Davis 30757; Prov. Kars, Kars-Susuz, 8 km. from Kars, 1800 m., 5 Jul. 1957, Davis 30592. B7: Prov. Tunceli, Pülümür-Selepur, 1950 m., 23 Jul. 1957, Davis 31588; ibid., 1900 m., 11 Jul. 1957, Davis 31002; Prov. Elaziğ, 35 km. S.E. of /

of Elâzig, 30 Jun. 1950, Reese. C5: Prov. Adana, Solakli, Masmutlidagh (nr. Ala dağ), 1900 m., Jul. 1906, Siehe 410 & Jul. 1913, Siehe 543. C6: Prov. Hatay, Kay-Pok-Dagh (nr. Kotschbel dağ, N. of Iskenderun), 20 Sept. 1884, Post.

Habitat: Montane on dry N. facing igneous slopes and marly hillsides; alt. 1650-1950 m. Fl. Jul.-Aug.

A. callichroum is a species distinct from A. constellatum, though partially sympatric with it. As a second thought, Boissier in Flora Orientalis treated the former as var. confertum of the latter. In addition to a more conferted growth with slender, tortuose and reddish stems, A. callichroum differs strongly from A. constellatum in having smaller, ovate, obtuse and often glabrescent fruits, wingless seeds, smaller, pubescent and generally emarginate or retuse petals, shorter pedicels, and a fan-shaped inflorescence with long arcuate-flexuose branches.

The basionym of both A. rhodopense subsp. armeniacum and subsp. bourgaei is Odontarrhena bourgaei. The type collections of Odont. bourgaei and A. callichroum are morphologically inseparable, and must be treated as referring to the same species. Subsequent Armenian collections do not appear to possess any significant discontinuities to permit taxonomic separation from the Amanus, Cilician and Anti-Taurus gatherings.

89. A. cypricum Nýar. in Bul. Grăd. Bot. Cluj, 7, 156, pl. 17, t.5, f.81, t.8, f.136-138 (1927); Nyar in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 42 (1949); Burtt in Kew Bull., 100 (1949).

Syn: A. alpestre L. var. suffrutescens Boiss., Fl. Or., 1, 268 (1867), pro parte quoad plantam Caricam a Pinard lectam!

A. virgatum Nýar. var. mutabile Nýar. in Bul. Grăd. Bot. Cluj. 7, 116 (1927)!

A. obovatum (meyer) Turcz. subsp. angulatum Nýar. in Bul. Grăd. Bot. Cluj, 9, 31, t.9, f.65 (1929)!

A. cypricum f. rigidum Nyar. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser.A, mem. 3, 1, 42 (1949)!

A. virgatum var. pinardi Nyar., op. cit., 90!

A. filiforme Nýar. var. glaucum Nýar., op. cit., 71!

Type: (Cyprus): Troodos Gebirge, um das Kloster Trodditissam auf Kalk-Diabas, 130 m., 11 Oct. 1893, Deschamps (holo. BRNM, n.v.).

Distribution: Cyprus and S.W. Anatolia. Map 27.

TURKEY: Prov. Burdur, Fethiye-Dirmil, 1500 m., 9 Jun. 1948, Huber-Morath 5722 (holo. A. filiforme var. glaucum, Hub.-Mor); ibid., 6 km. S. of Dirmil, 1560 m., 28 Jun. 1948, Huber-Morath 9268; ibid. S. of Dirmil, 1550 m., 29 Jun. 1948, Huber-Morath 9266; ibid., Yeşilova-Denizli, above Salda gölü, 1100 m., 1 Jun. 1962, Dudley (D.35304a & D. 35305); ibid., Tefenni-Yesilova, 8 km. from Yeşilova, 1150 m., 1 Jun. 1962, Dudley (D. 35283); ibid., Korkuteli-Tefenni, 52 km. from Korkuteli, 1100 m., 31 May, 1962, Dudley (D.35280); Prov. Denizli, Tavas-Denizli /

Tavas-Denizli 800-900 m., 10 Jun. 1962, Dudley (D.3555b). Caria, 1843, Pinard (orig. synt. A. alpestre var. suffrutescens G-B, holo. A. virgatum var. pinardi G, holo. A. obovatum subsp. angulatum W, iso. GH, K, BM).

Habitat: Disturbed areas, neglected fields, roadsides, dry hillsides, limestone slopes andscree, calcareous steppe; often colonising asbestos mines; alt. (130-) 1100-1829 m. Fl. Apr. - Jun.

This species grows in the same area of Anatolia as A. huber-morathii, but with its larger floral parts, larger ovate or broadly elliptic fruits, wingless seeds, smaller spathulate or obcuneate, obtuse or truncate sterile shoot leaves, and denser, fruticose and cushion-forming habit can easily be distinguished from the latter. The plants of A. huber-morathii are much taller, fewer-stemmed and have long linear-oblanceolate and acute sterile shoot leaves.

The Pinard gathering of A. cypricum from Caria was identified and cited by Boissier (1867) as A. alpestre var. suffrutescens, and duplicate specimens in different herbaria were later described by Nyárády as A. obovatum subsp. angulatum and A. virgatum var. pinardi. There is no doubt that this collection and many additional Anatolian gatherings, including A. filiforme var. glaucum, represent the taxon originally thought to be endemic to Cyprus. There are no evident morphological discontinuities which can be used to separate the Turkish and Cyprian material. The variability in stem length accounts for A. cypricum f. rigidum, but this feature is apparently not associated with any population units in Cyprus or Turkey, and as it is not associated with any other /

any other differential characters, it does not warrant taxonomic recognition. A. virgatum var. mutabile described from a Kotschy (No. 703) specimen from Cyprus, though with longer leaves and a taller stature than the typical A. cypricum, agrees with its floral and fruit morphology. A. virgatum var. mutabile can be regarded as merely a shade form of A. cypricum (Burtt, 1949). The easiest character to use to distinguish A. cypricum from A. virgatum, which does not occur in S.W. Anatolia or Cyprus, is the presence of indumentum on the ovaries and fruits of the former; the ovaries and fruits of the latter species are always glabrous.

Before Nyárády's circumscription, A. cypricum was known to many authors as A. condensatum (Holmboe, 1914); however, that species does not occur in Cyprus. Nyárády, in maintaining A. cypricum as strictly endemic to Cyprus, assigned several different and inappropriate names to gatherings of this species from Anatolia. The present author collected it from many new stations in S.W. Anatolia, and though its area of distribution in Turkey is relatively small, a matter of approximately 100 square kilometers, populations are frequently quite large and primarily occupy neglected fields and limestone banks surrounding lakes.

90. A. huber-morathii Dudley sp. nov. Pl. 15. Fig. 7, 7-18. Map 24.

Affinis A. fallacino (A. baldaccii Vierh. ex Nyár.) et verosimiliter A. murale Waldst. & Kit. sensu A. chlorocarpum Hausskn. sed ab ambobus habitu valde suffruticoso, foliis caulium fertilium et sterilium manifeste plicatis et valde argenteis, fructibus minoribus ellipticis vel anguste obovatis indumento parciore differt; a priore corymbis ultimis umbelliformibus (haud elongatis), pedicellis brevioribus tenuioribus recedit; a posteriore stylo tenuiore, seminibus angustissime alatis (haud late alatis) divergit.

Planta perennis, valde suffruticosa, a basi multiramosa. Caules floriferi stricti-ascendentes, parce foliosi, 18-25 (-35) cm. alti, a base rubro-purpurei indumento parce summum versus magis conspicuo. Surculi steriles dense foliati, erecti-ascendentes vel laxe patentes, 8-16 cm. longi. Folia caulium floriferorum lineari-oblanceolata, acuta vel subobtusa, subplicata, sulcata, virescentia, post anthesin decidua, 10-15 (-20) mm. longa, 1.5-2 mm. lata. Folia caulium sterilium lineari-oblanceolata, acuta, subrecurva, manifeste plicato-sulcata, (4-) 10-20 (-25) mm. longa, 1-1.5 (-2.5) mm. lata, indumento dense lepidoto e pilis albis argenteis minute punctatis 15-20 (-30) radiatis multo ramosis 0.4-0.5 mm. diam. composito. Corymbi constricti umbelliformes, (2.5-) 8-10 cm. longi et lati, ramulis stricte ascendentibus, floribus in sicco pallide flavis. Pedicelli in statu fructifero rigidi, divergentes, ascendentes, 2.5-4.5 mm. longi indumento appresso eo fructuum simile ± dense obtecti. Sepala 1-1.5 mm. longa, 0.5-0.8 mm. lata, membranacea, cucullata, anguste ovata, obtusa, margine angusta hyalina, pilis stellatis solum 1-7 munita. Petala 2-2.5 mm. longa, (0.5-) 0.6-0.7 mm. lata, clavata /

clavata vel obovata, integra vel emarginata, glabra vel raro lamina pilis stellatis minutis 1-3 munita. Filamenta longa 2-2.5 mm. longa, appendicibus 1-1.5-plo longiora; appendix bidentata vel ad apicem minute multidentata, in dimidio inferiore ad filamentum connata, parte libra 0.2-0.3 mm. longa. Filamenta brevia 1.-1.5 mm. longa; appendix libra filamentum subaequans, apice acuta vel bidentata. Antherae minutae, 0.4-0.5 mm. longae. Ovarium obovatum, obtusum, 1-1.5 mm. longum, 0.5-0.8 mm. latum, sursum apicem dense piliferum. Glandulae minutae, haud conspicuae. Stylus in statu fructifero tenuis, glaber, 1.2-1.6 mm. longus, stigmate globoso provisus. Ovula una per loculum. Silicula uniseminata, elliptica vel anguste obovata, (2-) 3-3.5 (-4) mm. longa, et 1.5-2 mm. lata, pallido-virescens, obtusa vel subacuta, valvis inaequaliter inflatis, indumento parco apicem versus magis conspicuo e pilis stellatis appressis minute punctatis 0.2-0.3 (-0.4) mm. diam. 4-8 radiatis multo ramosis composito obsitis. Semina (0.5-) 1-1.5 (-2) mm. longa et lata, pallide brunnea, anguste alata, 0.05-0.1 mm. diam. Fl. Jun., fr. Jul.

TURKEY. C3: Prov. Antalya, Antalya-Finike, 1350 m., stony ground, flowers yellow, 26 Jul. 1960, Khan, Prance & Ratcliffe 256 (holo. E, iso. K); ibid., dist. Kemer, (Lycia) between Ovacik yayla on Teke Dağ and Soğut yayla near Çalbali Dağ, dominent on metamorphic slopes, 13 Jul. 1949, Davis 15225 (E, K, BM). C2: Prov. Denizli (Caria), Suleymanlar deresi between Acipayam and Abbas Köy, 18 Jul. 1947, Davis 13461 (E, K, BM); Prov. Burdur, Yeşilova- Denizli, 20 miles from Yeşilova, 900 m., Quercus scrub and neglected fields, common in one area, 1 Jun. 1962, Dudley /

Dudley (D. 35324); ibid., (different plant than D. 35324), Dudley (D. 35325).

It was obvious from the type material and additional collections that this constituted a hitherto unrecognized taxon. Its affinity with any species occurring in Turkey is difficult to establish. Considering all species in Sect. Odontarrhena, this new species is most closely allied to A. fallacinum, a rare species found in Crete and Thessaly. In its habit, A. huber-morathii resembles "A. chlorocarpum", a minor variant of A. murale occurring in the Pindus region of N. Greece.

A. huber-morathii deviates from the forementioned species by its much woodier habit, very silvery, linear and always plicate leaves, and smaller usually narrowly elliptic fruits with a sparser indumentum. In addition, the new species may be differentiated from A. fallacinum by its umbellate ultimate fruiting branches and shorter more fragile pedicels; and from "A. chlorocarpum" by the slender and often curved styles, and very narrow seed wings.

Some affinity is expressed with A. cypricum which also has always plicate leaves and frequently similar fruit form and indumentum. However, the smaller spathulate-obovate leaves, usually larger emarginate or truncate fruits with a denser indumentum, larger petals, wingless seeds and distinctly cushion-forming type of growth of A. cypricum precludes a very close relationship with A. huber-morathii.

The populations of A. huber-morathii are frequently quite large and show a preference for serpentine or metamorphic rubble, but are distributed over /

over a relatively limited range in S.W. Anatolia.

It is with pleasure that this distinct species is named in honour of Dr. A. Huber-Morath, a friend and untiring worker on Anatolian Flora, who put his voluminous Alyssum collection at the author's disposal.

91. A. eriophyllum Boiss. & Hausskn. in Boiss., Fl. Or. 1, 273 (1867); Nyár. in Anal. Acad. Rep. Pop. Rom. Secț. Științe Geol. Geog. Biol., ser. A, mem. 3, 1, 68, Fig. 3, t.3, f.1, t.5, f.20-22 (1949). Fig.1A,f.

Syn: A. eriophyllum var. umbellatum Post, Fl. Syr., Pal. & Sinai, ed. 1, 83 (1883)!

A. eriophyllum f. punctatum Nyár., loc. cit.!

A. eriophyllum f. hirtum Nyár., loc. cit.!

Lectotype: (Turkey, C6: Prov. Maraş): in apricis montis Berytdagh (Berit dağ), Cataoniae, 1829 m., 11 Aug. 1865, Haussknecht (orig. G-B, iso. JE, K, BM).

Distribution: Endemic to Anatolia from the Anti-Taurus and the Amanus. Map 24.

TURKEY: B6: Prov. Malatya, Doğanşehir, 1400 m., 9 Jun. 1960, Stainton et al 5478. C6: Prov. Maraş, Kapu Chamdagh (S.E. of Maraş), 16-18 Sept. 1884, Post; ibid., Bazardijick Owa (nr. Maraş) 1800 m., 11 Jul. 1865, Haussknecht (orig. synt. A. eriophyllum G-B, holo. f. punctatum & f. hirtum JE, iso. W, G-BB, Hub.-Mor.); ibid., Akar dagh (Ahir dağ), 1882, Post (orig. synt. var. umbellatum G, iso. BM).

Habitat: Rare montane species; alt. 1400-1829 m. Fl. Jun.-Jul.

The indumentum which completely covers the sterile shoots of the species is composed of the largest and one of the most unusual types of stellate hairs in the genus (Fig. 1A, f). This white pannose-tomentose indumentum is unique in Alyssum and precludes confusion of A. eriophyllum with any other species, that is, if sterile shoots were collected. If sterile shoots are lacking, identification is facilitated by a number of other /

other characters. Some of its diagnostics are its sparse and coarse stellate hairs (0.4-0.5 mm. diam.) with unequal and divergent rays on the often glabrescent fruits, glabrous styles, lax and arcuate reddish stems, acute, linear-oblanceolate cauline leaves which decrease in size upwards, obtuse and ovate sepals, wingless seeds, and corymb branches as long as the main rachis but terminating in subumbellate few-flowered ultimate inflorescences.

As both of Nyárády's forms of A. eriophyllum are based on minor phenotypic variations with respect to the size and distribution of the stellate hairs on the fruits of duplicate specimens (in the Haussknecht Herbarium at Jena) of one of the original syntypes of A. eriophllum, formal recognition is not justified. The syntypes of A. eriophyllum var. umbellatum which are characterized by umbellate inflorescences do not constitute a deviation from the normal range of expression in the species.

Of the four specimens cited by Boissier as A. eriophyllum, only two fit his description, i.e. the Haussknecht gathering from Berit dağ and his gathering from Bazardijick Owa. The Kotschy specimen (No. 705) from Muş has a totally different type of indumentum on its sterile shoots to the white-pannose described for A. eriophyllum, and is correctly referred to A. filiforme (not A. anatolicum as claimed by Nyárády, 1929); in a similar manner the Kotschy gathering from Tolos dagh in the Amanus has the diagnostic characters of A. constellatum. It is interesting that Boissier prior to describing A. eriophyllum correctly identified the latter Kotschy gathering as A. constellatum.

Boissier claimed that A. eriophyllum was a biennial, a view which was followed by Post (1883; 1932). The only fact supporting this argument is that /

that occasionally plants bearing only sterile shoots are found separate from the fertile plants. However, many sterile shoots are also formed along the lower parts of the woody stock of the fertile specimens, showing that the latter are perennial plants. The feature of separate sterile plants is quite common in Sect. Odontarrhena (i.e. A. corsicum and A. callichroum) and cannot be regarded as indicative of a biennial habit. These sterile plants should be considered as the juvenile phase of a perenniating plant which will later develope flowering stems. In large populations of A. corsicum in S.W. Anatolia, separate sterile plants were distributed around the parents (which also had a prolific development of attached sterile shoots) in a pattern reminiscent of the distribution of saplings around a seed tree of Pinus strobus.

92. A. tortuosum Willd., Sp. Pl., 3, 466 (1800); Waldst. & Kit., Pl. Rar. Hung., 2, 94, t.91 (1802); Sibth. & Smith, Fl. Gr., 7, 21, t.623 as A. alpestre (1830); Reichenb., Ic. Fl. Germ. & Helv., 2, pl. 20, f.4276 (1837-1838); Velen., Fl. Bulg., 37 (1891); Busch in Fl. Cauc. Crit., 3 (4), 558 (1909); Nyar. in Bul. Grád. Bot. Cluj, 7, 128, t.4, f.72-75, t.6, f.1-3, 5-7, t.7, f.1-4, 6-8, t.9, f.1-11, 13-17 incl. subsp., var. and formes (1927); Nyar. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 47 (1949); Grossh., Fl. Kavk., ed. 2, 4, 213 (1950); Kotov in Fl. Ukr., 5, 333, pl.76 (1953); Fl. Rep. Pop. Rom., 3, 348, pl. 60, f.3 (1955).

Syn: A. novuum Winterl., Ind. Hort. Bot. Pest., 11, f.6 (1788) - nomen nudum.

A. tortuosum var. orientale DC., Syst. Nat., 2, 306 (1821)

Odontarrhena tortuosa (Willd.) Meyer in Ledeb., Fl., Alt., 3, 60 (1831)!

A. alpestre L. var. majus Koch, Synop. Fl. Deut., 582 (1836).

A. tortusosum var. elongatum Heuff. in Verh. Zoo.-Bot. Gesell., 8, 56 (1858).

A. alpestre var. typica Trautv. in Bull. Soc. Nat. Mosc., 1, 100 (1860)!

A. alpestre var. tortuosum (Willd.) Fenzl in Tchih., Asie Min., Bot. 1 (3), 301 (1860)!

A. alpestre subsp. tortuosum (Willd.) Nyman, Consp. Fl. Eur., 1, 57 (1878)!

A. borysthenicum Zap. in Pozprawy. Wydz. Mat.-Przyr. Akad. Umiejet, 12, 211 (1912).

A. grintescui /

A. grintescui Nyar. Bul. Grad. Bot. Cluj. 7, 140 (1927)!

A. tortuosum var. elongatum f. biacutum Nyar., op. cit., 131.

A. tortuosum var. elongatum f. obtusatum Nyár., op. cit. 132.

A. tortuosum subsp. heterophyllum Nyár., loc. cit.

? A. tortuosum subsp. heterophyllum f. pusillum Nyár., loc. cit.

A. tortuosum subsp. heterophyllum f. longicarpum Nyár., loc. cit.

A. tortuosum subsp. heterophyllum f. pedatum Nyár., op. cit., 133.

A. tortuosum subsp. heterophyllum f. angustissimum Nyár., loc. cit.

A. tortuosum f. strictum Nyár., op. cit., 130!

A. tortuosum f. submoderatum Nyar., loc. cit.

A. tortuosum f. ramosissimum Nyár., loc. cit.

A. tortuosum f. subrotundatum Nyár., loc. cit. - pro parte!

A. tortuosum f. obovatocarpum Nyár., loc. cit.!

A. tortuosum f. obovatocarpum subf. deminutum , Nyár., op. cit., 131.

A. tortuosum f. ellipticum Nyár., loc. cit.

A. tortuosum f. rhomboideum Nyár., loc. cit.

A. caliacrae Nyár. subsp. racemosum Nyár. in Bul. Grăd. Bot. Cluj, 9, 23 (1929)!

A. tortuosum subsp. cretaceum Kotov in Journ. Insg. Bot. AN Ukrain (URCR), (21-22), 238 (1939).

? A. gymnopodum Smirn. in Bull. Soc. Nat. Mosc. Biol., 48 (5-6), 116 (1939).

? A. diversicaule Smirn., op. cit., 117.

A. racemosum (Nyár.) Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 57, t.5, f.34,35 (1949)!

A. borzaeanum /

A. borzaeanum Nyar. subsp. aequiacutum Nyár., op. cit. 74.

A. tortuosum subsp. elongatum (Heuff.) Nyár., op. cit. 49

A. tortuosum subsp. heterophyllum f. raristellatum Nyár., op. cit., 48.

A. tortuosum subsp. heterophyllum f. rigidum Nyár., loc. cit.

A. tortuosum subsp. cuspidatum Nyár., op. cit., 49, t.4, f.10.

A. tortuosum subsp. typicum Nyár., op. cit., 50!

A. tortuosum subsp. typicum var. verum Nyár., loc. cit.

A. tortuosum subsp. typicum var. verum f. viride Nyár., loc. cit.

A. tortuosum subsp. typicum var. verum f. angustum Nyár., op. cit. 51!

A. tortuosum subsp. typicum var. verum f. strictum (Nyár) Nyár., loc. cit.!

A. tortuosum subsp. typicum var. verum f. ramosissimum (Nyár) Nyár., loc. cit.

A. tortuosum subsp. typicum var. verum f. subrotundatum (Nyár) Nyár., loc. cit.

A. tortuosum subsp. typicum var. verum f. obovatocarpum (Nyár) Nyár., op. cit., 52!

A. tortuosum subsp. typicum var. verum f. obovatocarpum subf. deminutum (Nyár) Nyár., loc. cit.

A. tortuosum subsp. typicum var. verum f. ellipticum (Nyár) Nyár., loc. cit.

A. tortuosum subsp. typicum var. verum f. racemiferum Nyár., op. cit., 53.

A. tortuosum /

A. tortuosum subsp. typicum var. submoderatum (Nyár.) Nyár., loc. cit.

A. tortuosum subsp. typicum var. submoderatum f. duristellatum Nyár., loc. cit.

A. tortuosum subsp. typicum var. sareptae Nyár., loc. cit.

A. tortuosum subsp. typicum var. sapeptae f. rhomboideum (Nyár.) Nyár., loc. cit.

A. cretaceum (Kotov) Kotov in Fl. Ukr., 5, 333, pl. 77 (1953).

Syntypes: (Hungary and Russia): in arenosis sterilissimis Hungariae (PR- Herb. Waldstein No. 502369), inque Sibiria (B, n.v.)

Distribution: Widespread in E. and S.E. Europe, Crimea, Caucasus and Siberia.

Habitat: Disturbed and ruderal areas, neglected fields, river banks, stony plains and mountain scree; alt. 300-1500 m. Fl. Apr.-Jun.

It is apparent that Nyárády's many infra-specific taxa of A. tortuosum are based on individual and very variable characters, which show no geographical or morphological correlation and do not appear to have a population basis. The type materials of A. grintescui and A. caliacrae subsp. racemosum (later raised to specific level: 1949) are morphologically continuous with A. tortuosum from the type localities of the two former taxa. The description and dsitribution of A. borzaeanum subsp. aequiacutum permit this name to be referred to A. tortuosum; likewise, the description and illustrations of A. tortuosum subsp. cretaceum (raised to specific level: 1953) allow it to be referred also to A. tortuosum. The type descriptions of A. gymnopodum and A. diversicaule have been compared with material of A. tortuosum /

A. tortuosum collected from near the type localities of the two former taxa. No apparent characters exist which would permit taxonomic separation, but due to the unavailability of their type specimens, A. gymnopodum and A. diversicaule are provisionally put into the synonymy of A. tortuosum. Kulczyński's view (in Flora Polska, 3, 176: 1927) that A. borysthenicum is synonymous with A. tortuosum is followed here.

93. <u>A. longistylum</u> (Somm. & Lev.) Grossh. & Schishk. <u>in sched</u>, Fl. Or. Exsic., Transcaucasia, Tiflis, 14 Jul. 1922, <u>Grossheim & Schishkin</u> 64; Nyár. in Bul. Grád. Bot. Cluj, <u>7</u>, 133 as <u>A. tortuosum</u> var. <u>longistylum</u> (1927); Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, <u>1</u>, 54 as <u>A. tortuosum</u> var. <u>longistylum</u> (1949).

<u>Syn.</u>: <u>A. tortuosum</u> Willd. var. <u>grandiflorum</u> Rupr. in Mém. Acad. Imp. Sc. St. Pétersb. ser. 7, <u>15</u> (2), 99 (1869)!

<u>A. tortuosum</u> var. <u>meyerianum</u> Rupr., <u>op. cit.</u>, 100!

<u>A. tortuosum</u> var. <u>viridescens</u> Rupr., <u>op. cit.</u>, 100!

<u>A. tortuosum</u> var. <u>schirwanicum</u> Rupr., <u>op. cit.</u>, !

<u>A. alpestre</u> L. var. <u>goktchaica</u> Fedtsch. in Bull. Herb. Boiss., <u>7</u>, (10), 776 (1899).

<u>A. serpyllifolium</u> Desf. var. <u>longistylum</u> Somm. & Lev. in Acta. Hort. Petrop., <u>16</u>, 43 (1900)!

<u>A. tortuosum</u> var. <u>longistylum</u> (Somm. & Lev.) Busch in Fl. Cauc. Crit., <u>3</u> (4), 565 (1909)!

<u>A. cuneipetalum</u> Nyár. in Bul. Grád. Bot. Cluj, <u>18</u>, 97, f. 3, n. 8, t. 4, f. 14, f. 5, n. 5, 6 (1938)!

<u>Syntypes</u>: (Russian Armenia): abunde in collibus siccis Prope Tiflis, 5, 8 & 9 Jul. 1890, <u>Sommier & Levier</u> (orig. FI, n.v., iso. 8 Jul. G, G-BB).

<u>Distribution</u>: Crimea, Caucasus, Russian and Turkish Armenia and Transcaspian. Map 24.

TURKEY. B9: Prov. Van, dist. Başkale, Ispiriz dağ, 3200 m., 31 Jul. 1954, <u>Davis</u> 23703. A9: Prov. Erzurum, Agundis, Olty (Oltu), 20 Jul. 1903 /

1903, <u>König</u> (orig. synt. <u>A. cuneipetalum</u> FI n.v., iso. G).

<u>Habitat</u>: Rocky metamorphic slopes; alt. 550-650 (-3200) m. Fl. Apr.-Jun.

This species is very close to <u>A. tortuosum</u> in having similar shaped leaves and fruits, a bicolored indumentum and tortuose stems. <u>A. longistylum</u> may be easily distinguished from <u>A. tortuosum</u> by its longer styles, larger and sparsely pubescent or glabrescent fruits, larger floral parts, wingless seeds, and stouter often woodier stock.

The type specimens of the numerous varieties of <u>A. tortuosum</u> described by Ruprecht (1869) were kindly sent on loan from the Leningrad Herbarium, and show no differences which would allow separation from <u>A. longistylum</u>. Though type material of <u>A. alpestre</u> var. <u>goktchaica</u> has not been seen, its description and area of occurence indicated that it can safely be referred to <u>A. longistylum</u>. One of the syntypes (<u>Sommier & Levier</u> 88, 5 Jul. 1890) of Nyárády's <u>A. cuneipetalum</u> is also a syntype of <u>A. serpyllifolium</u> var. <u>longistylum</u> (the basionym of <u>A. longistylum</u>). Judging from the photograph (Nyárády, 1938) and a duplicate in the Delessert Herbarium in Geneva, the other syntype of <u>A. cuneipetalum</u> (König from Prov. Erzurum in Turkish Armenia, not Prov. Kars) must also be referred to <u>A. longistylum</u>.

The author has seen only two collections of this species from Eastern Turkey; one of the syntypes of <u>A. cuneipetalum</u> and the subsequent <u>Davis</u> gathering from Turkish Kurdistan. However, the records of <u>A. tortuosum</u> and <u>A. tortuosum</u> var. <u>viridescens</u> (<u>Schischkin</u>; <u>Saposhnikov</u>) from Provinces Erzurum, Kars and Ağri (Schischkin, 1929) can probably be safely referred to A. /

A. longistylum; A. tortuosum sensu stricto, though known from the same areas in the Crimea, Caucasus and the Transcaspia as A. longistylum, has never been seen from Turkey.

94. <u>A. lanigerum</u> DC., Syst. Nat, <u>2</u>, 308 (1821); Boiss., Fl. Or., <u>1</u>, 269 (1867).

<u>Syn.</u>: <u>A. serpyllifolium</u> Desv. var. <u>longistylum</u> Boiss. <u>loc. cit.</u>, <u>pro syn.-non</u> Sommier & Levier!

<u>A. decandolleum</u> Nyár. in Bul. Grád. Bot. Cluj, <u>18</u>, 87. Fig. 3, n. 2, 4 (1938)!

<u>A. decandolleum</u> var. <u>acutuisculum</u> Nyár., <u>op. cit.</u>, 88, f. 4!

<u>A. decandolleum</u> var. <u>densum</u> Nyár., <u>loc. cit.</u>!

<u>A. decandolleum</u> var. <u>densistellatum</u> Nyár. <u>loc. cit.</u>!

<u>A. decandolleum</u> var. <u>obtusatum</u> Nyár. <u>loc. cit.</u>!

<u>A. polycladum</u> Rech. fil. in Phyton, <u>3</u>, 55 (1951)!

<u>Type</u>: (Iran): in Persia inter Kermancha et Amadan, <u>Olivier & Bruguière</u> (holo. P, iso. G-B).

<u>Distribution</u>: N. and Central Iraq and Iran, Transcaspian and Afghanistan.

<u>Habitat</u>: Metamorphic igneous dry slopes and scree; often in <u>Astragalus</u> scrub; alt. (1400-) 2000-3338 m. Fl. May-Jul.

The type material and descriptions of <u>A. decandolleum</u> and its numerous varieties do not appear to deviate from the normal range of variation in <u>A. lanigerum</u>. The floral parts, fruits and styles of all specimens determined by Nyárády as <u>A. decandolleum</u>, which the present author has seen, correspond closely with the original type and recent gatherings of <u>A. lanigerum</u>. <u>A. polycladum</u> is a more reduded and slender stemmed plant with smaller leaves than the typical <u>A. lanigerum</u>, but its floral parts, fruits and styles, indumentum, etc., are clearly identical. The dwarf growth/

dwarf growth and smaller leaves of _A. polycladum_ are probably reflections of its high alpine station of up to 3400 meters.

A. lanigerum is very polymorphic with respect to its habit, leaf shape and size, style length and indumentum density, but the different expressions do not appear to be correlated in any given populations or even on individual plants.

Nyárády (1949) contends that _A. lanigerum_ is synonymous with _A. longistylum_ (_A. tortuosum_ var. _longistylum_), but among many characters, the easiest diagnostics separating the latter are its bicoloured leaves, lanceolate and acute sepals, larger fruits which are evenly distributed for up to 8 cm. on the ultimate branches of the corymb (the fruits of _A. lanigerum_ being conferted and subumbellate at the apices of the ultimate corymb branches), and considerably larger floral parts.

The _Reese_ gatherings from Anatolia identified by Nyárády as _A. decandolleum_ and recorded by Huber-Morath (1943) correctly refer to _A. pateri_ subsp. _pateri_.

95. A. inflatum Nyár. in Bul. Grád. Bot. Cluj, 9, 43, t. 5, f. 113, t. 6, f. 41, t. 7, f. 50, 51, t. 9, f. 54-58 (1929); Bornm., Symb. ad Fl. Anat., 50 (1936); Nyár. in Anal. Acad. Rep. Pop. Rom. Secț, Științe Geol. Geog. Biol., ser A., mem. 3, 1, 44 (1949).

Syn.: A. pugiostylum Nyár. in Bul. Grád. Bot. Cluj, 18, 89, F. 3, n. 3, t. 3, f. 8 (1938) - pro parte excl. plantam a Aucher lectam!
A. inflatum subsp. pugiostylum Nyár., loc. cit.- pro syn!
A. decandolleum Nyár.- pugiostylum Nyár., op. cit., 91!
A. nyaradyi Bornm. & Gauba in Fedde Rep. Sp. Nov., 49, 253, t. 328a (1940)!

Lectotype: (Iran): Julukü (Saratowka), ad fines Persiae in schistosis montium (Regio Transcaspica, Aschabad, Sulukllü), 2 Jul. 1900, Sintenis 841 (not 481) (orig. WU, iso. W, G-BB, K, BM, E).

Distribution: Iran and Transcaspian.

Habitat: N. facing igneous and metamorphic slopes and scree, and river valleys; alt. 1100-2000 m. (-2400) m. Fl. May-Jun.

All of the syntypes of A. pugiostylum (Strauss) were loaned from the Haussknecht Herbarium in Jena and agree with the diagnostic characters of the type material and subsequent gatherings of the earlier described A. inflatum. Nyárády himself doubted the advisability of establishing a new species on the basis of these specimens and labelled most of them in exsiccata as A. inflatum subsp. pugiostylum. He also pointed out in the discussion that the flowering specimens of A. pugiostylum were indistinguishable from A. inflatum and with the exception of possessing a branched and sprawling habit were also indistinguishable from A. obtusifolium /

A. obtusifolium. The floral structures, indumentum and leaf shape and disposition of all the specimens of A. pugiostylum fall within the specific limits of A. inflatum. A duplicate of the Gauba (No. 1374) type of A. nyaradyi, and its original description and accompanying photograph, have also been compared with the abundant material of A. inflatum, with the result that it must be considered as synonymous. The type collection of A. nyaradyi was collected very near to the locality where the Sintenis 841 lectotype of A. inflatum was discovered.

The Aucher 4093A specimen (G) which Nyárády also cited as a syntype of A. pugiostylum is correctly referred to A. pateri subsp. pateri The Reese collections from Anatolia which were identified by Nyárády and recorded by Huber-Morath (1943) do not represent A. inflatum, which is entirely confined to Iran and Russian Turkmenia, but rather are identified as A. pateri subsp. pateri.

The Sintenis gathering (841, not 481 as initially cited by Nyárády) is chosen as the lectotype of A. inflatum in preference to the Litwinow 567 gathering, because in all herbaria where the latter collection has been seen, the depauperate specimens lack mature fruit, and are often mixed with plants of A. bracteatum.

96. A. pateri Nyár. in Bul. Grád. Bot. Cluj, 9, 33, pl. 26b (1929).

Key to subspecies

Apex of long filament appendage only once or twice dentate, ½ or less the length of filament; petals ± entire; styles glabrous pateri (T)

Apex of long filament appendage prominently dentate usually filament length; petals retuse; styles sparsely pubescent prostratum (T)

subsp. pateri. Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 75 & 79 (1949).

Syn.: A. alpestre L. var. suffrutescens Boiss., Fl. Or., 1, 268 (1867)- pro parte quoad plantam Argaeum a Kotschy lectam!

A. subfastigiatum Nyár. in Bul. Grád. Bot. Cluj, 7, 22, 24 & 26, t. 5, f. 117, 118, t. 6, f. 38, 39, t. 7, f. 47, 48, t. 9, f. 50 (1927), nomen nudum!

A. pateri var. minoricarpum Nyár. in Bul. Grád. Bot. Cluj, 9, 33, pl. 26a, t. 5, f. 119, t. 6, f. 37, t. 9, f. 51 (1929)!

A. pateri var. minoricarpum f. wanense Nyár., op. cit., 34!

A. pateri subsp. squarrosoramosum Nyár., loc. cit., pl. 26c, t. 9, f. 52!

A. pugiostylum Nyár. in Bul. Grád. Bot. Cluj, 18, 89 (1938)- pro parte quoad plantam a Aucher lectam!

Lectotype: (Turkey, A4/5: Prov. Kastamonu): Paphlagonia, Wilayet Kastambuli, Tossia (Tosya), in collibus ad Szuluc-Tschesme (nr. Kösen), 21 May 1892, Sintenis 3863 (orig. CL n.v., iso. G, W, K, BM).

Distribution /

Distribution: A predominately Irano-Turanian taxon widespread in Central Anatolia. Map 25.

TURKEY. A3: Prov. Bolu, Ala dağ, on Kartal tepe, 2100-2200 m., 12 Jul. 1962, Davis 37352; Prov. Ankara, N.W. of Beypazari, 4 km. from Kura köy, 28 May 1957, Kühne 324. A4: Prov. Çankiri, Çankiri, 800 m., 5 Jun. 1954, Davis 21528; Prov. Ankara, 40 km. S. of Çankiri, 1000 m., 29 Jun. 1958, Markgraf 10570; Prov. Kastamonu/Çankiri, Kochissar, Ilkas (Ilgaz), 1000 m., 23 Jun. 1929, Bornmüller 13871. B3: Prov. Afyonkarahisar, Denizli-Burdur, 10 km. from Dinar, 1000-1200 m., 10 Jun. 1962, Dudley (D. 35640); Prov. Konya, Sultan dağ, nr. Akşehir, 1900 m., 3 Jul. 1948, Huber-Morath 9273; ibid., Konya-Korisarii (Koraşi nr. Akşehir) nr. Kargyn, 1100 m., May 1902, Zederbour (orig. synt. A. pateri subsp. squarrosoramosum WU, iso. W). B4: Prov. Ankara, Ankara, 870 m., 11 Jul. 1939, Fröden 242; ibid., Şerefli Koçhhisar, 137 km. from Ankara, 25 Apr. 1953, Birand 1425; Prov. Konya, Cihanbeyli, 7 Jun. 1952, Davis 18637. B5: Prov. Niğde, Taspinar, foot of Hasan dağ, 15 Jun. 1952, Davis 18870; Prov. Nevşehir, Gulşehir Nevşehir, c. 12 km. from Gulşehir, 500 m., 2 Aug. 1956, McNeill 189; Prov. Kayseri, Kisge at W. foot of Bakir dağ, 3100 m., 27 Jun. 1952, Davis 19219; ibid., Soisaly nr. Erdschias dagh (Erciyas dağ), 1400 m., Jun. 1902, Zederbour (holo. A. pateri var. minoricarpum WU, iso. W); ibid., nr. Argaeum (Erciyas dağ), Yachjaille (Hacilar), 1358 m., 27 May 1859, Kotschy 184 (orig. synt. A. alpestre var. suffrutescens G-B, orig. synt. A. pateri var. squarrosoramosum W). B6: Prov. Kayersi, 5 km. W. of Pinarbasi- Pazouiran, 1540 m., 22 Jun. 1951, Huber-Morath 10992; Prov. Malatya /

Malatya, Darende- Akçadag, 1450-1480 m., 50 km. E. of Darende, 20 Jun. 1949, Huber-Morath 9274; B7: Prov. Erzincan, 30 km. W. of Erzincan, 1500, 18 Jul. 1958, Markgraf 109111. B9: Prov. Van, Gevas-Edremit, 9 Jul. 1954, Davis 22603; ibid., Van, 2840 m., 12 Jun., 1899, Kronenburg (holo. A. pateri var. minoricarpum f. wanense BRNU n.v., iso. G). B10: Prov. Ağri, Bayaz ir (Doğubayazit), Aucher 4093A (orig. synt. A. pugiostylum G, iso. G-B, W, K, BM). C3: Prov. Antalya, Korkuteli-Kizilcadağ, 4 miles from Korkuteli, 1100 m., 31 May 1962, Dudley (D. 35251a); Prov. Konya, Beyşehir-Konya, 13 km. from Beyşehir, 1100 m., 15 Jun. 1962, Dudley (D. 35847). C4: Prov. Konya, Konya-Sultanhani, 18 km. from Konya, 1050 m., 17 Jun. 1962, Dudley (D. 35920). C5: Prov. Içel, Gumgelek pass, 1 mile W. of Mersin, 1900 m., Jun. 1909, Siehe 249 pro parte; Prov. Niğde, Niğde, 1100 m., 3-6 Jun. 1898, Siehe 40 (orig. synt. A. pateri var. squarrosoramosum, BUC n.v., iso. G, BM, W); Prov. Adana, Farash- Bereketli (nr. Pozanti), 3000 m., Jul. 1911, Siehe 555.

Habitat: Disturbed and ruderal areas, cultivated fields and roadsides, enclosed vineyards, serpentine and igneous screes, gypsum and chalk hills and cliffs of S.E. exposure, clay and sandy banks, Astragalus steppe; often associated with Pinus brutia or P. nigra, Artemisia and Quercus coccifera; alt. 500-2200 (-2840) m. Fl. May-Jun.

A. pateri is one of the commonest species of Alyssum which forms large matted populations in the Central and Eastern Anatolian steppe. In most herbaria gatherings of this species as well as A. condensatum are found under the name A. alpestre L. var. suffrutescens Boiss.

Some difficulty may be experienced in distinguishing the partially sympatric /

sympatric A. pateri from the very polymorphic and more widely distributed A. condensatum (including A. venustum). These species resemble each other in habit and general facies, but there are a number of diagnostics which allow specific distinction. The fertile stems of A. pateri are always copiously branched and sprawling or occasionally ascending; they are reddish and provided with a sparse and early deciduous indumentum. The fertile stems of A. condensatum (especially subsp. condensatum) are often dwarfed and conferted, and are furnished with a dense white and persistent indumentum. The sparsely pubescent, greenish, and obtuse or emarginate or truncate fruits of A. pateri are ovate or narrowly obovate and smaller than most of the elliptic, densely pubescent fruits of A. condensatum. The fruits of A. condensatum subsp. flexibile, though sparsely pubescent, are always twice as large as those of A. pateri and are attenuate at their apices. The styles and petals of A. pateri are smaller than their equivalents on most specimens of A. condensatum. Some additional characters which can be used to distinguish A. pateri and A. condensatum are listed in the following table.

A. pateri	A. condensatum
petals entire or retuse, truncate at apices	petals always entire, rotund at apices
seeds narrowly winged	seeds wingless
fruit indumentum of stellate hairs coarse 7-10 rays (often branched & appearing many-rayed)	fruit indumentum of stellate hairs with slender 10-30 rays
fertile stems homophyllous leaves evenly distributed	fertile stems heterophyllous, the smaller, often obtuse basal leaves densely aggregated into a distinct zone

The original material of Nyárády's subspecies, varieties and forms of A. /

A. pateri has been carefully examined, and it is concluded that the differences which are stated to separate these taxa are merely expressions of the normal range of variation within populations and throughout the whole specific distribution. The one Anatolian specimen cited by Nyárády as A. pugiostylum (Aucher 4093A) does not have the diagnostics that the other syntypes of A. pugiostylum possess - thereby equating them with A. inflatum - but is rather correctly referred to the typical subspecies of A. pateri.

The Callier gathering from the Crimea which Nyárády cites as A. pateri (1929) is also referred (a duplicate in the Velenovsky Herbarium in Prag) by him (1949) to A. grintescui, a synonym of A. tortuosum. Duplicates of this gathering in the Florence Herbarium, Haussknecht Herbarium in Jena and the Delessert Herbarium in Geneva have been determined and cited by Nyárády (1949) as A. tortuosum var. longistylum; a duplicate in the Degen Herbarium in Budapest is considered by Nyárády as one of the syntypes of A. venustum var. nebrodensiforme. A. pateri is entirely confined to Anatolia, and accordingly Sintenis 3863 is chosen as its lectotype.

A brief explanation of Boissier's interpretation of A. alpestre L. in the Orient is in order. A. alpestre L. in the narrow sense (Linnaeus and Nyárády) is an alpine restricted to the Central and Western Alps. None of the Greek and Asiatic material which Boissier cites as varieties of A. alpestre can be equated with the European taxon. The Boissier varieties (1867) have been used extensively (e.g. Post, 1932) as "dust-bin" categories for Oriental specimens in Sect. Odontarrhena which are not properly understood. Nyárády (1927:144) recognized that A. alpestre sensu stricto does not occur in the Orient and established several binomials which may be applied to the Oriental gatherings. However, whereas Boissier's varieties /

varieties are extremely conservative, usually including several distinct species, Nyárády's interpretation of the Oriental taxa went to the opposite extreme. Not only does Nyárády divide species, such as A. pateri, into morphologically indistinguishable infra-specific taxa, but he also separates as distinct species, gathering which are morphologically continuous (i.e. A. halacsyi, A. epiroticum, A. lepidulum and A. novakii are all synonyms of A. sibericum.).

subsp. __prostratum__ (Nyár.) Dudley, __comb. & stat. nov.__; Nyár. in Anal. Acad. Rep. Pop. Rom. Sect. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, __1__, 78 __pro species__ (1949).

__Syn.__: __A. prostratum__ Boiss. & Huet ex Nyár. in Bul. Grád. Bot. Cluj, __18__, 98, fig. 3, n. 5, fig. 5, n. 4, t. 4, f. 4 (1938)!

__A. erzerumi__ Nyár., __loc. cit.__ - __pro syn.__!

__A. divrikii__ Nyár., __op. cit.__, 93, fig. 3, n. 6, t. 6 f. 9 (1938)!

__Type__: (Turkey, B8: Prov. Erzurum): Armenia, Circa Erzerum, Apr. (__sic__) Jun. 1853 (Bayburt-Erzurum, Kochapinar, 1829-2134 m.) __Huet__ (holo. JE, iso. G, G-B, W, GH, K, BM).

__Distribution__: Replacing the typical subspecies in the Armenian Highlands. Map 25.

TURKEY. A8: Prov. Erzurum, Erzurum- Izpir, Jun. 1853, __Huet__; __ibid.__, Kop dağ, 2896 m., 9 Aug. 1962, __Furze__ 3821a; Prov. Gümüşane, Vavuk dağ nr. Bayburt, 1829 m., 19 Jul. 1934, __Balls__ 1768; __ibid.__, dist. Bayburt, 31 km. S.E. of Gümüşane, 1500 m., 15 Jul. 1958, __Huber-Morath__ 14810. B7: Prov. Sivas, Divriki (Divriği), 1000 m., Jun. 1893, __Bornmüller__ 3247 (holo. __A. divrikii__ JE n.v., iso. G-BB); Prov. Malatya, 1 km. from Salihli-Kemaliye, 1350 m., 24 Jun. 1949, __Huber-Morath__ 9275; Prov. Tunceli, Pülümür, 1550 m., 8 Jun. 1957, __Davis__ 29280; Prov. Erzincan, 27 km. W.N.W. or Erzincan-Refahiye, 1600 m., 7 Sept. 1957, __Rechinger__ 5141. B8: Prov. Erzurum, Pasinler-Horasan, nr. Aras river, 1700 m., 12 Jun. 1957, __Davis__ 29449; __ibid.__, dist. Erzurum, Sari Koma pass, 2591 m., 2 Jul. 1960, __Furse & Synge__ 852. B9: Prov. Biltis, Biltis-Tatvan, 1900 m., 30 Jun. 1954, __Davis__ 23378.

__Habitat__: Disturbed areas, corn fields gravelly plains and S. facing igneous and calcarecus slopes and screes; alt. 1350-2591 m. Fl. Jun.-Jul.

The /

The following specimens are intermediate between subsp. pateri and subsp. prostratum: B7: Prov. Elâziğ, above Elâziğ, W. of Harput, 1400 m., 6 Jun. 1957, Davis 29173. C5: Prov. Adana, Masmutli dağ, (Ala dağ, nr. Pozanti), S.E. of Bereketli, 2000 m., Jul. 1913, Siehe 527.

This taxon was originally described by Nyárády at specific level, but examination of the type material, its duplicates and additional gatherings indicate that it has a maximum of three differential characters (see Key to subspecies) which can separate it from A. pateri. Nyárády himself stated that A. prostratum was closely allied to his A. pateri subsp. squarrosoramosum, now treated as a synonym of A. pateri subsp. pateri. Subspecies prostratum replaces the typical subspecies in the Armenian Highlands, but their distributions overlap in Turkish Kurdistan. A few intermediates occur the eastern and south-eastern range of the typical subspecies.

Nyárády allies A. divrikii to the Iranian A. lanigerum (A. decandolleum). However, the indumentum flower and fruit morphology, of A. divrikii as described and illustrated by Nyárády, and examination of duplicate material, clearly allows this binomial to be treated as synonymous with A. pateri subsp. prostratum.

97. A. obtusifolium Stev. ex DC., Syst. Nat., 2, 305 (1821).

Key to subspecies

Plant large; fertile stems stout, 15-40 cm. long; petioles of lower cauline leaves 3-6 mm. long — obtusifolium (E,O)

Plant dwarf; fertile stems slender 10 cm. long or less; petioles of lower cauline leaves 1-2 mm. long — helioscopioides (E)

subsp. obtusifolium. Deles., Ic. Sel. Pl., 2, 12, pl. 38 (1823); Busch in Fl. Cauc. Crit., 3 (4), 567 (1909); Hayek, Prod. Fl. Pen. Balc., 1, 441 (1925); Nyár. in Bul. Grăd. Bot. Cluj, 9, 15, t. 4, f. 100, t. 6, f. 48, t. 7, f. 61-63, t. 9, f. 67, pl. 22, f. 2 (1929); Nyár. in Anal. Acad. Rep. Pop. Rom. Secț Științe Geol. Geog. Biol., ser. A, mem. 3, 1, 33 & 39 t. 5, f. 47 as A. tortuosum subsp. sawranicum (1949); Grossh., Fl. Kavk., ed. 2, 4, 214 (1950); Fl. Rep. Pop. Rom., 3, pl. 60, f. 2 (1955).

Syn.: A. savranicum Andrz. in Besser, Adden. & Corr. Enum. Pl. Volk. Pod., 82 (1822)!

A. alpestre L. var. obtusifolium (Stev. ex DC), Fenzl in Tchih., Asie Min., Bot. 1 (3), 300 (1860)!

A. alpestre subsp. obtusifolium (Stev. ex DC.) Nyman, Consp. Fl. Eur., 1, 57 (1878)!

A. tortuosum Willd. var. elongatum Busch, op. cit., 566!

A. tortuosum subsp. sawranicum (Andrz.) Nyár. in Bul. Grăd. Bot. Cluj, 7, 136, pl. 13, t. 6, f. 8, t. 7, f. 9, t. 9, f. 18 (1927)!

A. transiens Nyár., op. cit., 160 & in Bul. Grăd. Bot. Cluj, 8, 152 /

152, pl. 11 (1928)!

A. obtusifolium subsp. typicum Nyár. in Bul. Grád. Bot. Cluj, 9, 16 (1929)- pro parte excl. plantam Anatoliam!

Type: (Russia- Crimea and Siberia): in Tauria meridionali et in Siberia, Steven (holo. H. n.v., iso. G-DC, W, K).

Distribution: Bulgaria, Romania, Crimea, Central Russia and the Caucasus.

Habitat: River beds and disturbed areas; alt. 0-500 m. Fl. Jun.-Jul.

subsp. helioscopioides Nyár., op. cit., 18; Rech. fil., Fl. Aegaea, 225 (1943); Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 34, t. 4, f. 102, 103, t. 6, f. 47 (1949).

Type: (Greece): Macedonia, Insula Thasos, in saxosis aridis et calcarei s, c. 700 m., Apr. 1909, Dimonie (holo. BP n.v., iso. WU, W, K, BM, E).

Distribution and habitat: Endemic to calcareous substrates on the Greek Island of Thasos; alt. 700 m. Fl. Apr.

This species is not known to occur in Turkey; all Anatolian specimens recorded as A. obtusifolium refer to other taxa. Both the Manissadjian and the Bornmüller 1334 gatherings from Prov. Amasya which were cited by Nyárády (1929) as A. obtusifolium subsp. typicum are correctly identified as A. sibiricum. Boissier's (1867) A. alpestre var. obovatum (including A. obtusifolium) includes Kotschy 284 from the Cilician Taurus and Boissier from Mesogis. The former collection is a syntype of A. giosnanum, and the latter refers to A. sibiricum. The Reese gatherings cited by Nyárády in Huber-Morath (1943) and Nyarady (1949) as A. obtusifolium are also/

also referred to _A. sibiricum_.

A. transiens has no discernible differences which would allow separation from _A. obtusifolium_, in fact one of the syntypes of _A. transiens_ is represented in the De Candolle Herbarium in Geneva as the type of _A. obtusifolium_. Likewise, the authentic material of _A. sawranicum_ (W) has all the diagnostics of _A. obtusifolium_. The holotype of _A. obtusifolium_ subsp. _typicum_ var. _alpinum_ is morphologically similar to Anatolian and Caucasian gatherings of _A. gehamense_, and is treated as synonymous with that species. Nyárády's _A. obtusifolium_ subsp. _cordatocarpum_ is correctly understood as a synonym of his earlier described _A. caliacrae_.

Subspecies _helioscopioides_ is known only from one collection from Thasos, but on the basis of its floral structure, leaf heteromorphy, etc., it appears to refer correctly to _A. obtusifolium_. Nyárády's placement of this taxon as a subspecies is provisionally accepted, until such time as more material is available from Thasos.

98. A. gehamense Federov. in Not. Syst. Geog. Inst. Bot. Tibil., fasc. 10, 65, f. 4 (1941); Grossh., Fl. Kavk., ed. 2, 4, 214, (1950); Nyár. in Bul. Grǎd. Bot. Cluj, 7, 138 as A. tortuosum var. trautvetteri (1927).

Syn.: A. alpestre L. var. microphylla sensu Trautv. in Acta Hort. Petrop., 2, 497 (1873) - non Meyer!

A. tortuosum Willd. var. trautvetteri Busch. in Fl. Cauc. Crit., 3 (4), 565 (1909)!

A. obtusifolium Stev. ex DC. subsp. typicum Nyár. var. alpinum Nyár. in Bul. Grǎd. Bot. Cluj, 9, 17, t. 5, f. 82, t. 8, f. 117 (1929)!

Type: (Russian Armenia): crescit in regione alti-alpina in cacuminibus Montium Aghmaghanensium (olium Gehamensium) in lapidosis mobilibus (Spitak), 23 Jul. 1938, Federov (holo. ERE n.v. iso. TBI n.v., photo E).

Distribution: Endemic to Turkish and Russian Armenia. Map 25.

TURKEY. A8: Prov. Trabzon, Messurach dagh (Meşoraşisagar), 2591 m., 2 Jul. 1933, Balls 444; ibid., Kara Karya Dagh, 3505 m., 24 Jul. 1934, Balls 1313A. A7: Prov. Gümüşane, Chromdagh (nr. Gümüşane), 13 Jun. 1894, Sintenis 5922 (holo. A. obtusifolium subsp. typicum var. alpinum WU, iso. W, G, G-BB, K, BM). A9: Prov. Kars, Aschich dagh, 29 Jul. 1871, Radde 426 & 428 (synt. A. tortuosum var. trauvetteri orig. L n.v., photo E).

Habitat: Rare alpine of igneous slopes and limestone screes; alt. 2591-3505 m. Fl. Jun.-Jul.

A /

A Radde collection (No. 428) of this taxon was determined and cited by Trautvetter (1873) as Odontarrhena alpestre var. microphylla. This combination was based on a misconception by Trautvetter of Meyer's (1831) Odontarrhena microphylla from the Altai. Busch (1909) recognised that Meyer's taxon and the Armenian and Caucasian high alpine plants were not conspecific and applied the name A. tortuosum var. trauvetteri to the latter. There is no doubt after comparing photographs (and type material when available) of Trauvetter's var. microphylla, Busch's var. trauvetteri, Nyárády's A. obtusifolium subsp. typicum var. alpinum and Federov's A. gehamense, that they all represent the same taxon and share morphological continuities which justify specific recognition.

A. gehamense is a very distinct alpine which is easily distinguished from A. tortuosum (occurring at much lower altitudes in the Caucasus) by its larger floral parts, obtuse sepals with very wide hyaline margins, pale cream-coloured petals, densely foliate, short and procumbent stems, spathulate to orbicular or obcuneate, obtuse, greenish-gray concolorous leaves, and prominently involucrate leaves which subtend a compact subumbellate corymb.

A. dechyanum Nyár. (in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 17, tab. 4, f. 5, tab. 5, f. 9, 10: 1949) probably refers to this species. Nyárády allies A. dechyanum to his A. obtusifolium subsp. typicum var. alpinum, a synonym of A. gehamense. The distribution in Daghestan, and the leaf and fruit illustrations of A. dechyanum correspond with those features of A. gehamense.

99. A. bracteatum Boiss. & Buhse in Nouv. Mém. Soc. Nat. Mosc., 12, 18 (1860); Boiss., Fl. Or., 1, 267 (1867); Busch in Fl. Cauc. Crit., 3 (4), 558 (1909); Nyár. in Bul. Bot. Grád. Cluj, 18, 91, fig. 5, n. 1, fig. 6 (1938); Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 23, t. 3, f. 3 (1949).

Syn.: A. bracteatum var. typicum Nyár. in Bul. Grád. Bot. Cluj, 18 92 (1938).

A. bracteatum var. dissimile Nyár., loc. cit.

Syntypes: (Caucasus): am Fuss des Illanglidagh bei Nachitschewan, 21 May 1847, Buhse (orig. G-B, iso. LE n.v., photo. E). (Iran), Persien (Ispahan), Aucher 4101B (orig. G-B, iso. W, G, K, BM).

Distribution and habitat: Open rocky hillsides, dry steppe, river banks and schist substrates in N. and Central Iran and the Caucasus; alt. 900-2896 m. Fl. Apr.-May.

Though most specimens of this species have orbicular or spathulate-obovate and obtuse leaves, some gatherings, including the original syntype collected by Buhse near Nachitschevan, have broadly elliptic and subacute leaves. Formal recognition of this variation was proposed by Nyárády as var. typicum and var. dissimile; however, after comparing material identified by Nyárády in the Delessert Herbarium in Geneva with all the available Persian collections, it is safer to treat these varieties as synonymous. Many specimens from Kazakistan and Transcaucasia have been determined (BM, GH, LE) and cited by Grossheim (1953) as A. bracteatum. Grossheim evidently did not recognize A. bracteatum in the sense of Boissier and Buhse (or Busch, 1909), as most of the specimens which he identified as /

as that species are referrable to A. tortuosum, or in the case of some gatherings from N. Iran, to A. lanigérum.

100. A. corymbosoides Form. in Verh. Natur. Ver. Brünn, 34, 329 (1895); Vandas Reliq. Form., 39 & 40 as A. tortuosum (1909); Bornm. in Engl. Bot. Jahrb., 59, 350 as A. rhodopense (1925); Nyár. in Bul. Grăd. Bot. Cluj, 8, 153, t. 4, f. 97, 99, t. 6, f. 23, 24, t. 7, f. 26, 27, t. 8, f. 112, t. 9, f. 36, 37, 120, 123 as A. rhodopense (1928).

Syn.: A. rhodopense Form. in Deut. Bot. Monat., 16, 20 (1898) & Form. in Verh. Natur. Ver. Brünn, 37, 83 (1898).

A. corymbosoides f. ciliata Form. in Verh. Natur. Ver. Brünn, 38, 72 (1899).

A. vardarense Bornm., op. cit. - pro syn.!

A. vranjanum Nyár. in Bul. Grăd. Bot. Cluj, 7, 110 t. 4, f. 69, t. 6, f. 67, t. 8, f. 95, t. 10, f. 118, pl. 5, f. 6, 7, pl. 9, pl. 4, f. 6, 3 (1927)!

A. vranjanum var. typicum Nyár., op. cit., 112!

A. vranjanum var. compactum Nyár., loc. cit., pl. 4, f. 8-9, pl. 5, f. 8-10.

A. vranjanum var. compactum f. rotundatum Nyár., loc. cit.

A. rhodopense var. bellidius Nyár. in Bul. Grăd. Bot. Cluj, 8, 156, t. 8, f. 112, 119 (1928)!

A. rhodopense f. angustum Nyár., loc. cit., t. 8, f. 111.

A. murale W. & K. subsp. dramense Nyár. in Öst. Bot. Zeit., 85, 56 (1936)!

A. rechingeri Nyár. in Bul. Grăd. Bot. Cluj, 18, 83, f. 3 n. 1, t. 3, f. 7 (1938) & Nyár. in Engl. Bot. Jahrb., 69, 458 (1939)!

A. /

A. rechingeri var. rhodopensiforme Nyár. in Eng. Bot. Jahrb. 69, 459 (1939)!

A. rechingeri-vranjanium Nyár., loc. cit.!

A. vranjanium var. compactum f. duristellatum Nyár., loc. cit.!

A. alpestre L. subsp. rhodopense (Form.) Stoj. & Steff. Fl. Bulg., 553 (1948)!

Type: (Yugoslavia): in collinis petrosis ad Demirkapu Korešjani Červec et Balia, Macedonia, Formanek (holo. BRNM n.v.).

Distribution and habitat: Disturbed areas, river banks and calcareous substrates in Yugoslavia, Greece, Bulgaria and Romania; alt. 60-800 m. Fl. May-Jun.

That Formanek contrasted this species with Aurinia corymbosa Griseb. has no relevance to the fact that as a specific epithet, corymbosoides has priority over Formanek's later rhodopense. The priority of A. corymbosoides was realised by Bornmüller (loc. cit.) and Nyárády (1928), but they both rejected this name in favour of A. rhodopense because they considered the former inappropriate.

The differences which Nyárády states to separate A. vranjanum (and its numerous infra-specific taxa) from A. corymbosoides commonly occur throughout the range of the latter species. Nyárády himself (1927) claims that they are very similar, and that var. compactum of A. vranjanum represents a transitional state, whose characters are closer to A. corymbosoides than to A. vranjanum! A. murale subsp. dramense is an example of the application of infra-specific taxa to unrelated species, a phenomona which occurs frequently in Nyárády's analysis of Sect. Odontarrhena /

Odontarrhena. Subspecies dramense clearly possesses the diagnostics (in particular the very asymmetrically inflated fruits which are strongly S-shaped in cross-section) of A. rhodopense, A. vranjanum and A. rechingeri - all synonyms of A. corymbosoides. A. rechingeri is said to differ from A. corymbosoides by being a taller plant, having larger inflorescences and brighter coloured petals. The stature of the plants of A. corymbosoides is very variable and is apparently associated with altitudinal differences; likewise, inflorescence branching appears to increase at lower altitudes. Petal colour is often unreliable in herbarium specimens; deep yellow petals often retain their original colour when dried, but they may fade very pale, and sometimes appear whitish. The type localities of A. rechingeri (and its var. rhodopensiforme) and A. murale subsp. dramense are all within an area in Greek Macedonia at the base of the Rhodope Mts. of approximately 40 square miles. Nyárády's intermediate category, "A. rechingeri-vranjanum sp. trans nov." also comes from the same area.

A. rhodopense subsp. armeniacum : 1928 (later as subsp. bourgaei : 1949) is based on the type material of Odontarrhena bourgaei. These names are correctly treated as synonyms of A. callichroum. Nyárády's A. rhodopense subsp. duristellatum (1949) from Iraq has little relationship to A. corymbosoides which is confined to the Balkan Peninsula. The type of subsp. duriestallatum together with numerous additional collections from N. Iraq were described by the present author as a new species, A. penjwinensis (1962).

101. A. borzaeanum Nyár. in Bul. Grăd. Bot. Cluj, 6, 90 (1926); Nyár. in Bul. Grăd. Bot. Cluj, 9, 4, t. 4, f. 86, 87, t. 6, f. 29, t. 7, f. 34-37, t. 9, f. 44, 45, t. 2 (1929); Bornm., Symb. ad Fl. Anat., 48 (1936); Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 74 (1949); Fl. Rep. Pop. Rom., 3, 352, pl. 60, f. 1 (1955).

Syn.: A. microcarpum Hausskn. & Bornm. in Mitt. Thür. Bot. Ver., 21, 3 (1905), pro parte quoad plantam a Bornmüller 4111 lectam - non Visiani!

A. alpestre L. subsp. borzaeanum (Nyár.) Stoj. & Steff., Fl. Bulg., 531 (1948)!

Type: (Romania): Dobrogea, distr. Constanţa, in arenosis maritimis inter lacum Tuzlaghiol et Pontum Euxinum (Marea Neagra) prope balneas Techirghiol et Movilla, c. 2-10 m., 2 Jul. 1923, Borza 647a (holo. CL n.v., iso. G, W, K, BM, OXF, E).

Distribution: Bulgaria, Romania and rarely in N.W. Anatolia. Map 25.

TURKEY. A2(A): Prov. Bilecik, 200 m., 7 Jul. 1899, Bornmüller 4111 (orig. synt. A. microcarpum JE n.v., iso. W, G); ibid., 5 km. W. of Bilecik, 1 Jul. 1962, Davis 36363. B2: Prov. Kütahya, Eskişehir- Kütahya, 5 km. from Kütahya, 900 m., 22 Jun. 1962, Dudley (D. 36090).

Habitat: Coastal areas, limestone steppe; often in Pinus brutia woods; alt. 0-10 (-900) m. Fl. May-Jun.

This species belongs to the same complex of species, including _A. caliacrae_, _A. corymbosoides_ and _A. sibiricum sensu lato_, whose fruits are very asymmetrically inflated and are strongly S-shaped in cross-section.

A. borzaeanum occurs only rarely in Anatolia, in north-west Bithynia. One of the specimens (_Bornmüller_ 4110) cited as _A.microcarpum_ is correctly referred to _A. borzaeanum_, the other gatherings from Paphlagonia pertain to the closely allied _A. sibiricum_. Though _A. borzaeanum_ occurs in the same area in Anatolia as the very common and widespread _A. sibiricum_, the former possesses a number of characters which clearly distinguish it from the latter. The uppermost prominently involucrate leaves of _A. borzaeanum_ are persistent, while the bracteate ones of _A. sibiricum_ are early deciduous. The smaller fruits of _A. borzaeanum_ have an indumentum of equal-rayed and appressed stellate hairs (measuring 0.2-0.4 mm. diam.), and the stellate hairs on its sterile shoot leaves are appressed or subappressed with short, equal and stiff rays. The indumentum on the fruits of _A. sibiricum_ is composed of coarser stellate hairs with unequal and divergent rays (measuring up to 0.7 mm. diam.), and that on the leaves of its sterile shoots is often tomentose with stellate hairs having long, unequal and sericeous rays, often up to 1.5 mm. long. The appendages of the short filaments of _A. borzaeanum_ are connate basally; those of _A. sibiricum_ are always free. The habit of _A. borzaeanum_ is also distinctive; its fertile stems are rigid and sparsely branched, and its inflorescence is sparingly branched and condensed, at most 5 cm. long /

long. The fertile stems of *A. sibiricum* are most often sprawling and copiously branched, and its inflorescence is strongly branched, up to c. 10 cm. long. The upper portions of the stems and inflorescence of *A. borzaeanum* are whitish with a dense felty indumentum; this indumentum if present on the stems of *A. sibiricum* is deciduous in the fruiting state.

One of the paratypes (*Nyárády* 647d) of *A. borzaeanum*, cultivated from seed collected in the Dobrogea district of Romania, is correctly referred to *A. obtusifolium*. The description and distribution of *A. borzaeanum* subsp. *aequiacutum* indicate that this name is probably synonymous with *A. tortuosum*.

102. <u>A. sibiricum</u> Willd., Sp. Pl., <u>3</u> (1), 465 (1800); Boiss., Fl. Or., <u>1</u>, 268 as <u>A. alpestre</u> var. <u>minutiflorum</u> (1867); Nyár. in Notizb. Bot. Gart. Mus. Berlin-Dahlem, <u>11</u>, 631, f. 11 (1932); Schwarz in Fedde Rep. Sp. Nov., <u>36</u>, 87 (1934); Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, <u>1</u>, 35 & 36 as <u>A. lepidulum</u> (1949).

<u>Syn</u>.: <u>A. minutiflorum</u> Boiss., Diagn. 1 (1), 73 (1842)!

<u>A. alpestre</u> L. var. <u>minutiflorum</u> (Boiss.) Fenzl in Tchih., Asie Min., Bot. <u>1</u> (3), 299 (1860)!

<u>A. alpestre</u> var. <u>suffrutescens</u> Boiss., Fl. Or., 268 (1867), <u>pro parte</u>!

<u>A. suffrutescens</u> (Boiss.) Hal., Consp. Fl. Gr., <u>1</u>, 93 (1900).

<u>A. suffrutescens</u> var. <u>typicum</u> Hal., <u>loc. cit</u>.!

<u>A. suffrutescens</u> var. <u>epirotum</u> Hal., <u>loc. cit</u>.!

<u>A. microcarpum</u> Hausskn. & Bornm. in Mitt. Thür. Bot. Ver., <u>21</u>, 3 (1905), <u>pro parte excl. plantam a Bornmüller 4111 lectam - non</u> Visiani!

<u>A. montanum</u> L. subsp. <u>montanum</u> proles <u>epirotum</u> (Hal.) Baumg. in Beil. Jahresb. Nied.-Öst. Land.-Lehrers. Wien.-Wien.-Neust., <u>34</u>, 8 (1907)!

<u>A. epirotum</u> (Hal.) Nyár. in Bul. Grăd. Bot. Cluj, <u>9</u>, 13, t. 5, f. 120, 121, t. 6, f. 32, 33, t. 9, f. 72 (1929)!

<u>A. novakii</u> Nyár., <u>op. cit</u>., 14.

<u>A. obtusifolium</u> Stev. ex DC. subsp. <u>typicum</u> Nyár., <u>op. cit</u>., 16 /

16, <u>pro parte quoad plantam a Manissidjian lectam</u>!

<u>A. halacsyi</u> Nyár., <u>op. cit.</u>, 10, t. 4, f. 88, 89, t. 6, f. 30, 31, t. 7, f. 38, 40, t. 9, f. 46, pl. 20!

<u>A. halacsyi</u> var. <u>densum</u> Nyár., <u>op. cit.</u>, 12, t. 7, f. 39!

<u>A. lepidulum</u> Nyár., <u>op. cit.</u>, 26!

<u>A. lepidulum</u> subsp. <u>genuinum</u> Nyár., <u>op. cit.</u>, 28, pl. 24a, t. 6, f. 50, 51, t. 7, f. 65, t. 9, f. 68!

<u>A. lepidulum</u> subsp. <u>genuinum</u> f. <u>pauloasperum</u> Nyár., <u>loc. cit.</u>, t. 7, f. 67!

<u>A. lepidulum</u> subsp. <u>genuinum</u> f. <u>asperum</u> Nyár., <u>loc. cit.</u>, t. 5, f. 104, t. 7, f. 68!

<u>A. lepidulum</u> subsp. <u>congregatum</u> Nyár., <u>loc. cit.</u>, pl. 24b, t. 6, f. 52, t. 9, f. 69!

<u>A. lepidulum</u> subsp. <u>congregatum</u> f. <u>minoristellatum</u> Nyár., <u>op. cit.</u>, 29, t. 5, f. 105!

<u>A. lepidulum</u> subsp. <u>congregatum</u> f. <u>maioristellatum</u> Nyár., <u>loc. cit.</u>, t. 5, f. 106, 107!

<u>A. lepidulum</u> subsp. <u>congregatum</u> f. <u>simplicius</u> Nyár., <u>loc. cit.</u>!

<u>A. lepidulum</u> subsp. <u>vestimentosum</u> Nyár., <u>loc. cit.</u>, pl. 24c, t. 5, f. 108, 109, t. 6, f. 53, t. 7, f. 66, t. 9, f. 70!

<u>A. lepidulum</u> subsp. <u>genuinum</u> f. <u>scopaeforme</u> Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, <u>1</u>, 38 (1949)!

<u>A. tenderense</u> Kotov in Fl. Ukr., <u>5</u>, 506, pl. 78, 78a (1953)!

<u>Type</u>: /

Type: (Russia-Siberia): in Siberia, *Richtscheid* (?) (holo. B, photo. 3 sheets E, iso. G-DC).

Distribution: Albania, Yugoslavia, Bulgaria, Romania, Turkey-in-Europe, Anatolia and Caucasus.

TURKEY. A2(E): Prov. Istanbul, Serai-Köy, *Friwaldsky*. A2(A): Prov. Bilecik, Sakarya valley, Küplü, Jun. 1960, *Curtis* 207; *ibid*., Bilecik-Pozaryeri, 400 m., 2 Jul. 1962, *Davis* 36440; Prov. Bursa, Mt. Olympo Bithynia (Ulu dağ), Jul. 1873, *Pichler* (holo. *A. lepidulum* subsp. *congregatum* f. *simplicius* BUC n.v., iso. G, G-B, W-Hal., Hub.-Mor., JE, W, GH, BM; *ibid*., Bursa-Soğukpinar, Soğukpinar, 500-1000 m., 16 May 1962, *Dudley* (D. 34749). A3: Prov. Adapazari, Doğançay, 100 m., 1 Jul. 1960, *Davis* 36326; Prov. Ankara, 10 km. W. of Beypazari, 2 km. W. of Zavije, 880 m., 26 May 1957, *Kühne* 176A; Prov. Bolu, Nallihan-Mudurnu, 1200 m., 9 Jul. 1962, *Davis* 37060. A4: Prov. Çankiri, Çankiri, 800-900 m., 3 Jun., 28 Jul. 1929, *Bornmüller* 13864 (orig. synt. *A. lepidulum* subsp. *genuinum* f. *scopaeforme* JE, n.v., iso. W, BM); Prov. Çankiri, Çankiri, 800 m., 5 Jun. 1954, *Davis* 21511; Prov. Kastamonu, Kastamonu, 1100 m., 9 Jun. 1954, *Davis* 21778; *ibid*., N. side of Ilgaz dağ, 1500 m., 28 Jul. 1962, *Davis* 38282; Prov. Ankara, Ravli-Kalecik, 4 Jun. 1954, *Davis* 21419. A5: Prov. Kastamonu, Tosya, 13 Jun. 1892, *Sintenis* 3684 (holo. *A. lepidulum* subsp. *congregatum* f. *minoristellatum* & f. *maioristellatum* BP, n.v.,; orig. synt. *A. microcarpum* JE n.v., iso. Wu, W, G-BB, K, BM); Prov. Sinop, Çangal dağ above Gökcaegaç, 1100 m., 27 Jul. 1962, *Davis* 38258; Prov. Samsun, 30 km. W. of Samsun, 1891/92, *Manissadjian* 107b; Prov. Amasya /

Amasya, Amasya, 400-600 m., 5 Jun. 1889, Bornmüller 1334 (orig. synt. A. microcarpum JE n.v., iso. G-BB); ibid., Mersivan (Merzifon), 11 Apr. 1891, Manissadjian (orig. synt. A. obtusifolium subsp. typicum BRBU n.v., iso. W). A6: Prov. Tokat, Tokat, Krichrigh dagh, Wiedemann. B1: Prov. Balikesir, Mt. Ida (Kaz dağ), Mt. Szu-Sszu dagh, 27 Jul. 1883, Sintenis 430; Prov. Izmir, Siphylo (Manisa dağ) 900-1200 m., 10 Jun. 1906, Bornmüller 9089 (orig. synt. A. halacsyi BP, n.v.; orig. synt. A. lepidulum subsp. genuinum f. pauloasperum BP n.v., iso. G, K, BM, E); ibid., 1837, Aucher 253 (orig. synt. A. alpestre var. suffrutescens G-B, iso. G, K). B2: Prov. Bursa, Bursa-Keles, 20 km. from Keles, 1000 m., 17 May 1962, Dudley (D. 34785); Prov. Kütahya, dist. Gediz, Şaphane dağ above Şaphane, 1500 m., 27 Aug. 1950, Davis 18510, ibid., Kütayha-Tayşanli, 10 km. from Tavşanli, 800-900 m., 23 Jun. 1962, Dudley (D. 36112). B3: Prov. Eskeşehir, Polatli-Sivrihisar, 20-30 miles from Polatli, 1000 m., 21 Jun. 1962, Dudley (D. 36025); Prov. Kütahya, Eskişehir-Kütahya, 20 km. from Kütahya, 800 m., 22 Jun. 1962, Dudley (D. 36079); Prov. Konya, Sultan dağ, Akscheker (Akşehir), 1100-1200 m., 10 Jun. 1899, Bornmüller 4109. B4: Prov. Ankara, Kavakli valley (Dikmen), 900 m., 13 Jun. 1929, Bornmüller 13863 (orig. synt. A. lepidulum subsp. genuinum f. scopaeforme JE n.v., iso. W, K, BM); ibid., dist. Şerefli Kochhisar, 16 km. S. of Şerefli Kochhisar-Aksaray, 930 m., 27 Jun. 1959, Huber-Morath 16234; ibid., 1892, Bornmüller 3138 (orig. synt. A. lepidulum subsp. genuinum f. asperum, BP n.v., iso. G. G-BB, W, K, BM, E). B5: Prov. Nevşehir, Nevşehir-Ürgüp, 1200-1300 m., 22 Jun. 1952, Davis 19129 /

19129; Prov. Kayseri, Kayseri, 1250 m., 1 Jul. 1856, Balansa 492 (orig. synt. A. alpestre var. minutiflorum G-B). B6: Prov. Sivas, Sivas, 1829 m., Jul. 1898, Maunsell. B8: Prov. Tunceli, dist. Pülümür, 2 km. S. of Mutri, 1260 m., 26 Jun. 1951, Reese. C1: Prov. Aydin, Samsun dağ above Priene, 700-900 m., 20 Aug. 1950, Davis 18362; ibid., Mesogis (Aydin dağ) above Thralles (Aydin), Jun. 1842, Boissier (orig. synt. A. lepidulum subsp. genuinum f. pauloasperum CL n.v., iso. G, W, K, E); ibid., nr. Thralles (Aydin), Jun. 1842, Boissier (holo. A. minutiflorum G-B, iso. W, GH). C2: Prov. Denizli, Boz dağ above Geyran yayla, 1829-2134 m., 16 Jul. 1947, Davis 13375; ibid., Tavas-Denizli, 15 miles from Denizli, 800 m., 10 Jun. 1962, Dudley (D. 355555); ibid., N. face of Buba dağ, Honaz dağ, S. of Denizli-Tavas, 4 Jun. 1938, Huber-Morath (orig. synt. A. lepidulum subsp. genuinum f. scopaeforme Hub.-Mor. iso. W); ibid., Boldan, 6 km. from Denizli, Jun. 1938, Huber-Morath 5575 (orig. synt. A. lepidulum subsp. genuinum f. scopaeforme Hub.-Mor.); Prov. Antalya, nr. Berdak (Bayat), Jun. 1864, Bourgeau 164 (orig. synt. A. alpestre var. suffrutescens G-B). C3: Prov. Burdur, nr. Bouldour (Burdur), May 1848), Heldreich (orig. synt. A. alpestre var. suffrutescens G-B, iso. BM); Prov. Konya, Beyşehir-Konya, 28 miles from Beyşehir, 1250 m., 15 Jun. 1962, Dudley (D. 35860). C4: Prov. Konya, nr. Konya, 1200 m., May 1902, Zedebour (holo. A. lepidulum subsp. vestimentosum WU, iso. W). Turkey-in-Europe, 1844, Thirke; ibid., 1842, Grisebach (orig. synt. A. alpestre var. suffrutescens G-B, iso. K). (orig. synt. A. alpestre var. suffrutescens G-B, iso. K).

Habitat: /

Habitat: Disturbed and ruderal areas, salt and calcareous steppe, limestone, conglomerate and igneous ledges and scree, marl and gypsum hills of S. and S.W. exposure; often found in Artemisia and Astragalus steppe, Juniperus and Quercus scrub, and Pinus and Abies woodlands; alt. (100-) 700-2134 m. Fl. May-Jul.

This species belongs to the same complex of species in Subsect. Odontarrhena as A. caliacrae, A. borzaeanum, A. cormbosoides and A. euboueum, all with very asymetrically inflated fruits which are strongly S-shaped in cross-section. A. sibiricum is one of the commonest Oriental Alyssum species which is very polymorphic with respect to its stature, size of inflorescnece, and leaf and fruit shape. The multiplicity of specific and infra-specific epithets (i.e. A. halacsyi, A. lepidulum and A. epirotum) are extremely artifical, being based on minor variations which occur uncorrelated and sporadically throughout the whole specific range. Whenever possible the original material (or their duplicates) of Nyárády's taxa have been carefully examined with the resulting conclusion that their differential characters lack a population or even individual constancy or correlation which would justify taxonomic recognition.

Schwarz (1934) correctly points out that the characters distinguishing A. halacsyi and A. lepidulum easily fall within the range of variation of Boissier's A. minutiflorum. A. minutiflorum (1842), considered by Fenzl (1860) as a variety of A. minutiflorum and maintained as such in Flora Orientalis, is conspecific with A. sibiricum. A. alpestre var. suffrutescens, though a "dustbin" group, contained /

contained a predominance of A. sibiricum, i.e. Grisebach, Heldreich from Greece, Bourgeau and Aucher. Halácsy (1900) realized that Boissier's A. alpestre var. suffrutescens in the sense of the Greek collections (Heldreich) could not refer to A. alpestre sensu stricto, and raised var. suffrutescens to specific rank. This combination, however, cannot be used validly in Alyssum because of an earlier homonym A. suffrutescens Boiss. (1867), which is a synonym of A. erosulum. Halácsy considered that a Baldacci gathering from the Epirus district in Western Greece deviated from the normal expression of his A. suffrutescens, and described it as var. epirotum. The basis of this variety was taken up by Baumgartner (1907), who for some inexplicable reason considered this taxon as proles epiroticum of A. montanum in Sect. Alyssum. Nyárády (1949) raised var. epirotum to specific rank.

After examining the original types of A. sibiricum in the Willdenow Herbarium in Berlin, Nyárády (1932) discussed at great length the fact that Willdenow's A. sibiricum was synonymous with A. lepidulum. He pointed out that Willdenow's notation of an area of collection in Siberia is erroneous, and that the original specimens of A. sibiricum were probably collected from somewhere in Caucasia (or the Crimea or Ukraine). That the geographic citation accompanying the description of A. sibiricum is erroneous does not affect the nomenclatural fact that the epithet sibiricum pre-dates Nyárády's lepidulum by 129 years!

All /

All of the specimens cited as _A. microcarpum sensu_ Hausskn. & Bornm. are referred to _A. sibiricum_, except _Bornmüller_ 4111 which is one of the rare Anatolian records of _A. borzaeanum_. The type material of the Ukrainian _A. tenderense_ has not been seen, but its description and excellent illustrations leave no doubt that it is to be treated as a synonym of _A. sibiricum_.

Careful study of large populations of _A. sibiricum_ in Anatolia has revealed its great morphological variability. Individual plants in these large populations can be identified as _A. lepidulum_, _A. minutiflorum_, _A. halacsyi_ and _A. epirotum_, depending upon the stage of development attained, i.e. prior to flowering, flowering, fruiting, after seed dispersal or in the completely sterile and rosulate condition. Nyárády himself doubted the validity of the distinguishing characters of _A. halacsyi_ when he (1949) transferred the _Bornmüller_ exsiccata (No. 9089), which he treated as a syntype of _A. halacsyi_ (1929), to _A. lepidulum_ subsp. _genuinum_ f. _pauloasperum_. The major character which Nyárády uses to separate _A. halacsyi_ from the closely allied taxa (see Nyárády's keys, 1929 and 1949) is the heterophyllous condition of its fertile stems. None of the original or duplicate specimens of _A. halacsyi_ possess a zone of basally aggregated cauline leaves as Nyárády claims; however, the cauline leaves of _A. sibiricum sensu lato_ gradually increase in size upwards.

103. _A. caliacrae_ Nyár. in Bul. Grăd. Bot. Cluj, _6_, 92 (1926); Nyár. in Bul. Grăd. Bot. Cluj, _9_, 20 pl. 23, t. 4, f. 90-92, 95, 96, t. 6, f. 25-28, 34-36, t. 7, f. 31-33, 41-46, t. 9, f. 40-43, 47-49 including all subsp., var. & formes (1929); Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, _1_, 57 & 58 (1949); Fl. Rep. Pop. Rom. _3_, pl. 60, f. 4 as _A. tortuosum_ subsp. _eximium_ (1955).

Syn.: _A. caliacrae_ var. _typicum_ Nyár. in Bul. Grăd. Bot. Cluj, _6_, 92 (1926)!

A. caliacrae var. _humerosum_ Nyár., _op. cit._, 93!

A. caliacrae var. _subincisum_ Nyár., _loc. cit._!

A. caliacrae var. _subincisum_ f. _apricum_ Nyár., _loc. cit._!

A. eximium Nyár., _op. cit._, 90!

A. tortuosum Willd. subsp. _eximium_ (Nyár.) Nyár. in Bul. Grăd. Bot. Cluj, _7_, 134 (1927)!

A. caliacrae subsp. _racemosum_ Nyár. f. _sinuosum_ Nyár. in Bul. Grăd. Bot. Cluj, _9_, 23 (1929).

A. caliacrae var. _typicum_ f. _extensum_ Nyár., _op. cit._, 22.

A. caliacrae subsp. _prodani_ f. _latirosulatum_ Nyár., _loc. cit._!

A. obtusifolium Stev. ex DC. subsp. _cordatocarpum_ Nyár., _op. cit._, 17, t. 6, f. 49, t. 7, f. 64, t. 9, f. 66!

A. alpestre L. subsp. _caliacrae_ (Nyár.) Stoj. & Steff., Fl. Bul., 530 (1948).

A. alpestre subsp. _calicrae_ var. _typicum_ (Nyár.) Stoj. & Steff., _loc. cit._!

_A_ /

A. alpestre subsp. _caliacrae_ var. _prodani_ (Nyár.) Stoj. & Steff., _op. cit._, 531!

A. alpestre subsp. _obtusifolium_ (Stev. ex DC.) Nym. var. _cordatocarpum_ (Nyár.) Stoj. & Steff., _op. cit._, 530!

A. caliacrae var. _subincisum_ f. _extensum_ (Nyár.) Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, _1_, 58 (1949).

A. caliacrae subsp. _prodani_ var. _sinuosum_ (Nyár.) Nyár., _op. cit._, 57.

Lectotype: (Romania): Dobrogea, dist. Caliacra, in abruptis calcareous supra Pontum Euxinum (Marea Neagră) ad "Cupul Caliacra" versus vallem Bolata et etiam versus pagum Giaursuiuciuc; alt. 50-80 m., 28 Jun. 1922, _Nyárády_ 648 (orig. CL n.v. iso. W, G, K, BM, OXF, E).

Distribution and habitat: Coastal areas and calcareous substrates along the Black Sea in Bulgaria, Romania and rarely in the Crimea; alt. 50-80 m. Fl. Jun.-Jul.

It is clear from a detailed examination of the type material and additional gatherings of _A. caliacrae_ that the many infra-specific taxa of this species created by Nyárády are not worthy of taxonomic recognition. The differentiating characters which are said to distinguish these taxa are infinitesimal and are expressions of the normal range of variation. The type materials of _A. eximium_ and _A. obtusifolium_ subsp. _cordatocarpum_ were all collected from near the classical /

classical locality for _A. caliacrae_ and have no discontinuities which would permit taxonomic separation. The type material of _A. caliacrae_ subsp. _racemosum_ (later treated as a full species by Nyárády:1949) has been examined (W) and must be treated as a synonym of _A. tortuosum_.

104. A. euboeum Hal., Consp. Fl. Gr., 1, 93 (1900); Nyár. in Bul. Grăd. Bot. Cluj, 9, 49, t. 5, f. 112, t. 8, f. 76, t. 10, f. 73 (1929); Rech. fil., Fl. Aegaea, 226 (1943); Nyár. in Anal. Acad. Rep. Pop. Rom., Secț. Științe Geol. Geog. Biol., ser. A, mem. 3, 1, 44, t. 5, f. 29, 30 (1949).

Type: (Greece): In Euboea septentrionale pr. Mantudi, Oct. 1848, Sartori (holo. W-Hal.).

Distribution and habitat: Rare endemic of Euboea, mainly on serpentine; alt. 550-1000 m. Fl. May-Jun.

105. A. condensatum Boiss. & Hausskn. in Boiss., Fl. Or. 1, 268 (1867).

Key to subspecies

Sepals ± persistent in fruit; indumentum on silicules whitish, dense, durable; styles ± pubescent; petals ± glabrous, (0.8-) 1-1.5 mm. wide; silicules obtuse, truncate, or emarginate. condensatum

Sepals early deciduous; indumentum on silicules greenish, sparse, easily displaced; styles ± glabrous; petals always pubescent, 1.5 (-2) mm. wide; silicules obtuse or attenuate. flexibile

subsp. condensatum. Bornm., Symb. ad Fl. Anat., 50 as A. pannulosum (1936); Burtt in Kew Bull., 99 (1949); Rech. fil. in Ark. För. Bot., 5, (1), 171 (1959).

Syn.: A. alpestre L. var. suffrutescens Boiss., loc. cit.- pro parte quoad plantam Pisidiam a Heldreich lectam!

Odontarrhena lycia Jord. & Fourr., Brev. Pl. Nov., fasc. 2, 3 (1868)!

A. pannulosum Hausskn. & Bornm. in Mitt. Thür. Bot. Ver., n.f., 20, 2 (1905)!

A. venustum Nyár. in Bul. Grăd. Cluj, 9, 36, t. 5, f. 114, t. 6, f. 43, t. 7, f. 54, t. 9, f. 59, pl. 27 (1929)!

A. venustum var. rosulatum Nyár., op. cit., 37, t. 6, f. 44, t. 7, f. 53, t. 9, f. 61 - pro parte excl. plantam Siehe lectam!

A. venustum var. nebrodensiforme Nyár., op. cit., 39- pro parte quoad plantam Bourgeau lectam!

A. venustum var. laxiusculum Nyár., op. cit., 40!

A. /

A. venustum var. multicarpum Nyár., loc. cit., t. 5, f. 115, t. 7, f. 55, t. 9, f. 60, pl. 28!

A. bornmuelleri Hausskn. ex Degen X A. obtusifolium var. alpinum Nyár. in Bul. Grăd. Bot. Cluj, 18, fig. 3, n. 9, 10, t.f, f. 10 (1938)!

A. venustum var. typicum Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 60 (1949)!

A. venustum var. rosulatum f. acutum Nyár., op. cit., 61!

A. venustum var. longielliptícum Nyár., loc. cit., t. 5, f. 46!

A. venustum var. lonielliptícum f. subbiacutum Nyár., loc. cit., t. 5, f. 45!

A. venustum var. spathulatum Nyár., op. cit., 62!

A. venustum var. nummularium Nyár., loc. cit.!

A. condensatum var. parvifolium Nyár., op. cit., 73, t. 2, f. 3!

Lectotype: (Turkey, C6: Prov. Gaziantep): monte Karabiyuckle (Karabiyikli) inter Aintab (Gaziantep) et Marach (Maraş), 11 Jul. 1865, Haussknecht (orig. G-B, holo. A. venustum var. longielliptícum JE, iso. W).

Distribution: A widespread Central Anatolian species extending into Syria, Lebanon and N. Iraq. Map 26.

TURKEY. A3: Prov. Ankara, 10 km. W. of Beypazari, 2 km. W. of Zavije, 880 m., 26 May 1957, Kühne 173; A5: Prov. Amasya, Amasya, 400-800 m., 2 Jul. 1889, Bornmüller 1335 (orig. synt. A. venustum var. rosulatum CL n.v., iso. WU, W, K, BM); ibid., 500 m., 17 Jun. 1889, Bornmüller 1334 (orig. synt. A. venustum var. rosulatum BRNU, n.v.,; orig. synt. A. /

A. venustum var. typicum BUC n.v., iso. W); ibid., Abadschi dagh (nr. Amasya) 1400-1500 m., 11-12 May 1890, Bornmüller 2884 (orig. synt. A. pannulosum JE n.v., iso. W, G-BB, K); ibid., Amasya, 400-600 m., 26 May 1889, Bornmüller 1336 (holo. A. venustum var. nummularium JE n.v., iso. W, G-BB). B1: Prov. Balikesir, Mt. Ida (Kaz dağ) Szu-Sszu dagh, 27 Jun. 1883, Sintenis 430 (holo. A. venustum var. rosulatum f. acutum WU, iso. K, BM). B3: Prov. Konya, Akscheker (Akşehir), 100 m., 3 Jul. 1899, Bornmüller 4105. B5: Prov. Kayseri, Everek (Develi), 1400 m., Jun. 1902, Zedebour. B6: Prov. Adana, dist. Feke, Bezoglan dağ above Obruk yayla, above Saimbeyli, 1900 m., 7 Jul. 1952, Davis 19698; Prov. Maraş, distr. Göksun, Binboga dağ, on Isik dağ above Karli yayla, 2700 m., 5 Jul. 1952, Davis 19986; Prov. Sivas, Tschamlü-Bel (Çamlibel dağ), Tokat-Sivas, 1700 m., 31 May, 7 Jun. 1890, Bornmüller 1699 (orig. synt. A. pannulosum JE n.v., iso. W); Prov. Malatya, Darende- Kavak Aghatch, 14 Jul. 1906, Post 292 pro parte. B7: Prov. Erzincan, Egin (Kemaliye), 13 May, 15 Jun. 1890, Sintenis 2280 (orig. synt. A. venustum & var. typicum BUC n.v., iso. WU, W, G, K). B9: Prov. Van, Tschatak (Çatak), 10 Jun. 1893, Manissadjian 794 (orig. synt. A. venustum var. multicarpum BRNU n.v., iso. W). C2: Prov. Denizli, Honaz dağ above Denizli, 1700 m., 3 Jun. 1938, Huber-Morath 5576; Prov. Muğla, Girdev dağ, S. side, 2200 m., 5 Aug. 1947, Davis 13853; Prov. Antalya, Mt. Elmali, 10 May, 25 Jun. 1860, Bourgeau 28 (holo. Odontarrehena lycia P. n.v., orig. synt. A. venustum var. nebrodensiforme W, iso. G, K, E). C3: Prov. Isparta, dist. Sutçüler, Dedegol dağ, 3 Aug. 1949, Davis; Prov. Burdur, /

Burdur, 4 km. S. of Burdur - Antalya, 1950 m., 10 Jun. 1938, Huber-Morath 5581 (holo. A. venustum var. spathulatum Hub.-Mor.); ibid., Bouldour (Burdur), 22 May 1845, Jun. 1846, Heldreich (orig. synt. A. alpestre var. suffrutescens G-B, iso. G, W, K); Prov. Antalya, dist. Kemer, Tahatali dağ, 2300 m., 10 Jul. 1949, Davis 15054; ibid., Korkuteli-Kizilçadag, 10 miles enak-Fariske, 5 km. from Ermenek, 1220 m., 12 Jun. 1950, Huber-Morath 11757; Prov. Içel, Mut-Kirobasi, 18 km. E. of Mut, 1270 m., 14 Jun. 1950, Huber-Morath 11758. C5: Prov. Içel, Gülekoghas (Külek boğ), 10 Jun. 1855, Balansa 426 (168) (holo. A. venustum var. laxiusculum W, iso. G, G-B, K, BM); ibid., Bulgar dağ, Ketschebele (nr. Külek), 2734 m., 4 Jul. 1853, Kotschy 55a (orig. synt. A. venustum var. multicarpum W, iso. G-B); ibid., Gülek (Külek), 1853, Kotschy (67E) (orig. synt. A. venustum var. multicarpum W, iso. G-B). C6: Prov. Adana, dist. Osmaniye, Yaglypinar Dazi. S. of Yarpuz, 1750-1900 m., 1 Jul. 1959, Huber-Morath 16233 pro parte; Prov. Maraş Akher dagh (Ahir dağ) 1829 m., Jul. 1907, Haradjian 1592; ibid., Maraş - Zeytun, Jehan Kenpri, 762 m., 5 Sept. 1934, Balls; Prov. Hatay, Mt. Amanus, Düldül, 1524-2051 m., Jul. 1908, Haradjian 2327; Prov. Urfa, Birecik, 1676 m., 6 Sept. 1934, Balls 1003A. C7: Prov. Adiyaman, Malatya-Kjachta (Kâhta) nr. Karatschor, 1400-1500 m., 16 Jul. 1910, Handel-Mazzetti 2253.

Habitat: Disturbed and ruderal areas, neglected fields, weathered limestone cliffs and scree, calcareous and Astragalus steppe, chalk and gypsum hills, clay slopes, acid sandstone; often in Quercus scrub; alt. (400-) 1000-2700 (-3000) m. Fl. May-Jul.

Rechinger (1959) recognized that this is a very polymorphic species, especially with respect to its habit and stature, fruit and leaf shape, and overall indumentum density. Formal recognition of the variability of individual characters on individual specimens (and their duplicates) accounts for the many infra-specific names of A. venustum.

Odontarrhena lycia Jord. & Forr., as suggested by Burtt (1949) is conspecific with A. condensatum. Nyárády (1929) considered a duplicate (BP) of the type collection of Odont. lycia (Bourgeau 28) as a component of his A. venustum var. nebrodensiforme, but in 1949 he treated the holotype (P) of Jordan and Foureau's taxon as representing A. venustum var. typicum, and additional duplicates (P and G) as A. venustum var. multicarpum. The Callier 20 gathering which Nyárády cites (1929) as A. venustum var. nebrodensiforme is cited by him (1949) as A. grintescui, a synonym of A. tortuosum. The Siberian gathering of A. venustum var. laxiusculum has not been seen, but it is very doubtful that it can be referred to A. condensatum. A most probable assignment of this specimen would be to A. tortuosum. All of the specimens cited as A. venustum var. rosulatum are conspecific with A. condensatum subsp. condensatum, except the Sieho 434 gathering (BP), a duplicate of which (UW) Nyárády cites as a syntype of A. filiforme. This number, in fact, does refer to the latter species.

Though Nyárády did not recognize A. condensatum in his work prior to 1949, he then constructed four varieties pertaining to that species. His A. condensatum var. typicum is based on a Haussknecht gathering from Berit dağ in the Anti-Taurus - cited by Boissier as A. condensatum - but this collection cannot be referred to the typical subspecies, and is identified /

identified as subsp. flexibile. The only Nyárády variety of A. condensatum (1949) which refers to subsp. condensatum is var. parvifolium. This variety has a similar reduced growth form to many Anatolian gatherings of A. condensatum which often have been designated as A. pannulosum. A. pannulosum was described by its authors as being in close relationship to A. condensatum, but Nyárády (1938) considered it to be the result of inter-sectional hybridization, between A. bornmuelleri (Sect. Alyssum) and A. gehamense (Sect. Odontarrhena : Nyárády's A. obtusifolium subsp. typicum var. alpinum). Depauperate specimens of A. condensatum occur throughout the whole specific range, especially in sterile and high altitude habitats, and their specific separation as A. pannulosum is unwarranted.

Burtt's selection (1949) of Aucher 266 as the lectotype of A. condensatum was an unsuitable choice and cannot be maintained; it refers to A. filiforme. This gathering does not fit the original description of A. condensatum, nor does it morphologically correspond with any of the specimens of A. condensatum (both subspecies) in the Boissier Herbarium in Geneva. From among these specimens, the Haussknecht collection from Mt. Karabiyuckle between Gaziantep and Maraş is adopted as the lectotype of the typical subspecies of A. condensatum. This gathering was designated by Nyárády (1949) as A. venustum var. longiellipticum.

subsp. flexibile (Nyár.) Dudley, stat. nov.

Syn.: A. alpestre L. var. minutulum Fenzl in Tchih., Asie Min., Bot. 1 (3), 303 (1860) - pro parte quoad plantam a Kotschy lectam!

A. alpestre var. genuinum Boiss., Fl. Or., 1, 268 (1867)!

A. alpestre var. suffrutescens Boiss., loc. cit. pro parte plantam Syriam a Kotschy lectam!

A. flexibile Nyár. in Bul. Grăd. Bot. Cluj, 7, 157, pl. 18, t. 5, f. 122, t. 6, f. 21, t. 7, f. 21, t. 9, f. 33 (1927)!

A. surculosum Schott & Ky. ex Nyár., op. cit., 150, t. 7, f. 14, t. 9, f. 26- pro parte quoad plantam Anatolicam a Kotschy lectam!

A. venustum Nyár. var. rosulatum Nyár. f. simplex Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 61 (1949)- pro parte quoad plantam a Siehe lectam!

A. condensatum Boiss. & Hausskn. var. typicum Nyár., op. cit., 72, t. 2, f. 3!

A. condensatum var. heterophyllum Nyár., op. cit., 73.

A. condensatum var. flexibile (Nyár.) Nyár., loc. cit.

Type: (Syria): circa Zebdaine pr. Damascum, frequens inter saxa jugi, inter Bludam et Halbun, 1896 m., 17 Jun. 1855, Kotschy 147 (holo. CL. n.v., orig. synt. A. alpestre var. suffrutescens G-B, iso. W, K, BM).

Distribution: In Anatolia from the Cilician Taurus, Anti-Taurus and /

and rarely in Turkish Kurdistan. Also from Syria and Lebanon. Map 26.

TURKEY. B6: Prov. Maraş, dist. Çardak, Berit dağ, 2800 m., 26 Jul. 1952, Davis 20347; ibid., 2338-2743 m., Aug. 1865, Haussknecht (orig. synt. A. condensatum G-B, holo. A. condensatum var. typicum JE, iso. W). B7: Prov. Tunceli, Munzur dağ above Ovacik, 2700 m., 17 Jul. 1957, Davis 31250. B9: Prov. Van, dist. Şatak, Kavussahap dağ, 3300 m., 23 Jul. 1954, Davis 23119. C3: Prov. Antalya, Akseki-Beyşehir, 10 miles from Akseki, 1400-1500 m., 14 Jun. 1962, Dudley (D. 35823). C5: Prov. Içel, Mersin, 1913, Siehe 2040; ibid., Bulgar dagh, Gusguta valley (nr. Külek boğ), 2508 m., (2338 m.), 26 Jun. 1853, Kotschy 10 (orig. synt. A. surculosum & A. alpestre var. minutulum W, iso. G, G-B, K); Prov. Adana, Farasch-Bereketli (nr. Pozanti), 3000 m., Jul. 1909, Siehe 309 (orig. synt. A. venustum var. rosulatum f. simplex JE, iso. BM, E). C6: Prov. Adana, dist. Osmaniye, Yagerpinar Dazi, S. of Yarpuz, 1750 m-1900 m., 1 Jul. 1959, Huber-Morath 16233 pro parte. C9: Prov. Hakâri, Kara dağ, 3500 m., 16 Aug. 1954, Davis 24499.

The following specimens are intermediate between subsp. condensatum and subsp. flexibile: B5: Prov. Kayseri, Bakir dağ, nr. Akoluk yayla above Kisge, 1900 m., 30 Jun. 1952, Davis 19370. B6: Prov. Maraş, Nurihak dağ, 2800 m., 17 Jun. 1960, Stainton et. al. 5658.

Habitat: A montane and alpine taxon on limestone scree and slopes; often in Pinus nigra woods and Abies and Cedrus forests; alt. (1400-) 200-3000 (3500) m. Fl. Jun.-Jul.

The Kotschy excicoata (No. 10) which Nyárády considered as a syntype of A. surculosum had been previously recognized by Fenzl in Tchihatcheff (1860) as a part of his polymorphic A. alpestre L. var. minutulum, and by Boissier as a component of his A. alpestre var. genuinum. The other syntype of A. surculosum (Schtschukin from Siberia, in W) and which Nyárády (1949) names as A. surculosum f. subterranum is correctly identified as A. obovatum (Meyer) Turcz. Kotschy 147, the holotype of subsp. flexibile (given full specific rank in 1927 and varietal status under A. condensatum in 1949) was referred by Boissier to his polymorphic "dustbin" group, A. alpestre var. suffrutescens. Nyárády's A. condensatum var. typicum, var. hetetophyllum and recombined var. flexibile all refer to subsp. flexibile. The Siehe gathering cited as A. venustum var. typicum f. simplex is correctly identified as A. condensatum subsp. flexibile. The other specimen cited for f. simplex, a duplicate (P) of Callier 20 from the Crimea is equated by Nyárády to A. grintescui, a synonym of A. tortuosum.

Subspecies flexibile is quite distinct in its typical expression from the typical subspecies, with which it is partially sympatric; but intermediates occur in the area of overlap.

106. A. filiforme Nyár. in Bul. Grǎd. Bot. Cluj, 9, 35, t. 5, f. 79, t. 6, f. 40, t. 7, f. 49, t. 10, f. 53 (1929); Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 71 (1949). Fig. 1B, p; fig. 2, j.

Syn.: A. anatolicum Huter in Öst. Bot. Zeit., 54, 360 (1904), nomen nudum - non Hausskn. ex Nyár.

A. filifolium Nyár. in Bul. Grǎd. Bot. Cluj, 9, 35 (1929), pro syn!

A. filifolium f. perlongum Nyár., op. cit., 36, t. 5, f. 116!

A. venustum Nyar. var. rosulatum, op. cit., 35 - pro parte quoad plantam a Siehe lectam!

A. filiforme var. typicum Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 71 (1949)!

? A. haussknechtii Boiss. f. gracile Nyár. op. cit., 40 (1949).

? A. haussknechtii f. macrocarpum Nyár., op. cit., 40.

Syntypes: (Turkey, B7: Prov. Elâziğ): Armenia Turcica, Kharput (Harput), Schuschnas (Şuşnaz- 11 km. NNE. of Elâziğ), 6 May, 8 Jun. 1889, Sintenis 309 (orig. BUC, n.v.; orig. synt. A. filiforme var. typicum BUC n.v., iso. W, G, G-BB, K, BM, E). (Turkey, C5: Prov. Içel). Gülek tepe (nr. Külek), 1300 m., 1895, Siehe 434 (orig. WU; orig. synt. A. filiforme var. typicum & orig. synt. A. venustum var. rosulatum BPU n.v., iso. G. W, K, BM, E).

Distribution: Widespread in Central, S. and S.E. Anatolia. Map 27.

TURKEY. B4: Prov. Ankara, Ankara, Barbey. B6: Prov. Malatya, Darende-Kavak Aghatch, 14 Jul. 1906, Post 292 pro parte. B6/7: Prov. Malatya, below Erhenek, Doğanşehir-Pazarcik, 900 m., 10 May 1957, Davis 27720.

B7 /

B7: Prov. Erzincan, Keşiş dağ, above Cimin, 1700 m., 26 Jul. 1957, Davis 31725; Prov. Tunceli, above Selepur, 1500 m., 23 Jul. 1957, Davis 31609; Prov. Elâziğ, Maden-Hazar gölü 1524 m., 22 Jun. 1954, Davis 22065; ibid., Keban Maaden (Keban), 29 Apr. 1889, Sintenis 177 (orig. synt. of A. filiforme var. typicum JE n.v., iso. E). B7/C8: Prov. Mardin, Diyarbakir, Maden-Ergani, 1000 m., 2 Jun. 1957, Davis 29072. B8: Prov. Muş, Musch (Muş), 1311 m., 9 Sept. 1859, Kotschy 750 (orig. synt. A. eriophyllum G-B, iso. W, G). B9: Prov. Van, Van., 1433 m., 15 Apr. 1898, Maunsell 20. C5: Prov. Konya, Seydifakili, nr. Ereğli, 1524 m., 30 May 1958, Brown 374; Prov. Içel/ Adana, Karli Boghas (nr. Pozanti), 1896, Siehe 294. C6: Prov. Gaziantep, Ak-dagh (nr. Gaziantep), Aucher 266 (Lectotype A. condensatum fide Burtt: 1949 - non Dudley p.580, No. 105).

Habitat: Limestone steppe, S. facing eroded shale and igneous slopes, stream banks and neglected fields; alt. 900-2000 m. Fl. May-Jul.

A. filiforme belongs to the complex in Subsect. Odontarrhena including A. anatolicum, A. singarense and A. haussknechtii, whose oblong and narrowly elliptic or conical fruits are symmetrically inflated. A basal cross-section of these fruits appears quadrangular or, in the case of A. haussknechtii, orbicular.

A specimen of Siehe 434 in the Herbarium of the University of Vienna is cited by Nyárády as a syntype of A. filiforme; however, a duplicate of this gathering in the Museum of Natural History in Budapest is considered by him to refer to A. venustum var. rosulatum (a synonym of A. condensatum, subsp. condensatum). All duplicates of this collection which/

which the present author has examined clearly represent A. filiforme. Because of Nyárády's mis-application of two specific epithets to the Siehe gathering, the Sintenis 309 from Harput is chosen as the lectotype of A. filiforme; furthermore, this number has mature fruits as well as flowers.

On the basis of its fruit and leaf shape and indumentum, and its floral structure, the Kotschy 750 syntype of A. eriophyllum is correctly referred to A. filiforme. The same morphological continuities are shared by the syntype of A. condensatum (Aucher 266). This specimen, contrary to the conclusion of Burtt (1949), does not fit the original circumscription of A. condensatum, and it does not have the characters which are diagnostic for the specimens of A. condensatum in the Boissier Herbarium in Geneva. A. filiforme var. glaucum, based on the collections of Huber-Morath from S.W. Anatolia, has little affinity with A. filiforme in the narrow sense, and is easily equated with A. cypricum.

107. A. singarense Boiss. & Hausskn. in Buser, Suppl. Fl. Or., 49 (1888); Nyár. in Anal. Acad. Rep. Pop. Rom. Sect. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 97, t.3, f.2, t.6, f.18 (1949); Blakelock in Kew Bull., 521 (1955).

Syn.: A. oxycarpum Boiss. & Bal. var. kurdicum Boiss., Fl. Or., 1, 269 (1867)!

A. anamense Velen. in Sitzb. Böhm. Gessel. Wissen., 11, 12 (1911) & in Fedde Rep. Sp. Nov. 13, 25 (1915)!

A. kurdicum (Boiss.) Nyár., op. cit.,

Type: (Iraq); in cretaceis montis Sindjar inter Zamuche et Zakinia, May 1867, Haussknecht (holo. G-B, iso. JE, W, G-BB, K, BM).

Distribution and habitat: Open hillside and limestone steppe in N. and Central Iraq. alt. c. 1372 m. Fl. May-Jun. A. anamense was described from "Arabia, dist. Anama" which is most probably equivalent to Amarah in Iraq, S. of Baghdad.

The basionym of Nyarády's A. kurdicum is Boissier's A. oxycarpum var. kurdicum. The type of this taxon, Kotschy 337, has been compared with the type and many subsequent gatherings of A. singarense with the resulting conclusion that the characters defining A. kurdicum fall well within the range of variation for A. singarense. Likewise, A. anamense must be treated as being synonymous (cf. Rechinger in Bot. Not., 115, 35: 1962).

The height of the stems of A. singarense is very variable, and appears to depend upon the altitude at which the plants are growing. Because of this variation, which is apparently not correlated with any other/

other characters, _A. singarense_ is placed twice in the Key to the subsect. _Odontarrhena_. Dwarfed plants with many fertile stems (such as _Kotschy_ 337) will come out in the key under 16b, while the taller forms with fewer fertile stems will conveniently key out under 16a.

The _Field and Lazar_ gathering from Iraq which Nyárády (1949) refers to _A. anatolicum_ is correctly identified as _A. singarense_.

108. A. anatolicum Hausskn. ex Nyár in Bul. Grád. Bot. Cluj. 9, 40, t.5, f.111, t.6, f.46, t.7, f.56, t.9, f.62, 63, pl.29 (1929).

Syn.: A. anatolicum var. tenuifolium Nyár., loc. cit. - Nomen nudum!
A. anatolicum f. reductum Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 43 (1949)!

Syntypes: (Turkey, B7; Prov. Ersincan): Egin, (Kemaliye). Altikise (nr. Kemaliye), 29 Jun. 1890, Sintenis 2771 orig. BPU n.v., iso. W, G, G-BB, K, E); ibid., Szanduk-Baschi (Sanduk - 4 km. NN.W. of Kemaliye), 6 Jun. 1890, Sintenis 2512 (orig. BUC n.v., iso. G, W, K); ibid., Salachlü (Salihi, 10 km. N. of Kemaliye), in collibus nudis, 25 June. 1890, Sintenis 2765 (orig. BUC n.v., holo. f. reductum JE n.v., iso. G).

Distribution: Central and E. Anatolia and the Anti-Taurus. Map 27.

TURKEY. B6: Prov. Adana, Hadjin (Saimbeyli) - Karaklissa, 9 Jul. 1906, Post 281; Prov. Malatya, Darende-Kavak Aghatch, 14 Jul. 1906, Post 292 pro parte. Asia Minor, 1858, Tchihatcheff.

Habitat: Calcareous steppe. Fl. Jun.-Jul.

This species is similar in some morphological expressions as A. singarense, a native of Iraq; this similarity accounts for Nyárády's misidentifying at least one collection (Field and Lazar) from Iraq as A. anatolicum. Whereas the fertile stems of A. singarense are often erect and tall, up to 60 cm., the sprawling fertile stems of A. anatolicum are rarely more than 25 cm. The dense, whitish indumentum on the smaller fruits of A. anatolicum is composed of appressed lepidote or sublepidote hairs which measure 0.2-0.3 mm. diam. The stellate hairs on the larger fruits/

fruits of <u>A. singarense</u> are not lepidote, but are provided with branched and spreading or suberect rays, and measure 0.4-0.5 (-0.6) mm. diam. The sterile shoots of <u>A. anatolicum</u> are always basally conferted, unbranched and less than 3 cm. long. Those of <u>A. singarense</u> are erect, often branched and up to 10 cm. long. In addition, the glabrous styles of <u>A. anatolicum</u> are about half as long as the pubescent styles of <u>A. singarense</u>.

The <u>Sintenis</u> gathering (No.309) from Harput which Huter (1904) cites as <u>A. anatolicum nomen nudum</u> and which Nyárády (1929:42) claims not to have seen, is in fact referred by Nyárády (1929:36) to <u>A. filiforme</u>. This gathering is one of the two syntypes of <u>A. filiforme</u> cited by Nyárády, and is chosen by the present author as the lectotype of that species. <u>A. anatolicum</u> can be distinguished from <u>A. filiforme</u>, its closest Anatolian ally, by the densely conferted basal cauline leaves, greenish and sparsely pubescent fruits with coarse, few-rayed stellate hairs measuring up to 0.8 mm. diam., and the smaller and gradually attenuate petals (Fig. 1B, a) of the latter species. The cauline leaves of <u>A. anatolicum</u> are evenly distributed, its whitish-gray fruits are densely pubescent with delicate lepidote or sublepidote hairs measuring 0.2-0.3 mm. diam., and its larger petals are abruptly constricted (as in Fig. 1B, b and c).

A duplicate of the <u>Sintenis</u> 2765 syntype of <u>A. anatolicum</u> in the Haussknecht Herbarium in Jena was designated by Nyárády (1949) as f. <u>reductum</u>; however, infra-specific ranks such as this cannot be maintained when the variation pattern is examined for the whole specific range.

109. A. hausknechtii Boiss., Fl. Or., 1, 269 (1867); Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 40, t.4, f.8, t.5, f.23-28 (1949) Fig. 2, k.

Syn.: A. haussknechtii f. pusillium Nyár. loc. cit.!

A. hausskneсktii f. normale Nyár., loc. cit.!

Type: (Turkey, C6: Prov. Maraş): in rupestribus alpinis montis Berytdagh (Berit dağ) Cataoniae, 2844-3160 m., 10 Aug. 1865, Haussknecht (holo. G-B, iso. W, G, BM.)

Distribution: Endemic to the Anti-Taurus. Map 27.

TURKEY. B6: Prov. Malatya, Darende - Kavak Aghatch, 14 Jul. 1906, Post 292 pro parte; Prov. Maraş, dist Çardak, Berit dağ, 2800 m., 26 Jul. 1952, Davis 20351; ibid.2896 m., 14 May 1934, Balls 1086.

Habitat: Alpine on limestone rocky slopes; alt. 2800-3160 m. Fl. May-Jun.

This rare alpine species from the Anti-Taurus can be easily distinguished from all other Anatolian Alyssa by its conical, acute and shortly stipitate fruits, with basally inflated and saccate valves. The basal cross-sections of such fruits are orbicular, a feature shared only by the globose and turgid fruits of A. fedtschenkoanum Busch from Siberia.

Nyárády (1949) gives no information regarding the bases of his forms of A. haussknechtii, i.e. pusillum, normale, gracile and macrocarpum, but as he cites only the holotype of A. haussknechtii, it is possible that all of his forms represent minor phenotypic variations in the same gathering, analogous to his forms punctatum and hirtum of A. eriophyllum. However, the holotype of A. haussknechtii, its duplicates and additional material, /

material, which the present author has seen, rarely have stems up to 8 cm. long (f. gracile) or have manifestly corymbose inflorescences (f. macrocarpum). These forms may be based on different material and might be correctly referred to A. filiforme or A. anatolicum.

(5) SECT. ODONTARRHENA

(ii) Subsect. Compressa

(a) Series Compressa

110. A. murale Waldst. & Kit., Pl. Rar. Hung., 1, 5, t. 6 (1799).

Key to infra-specific taxa

1. Fertile stems stout, (1-) 4-10 (-15) in number, arcuate ascending to erect, rarely lax and sprawling, (10-) 30-50 (-60) cm. long; stellate hairs on silicules 0.2-0.5 (-1) mm. diam., ± dense; short filament appendages free; seed wings 0.2-1 mm. wide

subsp. murale (E,T,O)

2. Stellate hairs on silicules appressed, never strigose, 0.2-0.5 mm. diam., with slender, equal and prominently branched rays (often appearing many-rayed); stellate hairs on vegetative parts similar, but slightly larger.

3. Fertile stems arcuate ascending to erect, (15-) 30-50 (-60) cm. long; fruiting corymbs compound, (5-) 8-15 (-20) cm. long, or if simple then leaves of sterile shoots concolorous; upper cauline leaves not bracteate, or if so then less than 10 x 2.5 mm.; seed wings 0.4-1 mm. wide.

4. Indumentum on leaves of sterile shoots bicolored; leaves of sterile shoots ± laxly distributed, flattened, mid-vein not depressed, (2-) 5-10 x 1-3 mm., rarely longer

var. murale (E,T,O)

4. Indumentum on leaves of sterile shoots concolorous; leaves of sterile shoots ± densely congested, especially at apex, frequently subplicate with mid-vein deeply depressed on upper /

upper surface, 10-15 x 3-5 mm. var. haradjianii (T,O)

3. Fertile stems dwarfed, lax, sprawling, never more than 20 cm. long; fruiting corymbs simple, (2-) 5-8 cm. long; upper cauline leaves laxly bracteate, 10-20 x 3-4 (-5) mm.; seed wings 0.2-0.3 mm. wide var. alpinum (T,O)

2. Stellate hairs on silicules appearing strigose 0.5-1 mm. diam. with coarse sparingly branched, suberect and spreading rays; stellate hairs on vegetative parts 1-1.5 mm. diam., with unequal rays var. pichleri (E)

1. Fertile stems slender, brittle, 20-30 in number, decumbent or deflexed, 5-15 cm. long; stellate hairs on silicules 0.2 mm. diam., sparse; short filament appendages connate for ½-¼ their length; seed wings c. 0.2 mm. diam. subsp. stoianoffii (E)

subsp. murale.

var. murale sensu lat. Reichenb., Ic. Fl. Germ. & Helv., 2, t. 20, f. 4277 as A. argenteum & f. 4278 (1837-1838); Boiss., Fl. Or., 1, 271 as A. argenteum (1867); Hal., Consp. Fl. Gr., 1, 91 (1900); Busch in Fl. Cauc. Crit., 3 (4), 568 (1909); Hayek, Prod. Fl. Pen. Balc., 1, 440 (1925); Nyár. in Mag. Bot. Lap., 24, t. 1, f. 26 (1925); Nyár. in Bul. Grád. Bot. Cluj. 7, 41, pl. 1, 2, t. 5, f. 9-22, 25, t. 5, f. 9-20, t. 6, f. 57-59, 63-66, t. 8, f. 77-81, 109, 118, t. 10, f.74-92 incl. subsp. var. & formes (1927); op. cit., 118, t. 3, f. 47-49, t. 5, f. 75, t. 8, f. 97, 125, t. 9, f. 122-124 as A. chalcidicum & vars.; op. cit., 120, t. 8, f. 115, 131-133, T. 1 as A. chlorocarpum & var.; Nyár. in Anal. Acad./

Acad. Rep. Pop. Rom. Sect. Ştiinţe Geol. Geog. Biol. ser. A, mem. 3, 1, 108 (1949); Grossh., Fl. Kavk., ed. 2, 4, 214, t. 24, f. 5 (1950); Fl. Rep. Pop. Rom., 3, 352, pl. 59, f. 1 (1955); Hegi, Ill. Fl. Mitt. Eur., ed. 2, 4 (1), 141, fig. 171, n. a-c (1960); Rech. fil. in Engl. Bot. Jahrb., 80, 330 (1961). Fig. 2, m.

Syn.: A. argenteum Wittm., Summ. Pl., 4, 430 (1790), non Allioni.

A. alpestre L. var. murale (Waldst. & Kit.) Willd., Sp. Pl., 3 (1), 462 (1800)!

A. alpestre var. elatius Koch in Flora, 24 (2), 462 (1841), nomen nudum.

Odontarrhena argentea (Wittm.) Ledeb., Fl. Ross., 1, 160 (1841).

A. argenteum Wittm. var. murale (Waldst. & Kit.) Griseb., Sp. Fl. Rum. & Bith., 1, 277 (1843)!

A. trochocarpum Fenzl in Tchih., Asie Min., Bot. 1 (3), 297 (1860)!

A. mesopotamicum Fenzl, op. cit., 311!

Odontarrhena muralis (Waldst. & Kit.) Schur, Enum Pl. Transs, 61 (1866)!

A. argenteum Wittm. var. chrysanthum Boiss., loc. cit. - pro parte excl. plantam a Balansa lectam!

Odontarrhena rubricaulis Jord. & Fourr., Brev. Pl. Nov., fasc. 2, 6 (1868)!

Odontarrhena tmolea Jord. & Fourr., op. cit., 7!

Odontarrhena clypeolata Jord. & Fourr., loc. cit.!

A. murale var. reichenbachianum Rupr. in Mém. Acad. Imp. Sc. St. Pétersb., ser. 7, 15 (2), 101 (1869).

A. /

A. murale var. biebersteinianum Rupr., loc. cit.

A. chalcidicum Janka in Öst. Bot. Zeit, 22, 175 (1872)!

A. chlorocarpum Hausskn. in Mitt. Thür. Bot. Ver. 3-4, 113 (1893)!

A. subvirescens Form. in Verh. Natur. Ver. Brünn, 37, 72 (1898).

A. gracile Form. op. cit., 73.

A. murale var. tenue Busch, op. cit., 571!

A. murale var. variabile Nyár. in Bul. Grád. Bot. Cluj, 6, 90 (1926)!

A. murale var. variabile f. biangulare Nyár., loc. cit.!

A. murale var. rotundum Nyár., loc. cit.!

A. murale var. rotundum f. typicum Nyár., loc. cit.!

A. murale var. rotundum f. lepidocarpum Nyár., loc. cit.!

A. orphanides Janka ex Nyár. in Bul. Grád. Bot. Cluj, 7, 85, t. 3, f. 40-44, t. 6, f. 60, t. 8, f. 82, 83, t. 10, f. 93, 94 (1927)!

A. chalcidicum f. rotundum Nyár., op. cit., 119!

A. chalcidicum f. ellipticum Nyár., loc. cit., - pro parte!

A. markgrafii Schulz var. lucidum Nyár., op. cit., 88, t. 10, f. 98, 99.

A. punctatum Nyár., op. cit., 85, t. 3, f. 32-39, t. 8, f. 128-130, t. 10, f. 95-97!

A. decipiens Nyár., op. cit., 73 & 113, t. 5, f. 1-8, t. 8, f. 93, 94, pl. 30, f. 1!

A. chlorocarpum subsp. gracile (Form.) Nyár., loc. cit., t. 8, f. 114, 126, 127.

A. chlorocarpum /

A. chlorocarpum var. subellipticum Nyár., op. cit., 121, pl. f. 5, pl. 5, f. 16, 17.

A. punctatum f. divergens Nyár., op. cit., 86!

A. murale subsp. caucasicum Nyár., op. cit., 73

A. murale subsp. caucasicum var. rotundum (Nyár.) Nyár., loc. cit.!

A. murale subsp. caucasicum var. rotundum f. typicum (Nyár.) Nyár. loc. cit.!

A. murale subsp. caucasicum var. rotundum f. lepidocarpum (Nyár.) Nyár., loc. cit.!

A. murale subsp. caucasicum var. rotundum f. lepidocarpum subf. densistellatum Nyár., op. cit., 74

A. murale subsp. caucasicum var. petaloides Nyár., loc. cit.!

A. murale subsp. caucasicum var. strictiramosum Nyár., loc. cit.!

A. murale subsp. caucasicum var. macrocarpum Nyár., loc. cit.!

A. murale subsp. caucasicum var. cordatum Nyár., loc. cit.!

A. murale subsp. caucasicum var. squamatistellatum Nyár., loc. cit.!

A. murale subsp. caucasicum var. squamatistellatum f. petans Nyár., loc. cit.!

A. murale subsp. caucasicum var. variabile (Nyár.) Nyár., op. cit., 76!

A. murale subsp. caucasicum var. variabile f. genuinum Nyár., loc. cit.!

A. murale subsp. caucasicum var. variabile f. griseum Nyár., loc. cit.!

A. murale subsp. caucasicum var. variabile f. reichenbachianum (Rupr.) Nyár., loc. cit.!

A. /

A. murale subsp. caucasicum var. variabile f. serpentinum Nyár., loc. cit.!

A. murale subsp. caucasicum var. variabile f. ellipticum Nyár., loc. cit.!

A. murale subsp. caucasicum var. variabile f. anomalum Nyar., loc. cit.!

A. murale var. macrocarpum Post, Fl. Syr. Pal. & Sinai, ed. 2, 1, 83 (1932)!

A. chalcedonicum Beuv. & Top. var. candilicium Beuv. & Top. in Bull. Soc. Bot. Genev., 28, 134 (1938), nomen nudum!

A. chalcidicum var. euboeum Beuv. & Top., op. cit., 151!

A. murale var. argenteum (Wittm.) Beuv. & Top., op. cit., 134!

A. murale subsp. caucasicum var. patens (Nyár.) Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem, 3, 1, 112 (1949)!

A. murale subsp. caucasicum var. petaloides f. rubricaule (Jord. & Fourr.) Nyár., op. cit., 111!

A. murale subsp. caucasicum var. petaloides f. steppacea Nyár., loc. cit. - pro syn.!

A. murale subsp. caucasicum var. variabile f. clypeolatum (Jord. & Fourr.) Nyár., op. cit., 115!

A. murale subsp. caucasicum var. variabile f. tmoleum (Jord. & Fourr.) Nyár., op. cit., 116!

A. caucasicum (Nyár.) Nyár., op. cit., 103!

Syntypes: (Romania): in muris vetustae arcis Devae in Transylvania atque in rupibus apricis vicini Banatus. (orig. PR, Herb. Waldstein No. 495746a /

495746a, b, & c; iso. GH, BM).

Distribution: Widespread in Central and S. Europe, Anatolia, Syria, Lebanon, N. Iraq, Caucasus and Transcaspian. Map 28.

TURKEY. A3: Prov. Adapazari, Sakarya, 140 m., 20 May 1950, Huber-Morath 11756; Prov. Bolu, above Mudurnu, 1300 m., 9 Jul. 1962, Davis 37094; Prov. Ankara, 10 km. W. of Beypazari, Zavije-Tepe köy, 1050 m., 1 Jun. 1957, Kühne 525 & 528. A4: Prov. Kastamonu, N. side of Ilgaz dağ, 2200 m., 28 Jul. 1962, Davis 38406; ibid., Karadere-Dewrende (Kücük, Ilgaz dağ), 14 Aug. 1892, Sintenis 4967; ibid., Şchersch-Oglu (nr. Kösen), 15 Jul. 1862, Sintenis 4692 (orig. synt. A. murale subsp. caucasicum var. petaloides WU, iso. G-BB); Prov. Ankara, dist. Kizilçahamam, 60 km. W. of Ankara, 860 m., 18 Jun. 1955, Huber-Morath 13733. A7: Prov. Gümüşane, Aymene (nr. Elias dağ), 10 Jul. 1894, Sintenis 6219; Prov. Trabzon, valley Kalanema dere, 30-200 m., 9 Jul. 1907, Handel-Mazetti 340. A8: Prov. Erzurum, Erzurum-Tortum, 34 km. N.E. of Erzurum 2030 m., 16 Jul. 1955, Huber-Morath 14812. B1: Prov. Balikesir, Mt. Ida (Kaz dağ) nr. Kareikos, 25 Jul. 1883, Sintenis 225 & 225b; Prov. Izmir, Sipyli (Manisa dağ), 200-300 m., 19-20 May 1906, Bornmüller 9087; ibid., Bergama, among ruins, 400 m., 21 May 1962, Dudley (D. 34829 ibid., Yamanlar dağ, ibid., 600-700 m., 13-22 May 1906 Bornmüller 9086. B2: Prov. Izmir/Manisa, Boz dağ (Tmolus), 27 Jul. 1854; and N. of Loudja nr. Izmir, 21 May 1854, Balansa 69 (holo. Odontarrhena tmolea P. n.v., iso. G-B, W, G, K, BM); Prov. Bursa, Bursa-Keles, 20 km. from Keles, 1000 m., 17 May 1962, Dudley (D. 34786); Prov. Kütahya, Kutahya-Tavşanli, 10 km. before Tavşanli, 800-900 m., 23 Jun. 1962, Dudley (D. 36111); ibid., Murat dağ, above Gediz at Mamam, 1400 m., 5 Jul. 1962

1962 /

1962, Davis 36689. B3: Prov. Eskişehir, Sivrihisar, 1200-1300 m., 22 Jun. 1962 Dudley (D. 36026); Prov. Afyonkarahissar, Afyon, 13 Jul. 1954, Bilger 5014; Prov. Konya, Sultan dağ, Akschehir (Akşehir), 1000 m., 13 & 22 Jun. 1899, Bornmüller 4108 (orig. synt. A. murale subsp. caucasicum var. petaloides WU, iso. W, G, G-BB, K, E). B4: Prov. Ankara, Beynam, 300 m., 5 Jul. 1947, Davis 13026; B5: Prov. Kayseri, Ali dağ (7 lieues SS Césarée), 1390 m., Jul. 1856, Balansa 989 (holo. Odontarrhena clypeolata P. nov., iso. G-B, G, W); ibid., Erdschias dagh (Erciyas dağ), Ali dağ, 1300-1800 m., Jun., 13 Jul. 1902, Zedebour (orig. synt. A. murale subsp. caucasicum var. petaloides WU, iso. W). B6: Prov. Adana/ Maraş, Hadjin (Saimbeyli)-Karaklisse, 9 Jul. 1906, Post 541. B7: Prov. Tunceli, dist. Pülümür, Pülümür, 4 km. from Pülümür, 1580 m., 26 Jun. 1951, Reese; Prov. Elâziğ, Elâziğ-Hazar gölü, 1524 m., 22 Jun. 1954, Davis 22084; Prov. Erzincan, Refahiye-Erzincan, 1700 m., 26 Aug., 1957, Davis 32692; ibid., Kharput (Harput) Schuschnas (Şuşnaz- 11 km. N.N.E. of Elâziğ), 8 Jun. 1889, Sintenis 616; B8: Prov. Erzurum., Ilica-Tercan, 1900 m., 10 Jul. 1957, Davis 30909; ibid., Erzurum nr. Maimansour, 1853, Huet 696 (orig. synt. A. argenteum var. chrysanthum G-B, iso. G); Prov. Bingöl, Erzincan-Erzurum, 54 km. W.S.W. of Erzurum, - Tercan, 6 Sept. 1957, Rechinger 15096. B9: Prov. Biltis, Tatvan, 30 km. from Nemrut dağ, 13 Jul. 1956, Birand 242. C2: Prov. Burdur, Tefenni-Dirmil, 9 km. from Tefenni, 1190 m., 26 Jun. 1948, Huber-Morath 9270; Prov. Denizli, Muğla-Kale, 20-30 km. from Kale, 900 m., 9 Jun. 1962, Dudley (D. 355551); Prov. Muğla/Antalya, Fethiye-Elmali, 120 km. from Fethiye, past Kaşnova, nr. Sütleğen, 1250 m., 30 May 1962, Dudley (D. 35194) Prov. Antalya, Elmali, 17 May 1860, Bourgeau 25 (holo. Odontarrhena /

Odontarrhena rubricaule P., n.v., orig. synt. A. argenteum var. chrysanthum G-B, iso. W, G, K, BM, E). C3: Prov. Isparta, dist. Sütçüler, Sarp dağ above Kuzdere, 1300 m., 28 Jul. 1949, Davis, 15834; Prov. Antalya, dist. Kemer, Ovacik-Teke dağ, nr. Soguť Cumasi yayla nr. Çalbali dağ, 1100-1300 m., 13 Jul. 1949, Davis 15228; ibid., Akseki-Beyşehir, 5 miles from Akseki, 1400 m., 14 Jun. 1962, Dudley (D. 35811). C5: Prov. Içel, Bulgar dagh, Gisel deppe, Gusguta valley (nr. Külek), 1829 m., 1853, Kotschy 124a (holo. A. trochocarpum (iso. G-B). C6: Prov. Hatay, Belen, Aug. 1879, Post 1101; ibid., E. of Belen, 500-520 m., 15 Jun. 1953, Huber-Morath 12829; ibid., Amanus, Harounie, 300-400 m., Jul. 1916, Haradjian 3127; C7: Prov. Urfa, Mt. Karadsche Dagh (Karacadağ), 10 Jun. 1841, Kotschy 154 (holo. A. mesopotamicum W, iso. G-B). C8: Prov. Diyarbakir/Mardin, Diyarbakir-Mardin, 1841 (1843), Kotschy 173. D6: Prov. Hatay, Cassius (Akra dağ), 9 Jun. 1889, Post; ibid., Urdu, 700-900 m., Dinsmore 20363.

Habitat: Disturbed and ruderal areas, sea coasts, cultivated fields, stream and clay banks, coarse turf, igneous, serpentine, volcanic, metamorphic and limestone slopes and screes of N. and N.W. exposure, calcareous and Astragalus steppe; often in Quercus coccifera, Q. pubescens and Juniperus scrub, Pinus brutia or P. nigra woods, and Cedrus and Abies forests; alt. (40-) 500-2300 m. Fl. Apr.-Jul.

Due to the extreme polymorphism of A. murale, approximately 40 specific and infra-specific epithets have been proposed for minor variations within the typical subspecies; however, when considered throughout/

throughout the whole morphological distribution pattern, A. murale seems to represent one highly variable and actively evolving genetic unit. Within this species and excluding its typical expression, there are six reference points of variation, morphologically and geographically correlated, which merit taxonomic distinction. The following table details the diagnostic characters and distribution of the recognised infra-specific taxa.

1. subsp. murale: fertile stems few, ascending or lax; stellate hairs on fruits ± dense, 0.2-0.5 (-1) mm. diam.; appendages of short filaments always free; seed wings 0.2-1 mm. wide. Widespread in Central and S. Europe, the Levant and extending as far east as Iraq, Caucasia and Transcaspia.

   a) var. murale: vegetative indumentum bicolored with equal and ± short-rayed, appressed stellate hairs, 0.2-0.5 mm. diam.; seed wings 0.4-1 mm. wide; leaves flat, midvein on upper surface not conspicuously depressed, uppermost cauline not bracteate or involucrate: distribution as subsp. murale.

   b) var. alpinum: vegetative indumentum bicolored, as on var. murale; seed wings 0.2-0.3 mm. wide; leaves as on var. murale, but uppermost cauline bracteate and involucrate. Anatolian from the Cilician Taurus to Lazistan and extending into Central Caucasus.

   c) var. pichleri: vegetative indumentum bicoloured with stellate hairs 1-1.5 mm. diam. of coarse, long, strigose and unequal rays; seed wings as on var. murale; leaves as on var. murale. Forming local populations in Bulgaria, Romania, N. Greece and Yugoslavia.

d) /

d) var. <u>haradjianii</u>: vegetative indumentum concolorous with appressed equal-rayed stellate hairs, 0.2-0.5 mm. diam.; seed wings as on var. <u>murale</u>; leaves frequently conduplicate, mid-vein on upper surface conspicuously depressed, uppermost cauline not bracteate or involucrate. Amanus, Syria and Lebanon.

2. subsp. <u>stoianoffii</u>: fertile stems many, decumbent or deflexed; stellate hairs on fruits sparse 0.2 mm. diam.; appendages of short filaments always connate to filament; seed wings c.0.2 mm. diam. or less. Rare in Samothrace and the southern Rhodope Mountains.

Rechinger (1961) remarked that three "races" (or <u>Sippen</u>) of <u>A. murale</u> occur on Euboea, namely <u>A. chalcidicum</u>, <u>A. chlorocarpum</u> and <u>A. orphanides</u> (he also designated yet another, but without a specific epithet), but due to the presence of many intermediates he maintained that formal recognition could not be substantiated. Numerous collections from the Pindus in N. Greece, especially those of <u>Davis</u> in 1962 from large interconnected populations (see discussion under <u>A. fallacinum</u>), show a similar pattern of variation and occurrence of intermediates as in the <u>Rechinger</u> gatherings from Euboea. <u>Rechinger</u> (<u>loc. cit.</u>) also suggests that for a successful clarification of the biology and mechanics of the variation within the <u>A. murale</u> complex, cultivation and hybridization experiments combined with a thorough investigation of chromosome numbers would be advantageous. However, for the purposes of identification, particularly herbarium specimens, the many/

many specific and infra-specific groups (or races) are treated here as synonyms of *A. murale sensu lato*. Nyarády (1927:70) suggests that *A. murale* and the many "splits" which he described might be better considered as a "collective species", and (1927:81) continues that *A. chlorocarpum*, *A. gracile*, *A. orphanides*, *A. pichleri*, *A. degenianum* etc. are not very far differentiated from, and are phylogenetically associated with *A. murale sensu stricto*. These taxa, because of their similarities, he visualises, could eventually be treated as subspecies. The present author takes an even more conservative view, in the light of the large amount of populational and individual variation, and reduced most of the taxa considered as distinct by Nyárády, into the synonymy of *A. murale* in the broad sense. The only taxa retained at infra-specific rank are those which possess a constant population and geographical pattern of character differentiation.

Jordan and Fourreau's *Odontarrhene rubricaulis*, *O. tmolea* and O. clypeata (all transferred at one time or another to *Alyssum*) are inseparable from one another and from the abundant gatherings of *A. murale* from Europe and Anatolia. It was observed in large populations of *A. murale* in W. Anatolia that different fertile stems of individual specimens (*Dudley*, D.348291; D.34884: D.34786) could be identified as *Odont. rubricaulis*, *O. tmolea*, and *O. clypeata*, depending upon the shape and size of fruits. Even all the duplicates of the type of *Odont. tmolea* (*Balansa* 69) have very variable fruit forms. Fenzl's *A. trochocarpum* and *A. mesopotamicum* are morphologically indistinguishable /

indistinguishable and easily fit into the variation pattern of _A. murale_ var. _murale_ which is widespread in Anatolia. The _Balansa_ gathering from Murat dağ in Phrygia, which Boissier cites as _A. argenteum_ var. _chrysanthum_, is correctly referred to _A. virgatum_.

var. pichleri (Velen.) Dudley, stat. nov.; Nyár. in Bul. Grád. Bot. Cluj, 7, 83, t. 3, f. 23, 24, 26-29, t. 6, f. 62, t. 8, f. 103, 113 pro species (1927); Hayek, Prod. Fl. Pen. Balc., 1, 440 pro species (1925); Bornm., in Engl. Bot. Jahrb., 59, 349 pro species (1925); Nyár. in Anal. Acad. Rep. Pop. Rom. Secț. Științe Geol. Geog. Biol., ser. A, mem. 3, 1, 106 pro species (1949).

Syn.: A. pichleri Velen., Fl. Bulg., 38 (1891)!

A. murale f. hirsutam Vandas, Rel. Form., 38 (1909).

A. murale f. stellulatum Borza in Bul. Grád. Bot. Cluj, 4, 60 (1924)!

A. pichleri f. stellulatum (Borza) Nyár. in Bul. Grád. Bot. Cluj, 7, 84 (1927)!

A. murale subsp. pichleri (Velen.) Stoj. & Steff., Fl. Bulg., 530 (1948)!

Type: (Bulgaria): in collibus ad Philippopolin (Plovdiv), 1890, Pichler (holo. PRC).

Distribution and Habitat: Rare on calcareous and silicaceous substrates in Yugoslavia, N. Greece, Bulgaria, Romania and ? Turkey-in-Europe; alt. (120-) 400-900 m. Fl. May-Jul. A number of specimens seen from the Dalmatian coast in Yugoslavia are intermediate with var. murale with regard to the size and form of the stellate hairs. Map 28.

? Turkey-in-Europe: Rumelia, Friwaldsky (W,E).

Its indumentum of large and unequal, divergent rayed stellate hairs is the only character (Nyarady, 1927:84) which distinguished this taxon from the typical expression of A. murale. Specimens having an intermediate type of hair are common from the Dalmatian Coast.

var. haradjianii (Rech. fil.) Dudley, comb. & stat. nov.

Syn.: A. constellatum sensu Nyár. in Anal. Acad. Rep. Pop. Rom. Secț. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 96 (1949) - non Boissier!

A. haradjianii Rech. fil. in Ark. För Bot., ser. 2, 5 (1), 172 (1959)!

Type: (Turkey, D6: Prov. Hatay). Cassius (Akra dağ), 300-700 m., Jun. 1909, Haradjian 3021 (holo. G, iso. W, K, E).

Distribution: The Amanus in S. Anatolia, Syria and Lebanon. Map 28.

TURKEY. C6: Prov. Hatay, Soff dagh (Ssoff dagh-Sûf dağ, N. end of Kurt dag), 1106 m., 27 Jun. 1865, Haussknecht (910); ibid., nr. Belen, Mt. Apisch Geyae (Daz dağ), 914 m., Jun. 1862, Kotschy 268; ibid., Hourd dağ (nr. Belen) Kara dağ, 1219 m., Jun. 1862, Kotschy 267. D6: Prov. Hatay, Cassius (Akra dağ), 400-650 m., Jun. 109, Haradjian 3022; ibid., 1300-1800 m., Jun. 1909, Haradjian 3129.

Habitat: Montane; alt. 300-1300 (-1800) m. Fl. May-Jun.

The distinguishing characters of A. haradjianii are not of an order that would permit its taxonomic recognition above the rank of variety. The height of the fertile stems of the Haradjian gatherings, which caused Rechinger (1959) to interpret this taxon as intermediate between Nyárády's artificial categories "Humiliories" and "Elatiories", is not constant in the other specimens; often (for example, the Haussknecht gathering from Ssoff dağ in the Amanus, cited by Nyárády: 1949 as the only specimen he had seen of A. constellatum). The plants may be as tall or taller than many collections of the typical variety. The small local populations of var. haradjianii, though constant in their morphology, are sympatric in the Amanus and in montane Syria and Lebanon with var. murale.

var. alpinum Boiss. ex Nyár. in Bul. Grad. Bot. Cluj, 18, 83 (1938)!

Syn.: A. argenteum Wittm. var. alpinum Boiss. ex Fenzl in Tchih., Asie Min., Bot. 1 (3), 296 (1860), nomen nudum!

Odontarrhena depressa Jord. & Fourr., Brev. Pl. Nov., fasc., 2, 6 (1868)!

? A. tortuosum Willd. var. tenuiramea Rupr. in Mém. Acad. Imp. Sc. St. Petersb., ser. 7, 15 (2), 100 (1869).

A. murale var. viride Nyár. in Anal. Acad. Rep. Pop. Rom. Sect, Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 108 (1949)!

A. alpinum (Nyár.) Nyár., op. cit., 104!

A. murale subsp. alpinum (Boiss.) Nyár., op. cit., 109!

Type: (Turkey, C5: Prov. Içel): regione alpine du Taurus; au-dessus de Boulgarmaden (nr. Külek), 27 Aug. 1855, Balansa 429 (not 129) (holo. P n.v., also holo. of Odontarrhena depressa & A. alpinum; iso. G-B, G, K, BM, E).

Distribution: Diffuse from the Cilician Taurus to N.E. Anatolia (Lazistan) and Central Caucasus. Map 28.

TURKEY. A8: Prov. Erzurum, Kop dağ, 2338-2896 m., 9 Aug. 1962, Furse 3811 and 3821b; Prov. Rize, dist. Hemsun, Ortaköy-Cat, 2000 m., 2 Sept. 1952, Davis 21184; ibid., Djimil (Cimil), 2000-2032 m., Jul., Aug. 1866, Balansa 47.

Habitat: Montane confined to igneous and volcanic rock; alt. 2000-2896 m., Fl. Jul-Aug.

The differential characters which define this variety occur individually throughout the specific range; only a few and sporadic Anatolian /

Anatolian (and Caucasian) populations have the consistent correlation of dwarfer and lax stems, simple inflorescences, larger and bracteate upper cauline leaves, and narrower seed wings. The type gathering of var. _alpinum_ (treated as a subspecies of _A. murale_ and also given full specific rank by Nyárády: 1949) is also the holotype of _Odontarrhena depressa_.

Caucasian specimens determined by Busch as _A. tortuosum_ var. _tenuirameum_ Rupr. were loaned from the Leningrad Herbarium. They are morphologically continuous with the Lazistan gatherings of _A. murale_ var. _alpinum_. Busch (in _Flora Cauc. Crit._, _3_ (4), 565: 1909) records the _Ruprecht_ type, and cites the variety as growing in "Pontus lazicus". If Ruprecht's taxon is conspecific with _A. murale_ var. _alpinum_, as the earliest name at varietal rank var. _tenuirameum_ should be applied to our Anatolian material. However, as the present author has not examined the _Ruprecht_'s type material, it seems advisable to retain var. _alpinum_.

subsp. stoianoffii (Nyár.) Dudley, comb nov.; Rech. fil., Fl. Aegaea, 226 as A. degenianum (1943); Nyár. in Anal. Acad. Rep. Pop. Rom. Sect. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 103 as A. degenianum, pro parte excl. Syria & Lebanon (1949); op. cit., 106 as subsp. of A. pichleri.

Syn.: A. degenianum Nyár. in Bul. Grăd. Bot. Cluj, 7, 87, t. 3, f. 45, 46 (1927)!

A. degenianum f. subcaespitosum Nyár., loc. cit.!

A. pichleri subsp. stoianoffii Nyár. in Fedde Rep. Sp. Nov., 27, 395, t. 103, f. 3 (1930).

Type: (Bulgaria): Macedonia bulgarica, in graminosis alpinis sub cacumine Kalabak, m. Belasica, alt. c. 2000 m., 20 Jul. 1920, Stojanoff (holo. SOM, n.v.).

Distribution and habitat: Montane in grassy meadows on the N. Greek island of Samothrake and the S. Rhodope Mountains in Bulgaria; alt. (600-) 1000-2000 m. Fl. Jun. Map 28.

Though the type of this subspecies has not been seen, its description and accompanying photograph of the type clearly establishes it as the same taxon which Nyárády had previously regarded as A.degenianum. The specimens of A. degenianum cited by Nyárády (1949) from Lebanon, all refer to A. murale subsp. murale var. hardjianii.

Map 28 was constructed before subsp. stoianoffii was considered equivalent to A. degenianum, and the "d" (referring to the epithet degenianum) should be regarded as indicating the distribution of subsp. stoianoffii.

111. A. tenium Hal., Consp. Fl. Gr., 1, 93 (1900); Hayek, Prod. Fl. Pen. Balc., 441 (1925); Wein in Öst. Bot. Zeit.; 74, 198 (1925); Bornm., op. cit., 262 (1925); Nyár. in Bul. Grăd. Bot. Cluj., 7, 98, t.3, f.85 (1927); Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 21, t.4, f.11, t.5, f.43, 44 (1949).

Syn.: Odontarrhena diffusa Jord. et Fourr., Brev. Pl. Nov., fasc. 2, 5 (1868), non Tenore!

A. tenium var. lanceolatum Nyár. in Bul. Grăd. Bot. Cluj. 7, 98 (1927).

Type: (Greece): in Cycladum insula Tenos (Tinos), Mt. Tziknia, 4 Jun. 1851, Sartori 2873 (1608) (holo. W-Hal., iso. W, G, E).

Distribution and Habitat: Montane species from the Cyclades and S. Greece. Map 28.

Nyárády cites the Heldreich 754 specimen (from Tenos in the Cyclades, not Attica as claimed by Nyárády), in the Herbarium of the University of Vienna as one of the syntypes of A. tenium var. lanceolatum, and also cites duplicates of this gathering in the Herbarium of the University of Bucharest and the Kerner Herbarium in Vienna as representing the typical A. tenium. Odontarrhena diffusa Jord. & Fourr. and A. tenium are based on the same Sartori gathering; Jordan and Fourreau's epithet cannot be applied to this species because of an earlier Alyssum diffusum (Tenore, 1815).

Wein (loc. cit.) claims that Desfontaine's Alyssum paniculatum from Crete represents the same taxon as A. tenium from Tenos. However, Bornmüller (loc. cit.) points out that A. paniculatum is synonymous with A. creticum. /

A. creticum. The type material of A. paniculatum is based on the same Tournefort collection which Linnaeus used to define A. creticum (now Alyssoides creticum). Duplicates of the Tournefort gathering of Alyssum creticum, labelled "Alyssoides fruticosum creticum, leucoji folio incano" in the British Museum have been compared with the description and figure of Alyssum paniculatum. The present author contends, with Bornmüller, that Alyssum paniculatum is a synonym of Alyssoides (Alyssum) creticum.

112. A. subspinosum Dudley in Notes Roy. Bot. Gd. Ed., 24 (2), 160, Pl. 6 (1962).

Type: (Jordan): south of Nagb Ishtar, 6 May 1955, Hunting Aero Survey 1726 (holo. E).

Distribution and habitat: Rare on bare sandstone known only from the type collection in Jordan. Map 28.

113. A. akamasicum Burtt in Kew Bull., 100, pl. 3 (1949).

Type: (Cyprus): Akamas peninsula, 3 May 1941, Davis 3308 (holo. K, iso. G.W. Hub.-Mor. E).

Distribution and habitat: Endemic confined to W. Cyprus on diallagitic rock, serpentine scree and associated with Pinus brutia; alt. 305 m. Fl. Mar.-Apr. Map 28.

114. A. cassium Boiss., Diagn., 2 (8), 34 (1849); Boiss., Fl. Or., 1, 273 (1867); Bouloumoy, Fl. Lib., Syr., t.27, f.38 (1930); Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 107 (1949). Fig. 2, n.

Syn.: A. cassium var. canescens Post., Fl. Syr., Pal. & Sinai, ed. 1, 84 (1896)!

A. giosnanum Nyár. subsp. explanatum Nyár. in Bul. Grăd. Bot. Cluj. 18, 84 (1938)!

Type: (Turkey, D6: Prov. Hatay): in agris derelictis et collibus ad radices jugi Casii (Akra dağ), 1846, Boissier (holo. G-B, iso., G, W, K, E).

Distribution: The Amanus in S. Anatolia and N. Syria. Map 25.

TURKEY. C6: Prov. Adana, Kasapligil Adana-Osmaniye, c. 980 m., Huber-Morath 20; ibid., Osmaniye, 15 Oct. 1957, Kühne 1446; ibid., Osmahiye-Adana, Karap limil, 980 m., 6 Jul. 1944, Herb. Turc. 20; ibid., distr. Bahçe, Dildol dağ, 400 m., 25 Aug. 1949, Davis 16461; Prov. Hatay, Amanus Mt., 914 m.-2134 m., Aug. 1913 Haradjian 4569; ibid., Wadi-Kandil (Amanus dağ), 7 Jun. 1884, Post; ibid., nr. Belen, nr. Nackislik, 549 m., 22 Jul. 1862, Kotschy 58; ibid., Harunije (Amanus), 300-400 m., Jul. 1911, Haradjian 3627; ibid., Bityas, 3 Aug. 1880, Post 11109; ibid., Kotsch-bel dagh (Amanus dağ., N. of Payas), 457 m., 11 Sept. 1884, Post (holo. A. cassium var. canescens, iso., BM); ibid., Amanus, Jul. 1903, Thespart 259; ibid., Soukluk (3 km. W. Belen), 15 Aug. 1929, Dinsmore 20363 pro parte and 20422; ibid., nr. Belen, 27 Feb. (?) 1865, Haussknecht 80 (orig. synt. A. giosnanum subsp. explanatum JE).

Habitat: /

<u>Habitat</u>: Open and abandoned ground; often in <u>Quercus</u> scrub and <u>Pinus</u> forests; alt. 300-914 (-2134) m. Fl. Jun.-Aug.

This very distinct species is confined entirely to the Amanus, extending as far south as the Syrian slopes of Mt. Cassius (Akra dağ), and is partially sympatric with <u>A. cilicicum</u> and <u>A. giosnanum</u>. <u>A. cassium</u> is distinguished from those two species by its biennial habit (as shown by the lack of sterile shoots and one whorl of basal leaf scars), densely foliate stems, obcordate or broadly obovate and smooth margined fruits with sparse and coarse stellate hairs, longer and rigid pedicels, and bicoloured leaves which abruptly decrease in size upwards (heterophyllous). In direct contradiction to the original descriptions of <u>A. cassium</u> and <u>A. cilicicum</u>, it was found that the type and additional material of <u>A. cassium</u> always have entire petals, while those of <u>A. cilicicum</u> are more often retuse or emarginate. The inflorescence of <u>A. cassium</u> is compact with erect or ascending branches which seldom measure more than 6 cm. long. The inflorescence of <u>A. cilicicum</u> is paniculate and has arcuate-flexuose branches which measure 15-20 cm. long. The characters distinguishing <u>A. cassium</u> from <u>A. cilicicum</u> and <u>A. giosnanum</u> are also of value in separating the former from the very polymorphic <u>A. murale</u>.

Post's <u>A. cassium</u> var. <u>canescens</u> does not possess any deviating characters sufficient to allow separation from the other collections of the species; likewise, the material constituting <u>A. giosnanum</u> subsp. <u>explanatum</u> is referrable to <u>A. cassium</u>.

The <u>Siehe</u> 626 gathering which Nyárády (1949) refers to <u>A. cassium</u> was /

was previously (1927) considered by him as one of the syntypes of _A. chalcidicum_ var. _ellipticum_. The original and many duplicates of this gathering have been examined by the present author with the resulting conclusion that they must all be referred to _A. cilicicum_.

(5) SECT. ODONTARRHENA

(ii) Subsect. Compressa

(b) Series Crenulata

115. A. cilicicum Boiss. & Bal., Diagn., 3 (5), 34 (1856); Boiss., Fl. Or., 1, 273 (1867); Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 80, t.6, f.1 (1949).

Syn.: A. chalcidicum Janka f. ellipticum Nyár. in Bul. Grăd. Bot. Cluj. 7, 119, t.8, f.125 (1927), pro parte!

A. viride Nyár., op. cit., 152, t.6, f.42, t.7, f.52!

Type: (Turkey, C5: Prov. Içel): in herbidis vallis (Bords du) Guzel Déré supra Sedichig in Cilicia litterali (4 lieues au NO de Mersina), 9 Jun., Sept. (2 Oct.) 1855, Balansa 435 (170) (holo. G-B, iso. W, G, K, BM, OXF, E),

Distribution: Endemic to the Cilician Taurus and Amanus. Map 29.

TURKEY. C5: Prov. Niğde, Bulgar Maaden above Magara, 1895, Siehe 626 (orig. synt. A. chalcidicum f. ellipticum WU, iso. G-BB, K, BM, OXF, E); Prov. Hatay, Amanus Mts. above Arsus (Arsuz), 180 m., 4 Jul. 1862, Kotschy 178; ibid., above Arsus, Magara Dagh, 1219 m., 4 Jul. 1862, Kotschy 203, C6: Prov. Hatay, Amanus dağ, Egbez (Ekbès), 457-610 m., 1900, Haradjian 629; ibid., Kurt dağ, 1891, Post. Cilician Taurus, 1836, Kotschy 120 (holo. A. viride W). Cilicia, Boissier.

Habitat: Montane; alt. 457-1219 m. Fl. Jun.-Jul.

A. cilicicum belongs to the same complex of species having crenulate fruit margins in Subsect. Compressa as A. giosnanum, and is sympatric with that species in the Amanus and the Cilician Taurus. The petals and longer styles of A. cilicicum are glabrous, while those of A. giosnanum are always pubescent. A. cilicicum is also characterised as a perennial (not biennial as claimed by Boissier, 1856 and 1867) having erect or ascending sterile shoots, the leaves of which are greenish, narrowly oblanceolate and acute. The sterile shoots of A. giosnanum are conferted or decumbent with silvery-white, broadly obovate or spathulate leaves. The configuration of the wings of the long filaments of these two species is also strikingly different. The long filaments of A. cilicicum have bilateral wings which are multidentate at their apex and are connate only for c. ½ their length (as in Fig. 1B, p). The wings of the long filaments of A. giosnanum are unilateral, multidentate at their apex and are connate for almost their entire length (Fig. 1B, q).

Examination of the floral structure of the original material and duplicates of one of the syntypes of A. chalcidicum var. ellipticum (Siehe 626) indicates that this gathering should be referred to A. cilicicum. The other Anatolian syntype of A. chalcidicum var. ellipticum (Andrasovszky 317, collected in 1911) was not available, but judging from its locality near Konya, it probably represents A. murale sensu lato, rather than A. cilicicum.

The floral structure (the crenulate margin is easily observed on the immature fruits) of the holotype of A. viride agrees with that of A. cilicicum. However, the single specimen on which the description of A. viride is based is very depauperate, a fact which accounts for the wide /

wide discrepency in stature between that taxon and most collections of A. cilicicum. The Kotschy 203 gathering from Magara dağ above Arzus in the Amanus has a habit similar to that of the type collection of A. viride, but it also has the diagnostic floral and fruit characters of A. cilicicum.

The fruits of the holotype, its duplicates and additional material of A. cilicicum have obvious crenulate margins; Nyárády's figure (1949), preporting to be a fruit from the type gathering of A. cilicicum, is inexplicable in that the margin of the fruit drawn is smooth and entire. Furthermore, the three filaments of A. viride drawn by Nyárády (1927) are all clearly short filaments. The present author has examined flowers from the type material of that binomial and has found that its long filaments are all bilaterally winged and the wings are connate for c. ½ their length.

Nyárády's A. cilicicum var. guelekii has the same type (Kotschy 83a) as his A. giosnanum var. maioricarpum; both names are treated as synonyms of A. giosnanum.

116. A. giosnanum Nyár. in Bul. Grád. Bot. Cluj. 6, 127, t.3, f.52, 53, t.5, f.78, t.8, f.102, t.10, f.129-132 (1927); Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 95 (1949). Fig. 1B, q.

Syn.: A. giosnanum var. maioricarpum Nyár., in Bul. Grád. Bot. Cluj, 6, 127 (1927)!

A. cilicicum Boiss. & Bal. var. guelekii Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ, Ştiinţe, Geol. Geog. Biol., ser. A, mem. 3, 1, 80 (1949)!

Lectotype: (Turkey, C5: Prov. Içel/Adana): Asia Minor, Cilicia, in Wald von Pinus brutia prope pagum Giosna, alt. circa 1000 m., 1895, Siehe 687 (not 682) (orig. WU, iso. G-B, K, BM, OXF, E).

Distribution: S.W. and S. Anatolia, primarily from the Cilician Taurus and Amanus. Map 29.

TURKEY. C2: Prov. Muğla, Taurus near Trimali, Oct. 1841, Forbes 183. C5: Prov. Içel, Güllek (Külek) Bulgar Dagh, 1219 m., 11 Jul. 1853, Kotschy 284 (orig. synt. CL. n.v. iso. W, K, BM); ibid., Kotschy 83a (holo. A. giosnanum var. mairocarpum WU, holo. A. cilicicum var. guelekii G, iso. G, B, K). C5, Prov. Adana, Soğukuluk, east of Pozanti, Ala dağ, 1800 m., 23 Aug. 1958, Markgraf; Prov. Niğde, Bulgar Maaden above Magara, 1400 m., 1896, Siehe 626a. C6: Prov. Maraş, Akher Dagh (Ahir dağ), 1829 m., Jul. 1907, Haradjian 1399; Prov. Hatay, Amanus Mts., Osmaniye-Zorkunyayla, 1000 m., 11 Oct. 1957, Kühne 1394; ibid. dist. Belen, below Belen, 400 m., 23 Apr. 1957, Davis 27013; ibid. nr. Egbez (Ekbes), 457-1906, Haradjian 609; ibid. Harunidji (Harounie), 90-120 m., Jul. 1911, Haradjian /

Haradjian 3627. In Monte Tauro, 1836, Kotschy 41 (orig. synt. A. elatum sensu lat. G-B, iso. G, W, K, BM, OXF).

Habitat: Calcareous, serpentine and metamorphic dry slopes, and often in Pinus brutia or P. nigra woods; alt. (400-) 1000-1829 m. Fl. (Apr.) Jul.-Oct.

The locality where the lectotype of this species was collected lends its name as the specific epithet. The Siehe 687 (not 682 as indicated by Nyárády) gathering is chosen as the lectotype because both mature fruits and flowers are present on all specimens examined, and because this gathering has never been designated as the type of any other binomial or confused with any other species: Fenzl in Tchihatcheff (1860) refers Kotschy 284 (the other syntype of A. giosnanum) to A. constellatum; Boissier (1867) cites it as a species of A. alpestre var. obovatum. The holotypes (Kotschy 83a) of A. cilicicum var. guelekii and A. giosnanum var. maioricarpum are identical. This gathering was collected in the same area, at the Cilician Gates, as the Kotschy 284 syntype of A. giosnanum. There are no visible differences between var. maioricarpum and the lectotype or additional collections of A. giosnanum. The Kotschy gathering (No.41) which Boissier cites as a syntype of A. elatum and later referred to A. constellatum together with Kotschy 83 in Flora Orientalis is correctly identified as A. giosnanum.

On the basis of the floral structure, and the leaf and fruit shape and indumentum of the type material of Nyarady's A. giosnanum subsp. explanatum, this taxon is correctly referred to A. cassium. In the discussion accompanying the description of this subspecies, Nyárády (1938) doubts that it really/

really should be referred to <u>A. giosnanum</u>, and the reasons he gives substantiate the reduction of this subspecies to a synonym of <u>A.cassium</u>.

117. A. heldreichii Hausskn. in Mitt. Thür. Bot. Ver., n.f., 3 (4), 113 (1893); Hal., Consp. Fl. Gr., 1, 92 (1900); Huter in Öst. Bot. Zeit., 54, 260 (1904); Nyár. in Bul. Grǎd. Bot. Cluj, 7, 117, t. 4, f. 57-59, t. 5, f. 74, t. 8, f. 96, t. 10, f. 119-121 (1927); Nyár. in Notizbl. Bot. Gart. Mus. Berlin-Dahlem, 11 (107), 634, f. 12, No. 1-2 (1932); Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 81 (1949).

Syn.: A. heldreichii var. astrotrichocarpum Hausskn. in sched., Iter. Thessal., Pindus Tymphaeus, Witomo, 14 Jun. 1896, Sintenis 218!
A. heldreichii f. glabrum Nyár., loc. cit.!

Lectotype: (Greece): Pindus Tymphaeus in valle superiori Penei circa Malakasi, 914-1067 m., substr. silic.-serp., 17-18 Jul. 1885, Heldreich (orig. JE n.v., iso. W, W-Hal., G, G-BB, K, E).

Distribution and habitat: Endemic in the Pindus region of N. Greece in woods and on serpentine and silicaceous schist; alt. 900-1700 m. Fl. May-Jul.

This species is the only European representative of the complex of species having crenulate fruit margins in Subsect. Compressa.

The occurence of a few stellate hairs on the fruits, especially when immature, is not associated with any other deviating character, nor is this feature correlated geographically or ecologically. Glabrous and sparsely pubescent fruits or ovaries are known to occur together on individual plants; a case similar to A. smolikanum. For this reason toxonomic recognition of astrotrichocarpum and glabrum as varieties or forms is not justified.

118. _A. elatum_ Boiss. & Heldr., Diagn., 2 (8), 33 (1849); Boiss., Fl. Or., _1_, 271 (1867) - _pro parte_.

Lectotype: (Turkey, C3: Prov. Antalya): ad rupes portus Tcherali (Çirali) (in campis sterilibus au pied des Montagnes, près du portus), 13 May 1845, _Heldreich_ 620 (orig. G-B, iso. W, Hub.-Mor., G, K, BM, OXF, E).

Distribution: Endemic to S.W. Anatolia. Map 29.

TURKEY. C1: Muğla, Marmaria-Tekir, 9 km. from Datça, sea level, 6 Jun. 1962, _Dudley_ (D.35431). C2: Prov. Muğla, Marmaris-Datça, 25-30 km. from Hisarönü, 250 m., 6 Jun. 1962, _Dudley_ (D.35424); _ibid_., dist. Marmaris, Ordugah, 13 Jul. 1960, _Khan et. al._ 32. C3: Prov. Antalya, Tekirova bay, E. of Tahatli dağ, 20 m., 25 May 1950, _Huber-Morath_ 9874; _ibid_., Adrasan bay, Çirali-Finike, 10 m., 27 May 1950, _Huber-Morath_ 9875.

Habitat: Serpentine rubble and outcrops nr. sea coast, neglected and cultivated fields and _Hypericum_ macchie; alt. sea level - 250 m. Fl. Apr.-Jul.

This very distinctive species belongs to the species complex in Subsect. _Compressa_ including _A. giosnanum_, _A. cilicicum_, _A. crenulatum_ and _A. heldreichii_ all with crenulate fruit margins (easily observed even on immature fruits). _A. elatum_ is the only species in the subsection which consistently has glabrous fruits, though the fruits of _A. heldreichii_ from the Pindus are more often glabrous than not.

A lectotype had to be chosen for this species because of the discordant elements in the Boissier Herbarium. Of the four gatherings cited, only the _Heldreich_ specimen (and its duplicates) from Tcherali fits Boissier's description (see discussion under _A. corsicum_). The _Boissier_ and/

and Pinard gatherings from Caria and referred to A. corsicum, and the Kotschy 41 is correctly identified as A. giosnanum (not as A. constellatum as indicated by Boissier in Flora Orientalis). Furthermore, it is obvious that Boissier based the description of A. elatum on the Heldreich gathering, for in the Diagnoses the description is headed by "Alyssum elatum Boiss. et Heldr. in pl. Anat. exs. 1846".

119. <u>A. crenulatum</u> Boiss., Diagn., 2 (8), 33 (1849); Boiss., Fl. Or., <u>1</u>, 271 (1867). Fig. 2, O.

<u>Type</u>: (Turkey, D6: Prov. Hatay): in collibus ad radices meridionales jugi Cassii (Akra dağ) in via inter Latakieh et Suadieh, Jun. (May-Jul.) 1846, <u>Boissier</u> (holo. G-B).

<u>Distribution</u>: Endemic to Mt. Cassius in the S. Amanus and the adjacent part in N. Syria. Map 29.

TURKEY. D6: Prov. Hatay, Syria, Cassius, 1846, <u>Pinard</u>; <u>ibid</u>., above Wadi Kandil (Cassius), 6 Jun. 1884, <u>Post</u>; <u>ibid</u>., 1 mile S. of Urdu (Yaylâdağ) 700-900 m., <u>Dinsmore</u> 20363; <u>ibid</u>., 20 km. S. or Urdu (Yaylâdağli), (700-) 800-900 m., 2 Jun. 1938, <u>Dinsmore</u> 20362.

<u>Habitat</u>: Woodlands and dry roadsides; alt. 530-900 m. Fl. Jun.

Of all the species in Subsect. <u>Compressa</u> having crenulate fruit margins, <u>A. crenulatum</u>, the type species of Series <u>Crenulata</u>, has the most prominent fruit wings. In addition to this feature and its biennial habit, <u>A. crenulatum</u> is distinguished from <u>A. cilicicum</u>, which also grows in the Amanus, by the sparser and branched-rayed stellate hairs on its always orbicular fruits. The indumentum on the obovate or elliptic fruits of <u>A. cilicicum</u> is denser and is composed of stellate hairs which have fewer and unbranched rays. In <u>A. crenulatum</u> the ultimate inflorescences terminating the panicle branches are umbellate or subumbellate, while those of <u>A. cilicicum</u> are more elongate and its pedicels are spaced apart approximately twice the distance between those of <u>A. crenulatum</u>.

Boissier indicated that <u>A. crenulatum</u> was a woody plant provided with sterile shoots which had linear and densely lepidote leaves. Neither the /

the holotype of A. crenulatum in the Boissier Herbarium in Geneva, nor any of its duplicates in other herbaria (nor any subsequent gatherings from Mt. Cassius and surrounding areas) have sterile shoots which would indicate a perennial habit. Boissier's error stems from his confusion with A. crenulatum, a flowering specimen of A. samariferum, which has a copious development of sterile shoots and was collected at the same time as the type of the former. The lack of any sterile shoot formation at the base of the plants of A. crenulatum, and the presence of one whorl of basal leaf scars, leads the present author to assume that this species is a biennial. The only other true biennials in Alyssum are A. cassium (as correctly indicated by Boissier) and A. wierzbickii.

(5) SECT. ODONTARRHENA

(iii) Subsect. Samarifera

120. A. floribundum Boiss. & Bal., Diagn., 3 (5), 33 (1856); Boiss., Fl. Or., 1, 272 (1867); Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinte Geol. Geog. Biol., ser. A, mem. 3, 1, 82, t.4, f.12, t.6, f.2, 3 (1949). Fig. 2, p.

Type: (Turkey, C5: Prov. Içel): in schistosis vallis Guzel déré supra Sedichig in Cilicia littorali (à 4 lieues NO de Mersina regione chaud superioir), 20 May, 9 Jun. 1855, Balansa 434 (171) (holo. G-B, iso. G, W, K, BM, OXF).

Distribution: Rare endemic with a wide distribution in S. and W. Anatolia. Map 31.

TURKEY. B2: Prov. Kütahya, Tavşanli- Inegöl, 15 km. from Tavşanli, 1000 m., 23 Jun. 1962, Dudley (D.36151). C5: Prov. Niğde, Taurus, east of Ulukişla, 12 Jul. 1937, Reese. C2: Prov. Burdur, high pass, 6 km. S. of Dirmil, 1550 m., 29 Jun. 1948, Huber-Morath 9267. C5: Prov. Adana, Région montagneuse supérieure Masmenu dagh, à 25 lieues SSO de Césarée (Kayseri), 8 Aug., 6 Sept. 1855, Balansa 433 (171); ibid., Pozanti, E. of Kürkuin, Bogazi, 900 m., 21 Aug. 1958, Markgraf 11250; Prov. Içel/Adana, Junduk banaj, on the Aidepe, 1200 m., Jul. 1912, Siehe 230.

Habitat: Saxatile on weathered limestone cliffs, on schist and eruptive stone and often in Pinus brutis or P. nigra woods; alt. 900-1500 m. Fl. May-Aug.

of/

Of all members of the Subsect. Samarifera, this species has the smallest fruits, the shortest pedicels, the smallest floral parts and the largest, most copiously branched corymbs. The shape of the leaves of the sterile shoots is similar to that of A. samariferum; however, the indumentum on those of A. floribundum is strongly silvery only on the lower surface and greenish on the upper surface. The leaves of the sterile shoots of A. samariferum are more or less concolorous, and the more undulate fruits are at least twice as large as those of A. floribundum. The characteristic linear-oblanceolate and acute leaves of the sterile shoots, the shorter styles and the smaller fruits clearly separate A. floribundum from A. trapeziforme and A. peltarioides, though the shape of the fruits of these three allied species is similar.

The author collected this species in its most westerly station in Prov. Kütahya (Phrygia) where it formed a small population of saxatile, cushion-forming, suffruticose plants on sheltered precipitous cliffs.

121. A. trapeziforme Bornm. ex Nyár. in Anal. Acad. Rep. Pop. Rom. Sect. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 83, t. 1, f. 1, t. 6, f. 4-6, (1949); Boiss., Fl. Or., 1, 272 (1867), quoad plantam hybridam Masmenu a lectam.

Syn.: ? A. troodi Boiss. var. continentis Schulz in Notizbl. Bot. Gart. Mus. Berlin-Dahlem, 11 (105), 311 (1932).

Type: (Turkey, C5: Prov. Adana): Masmeneudagh SSO de Césarée (Kayseri) (region montagneuse superieure du... à 25 lieues au SSO...), 8 Aug. 1855, Balansa 431 (173) (holo. JE, iso. G-B, G, GH, W, K, BM, OXF).

Distribution: Rare Anatolian endemic found only from the type locality in the Cilician Taurus. Map 30.

TURKEY. C5: Prov. Adana, Masmutli dagh (Masmenu dağ), S.E. of Bereketli, 2000 m., Jul. 1912, Siehe 520.

Habitat: Montane; alt. c. 2000 m. Fl. Jul.

The fruit shape of A. trapeziforme is similar to that of A. floribundum; in leaf shape and size, and the tendency of the fruit to dry reddish-purple, it resembles A. peltarioides. The considerably larger and more undulate fruits, the obovate or spathulate and obtuse or truncate sterile shoot leaves, the longer styles, and the type and density of the stellate hairs on the leaves of A. trapeziforme separate it without difficulty from A. floribundum. From A. peltarioides, A. trapeziforme may be clearly distinguished by the broadly elliptic, acute or truncate fruits, the longer styles, and the long-rayed, coarse stellate hairs on the leaves.

Nyárády expressed doubt as to the correct status of this taxon when he named the original material as A. peltarioides subsp. trapeziforme. The morphological /

morphological discontinuities separating this species from all the others in the subsection are sufficient to allow the recognition at specific rank (Nyárády, 1949). It is sympatric with one of its allies, A. floribundum, but appears to be confined to a very limited range; it has been collected only twice, both times from the same mountain in the Anti-Taurus.

122. A. peltarioides Boiss. in Ann. Sc. Nat., ser. 2, 17, 158 (1842); Boiss., Fl. Or., 1, 272 (1867); Busch in Fl. Cauc. Crit., 3 (4), 572 (1909); Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 84 (1949); Grossh., Fl. Kavk., ed. 2, 4, 215, t. 24, f. 6 (1950).

Key to subspecies

Fruiting corymbs condensed, subumbellate, few-fruited, not more than 5 cm. long; fertile stems congested or decumbent, 5-10 cm. long

peltarioides (T)

Fruiting corymbs widely spreading, many-fruited, always longer than 5 cm.; fertile stems arcuate-ascending or erect, 25-50 (-75) cm. long

virgatiforme (T)

subsp. peltarioides

Syn.: A. peltarioides var. depressum Nyár., loc. cit.!

Type: (Turkey, B7: Prov. Erzincan): Olympus Armeniae (Keşiş dağ) Aucher 286 (holo. G-B, iso. G, K, BM, OXF).

Distribution: Armenian Highlands, Turkish Kurdistan and the Anti-Taurus. Map 30.

TURKEY. A8: Prov. Erzurum, Kop dağ, 2338 m., 8 Aug. 1962, Furze 3718. A9: Prov. Kars, Aschich-Ade (north of Tuzluca), 29 Jul. 1871, Radde 422. A/B8: Prov. Erzurum, Erzurum-Bayburt, above Kochaponar, 1829-2134 m., Aug. 1853, Huet. B5: Prov. Kayseri, Mt. region of Aslandach, 12 lieues à OSE Mt. Argée (Erciyas dağ), 5 Aug. 1856, Balansa 491. B7: Prov. Erzincan, Kechich dagh (Keşiş dağ) 1834, Montbret 2398; ibid., Sipikor dağ 1524-1829 m., 5 Jul. 1189, Sintenis 1268 (holo. var. depressum JE, iso. G, /

G, G-BB, W, GH, K); ibid., 1650 m., 26 Jun. 1934, Balls 1531. B8/9: Prov. Erzurum, Erzurum-Bayazit (Doğubayazit), 77 km. from Erzurum, Kopdagh, 1930 m., 27 Jul.1956, Karamonğlu 78. B9: Prov. Van, Başkale, Ispiriz dağ, 2300 m., 31 Jul. 1954, Davis 23784; ibid., 10 km. S.E. of Pelli, 2591 m., 8 Jul. 1954, Davis 22579; ibid., Artos dağ, 3048 m., 14 Jul. 1954, Davis 22731. C9: Prov. Hakâri, Karadağ (north of Çölemerik), 3580 m., 16 Aug. 1954, Davis 24501. C9/10: Prov. Hakâri, Cilo Tepe, 3100 m., 8 Aug. 1954, Davis 24082a.

Habitat: Alpine on screes and rocky slopes of N. exposure nr. melting snow; alt. 2000-3580 m. Fl. Jun.-Sept.

This species most clearly resembles A. virgatum but may be distinguished by the broader, spathulate or obovate sterile shoot leaves, longer styles, often smaller fruits plus the characters detailed in the discussion under A. virgatum. Furthermore, the dwarf habit and geographical range of A. peltarioides subsp. peltarioides are additional differentiating features.

Subspecific rank for the infra-specific taxa of this species is warranted as the distinguishing characters are constant over the whole range of the species, coupled with altitudinal and geographical preferences. The most westerly stations of the species are composed entirely of subsp. virgatiforme; however, in some localities in the eastern part of the range, the two subspecies are sympatric but are confined to different altitudes (Sintenis 3126 and Sintenis 1268 from Sipikor dağ; Aucher 286 and Davis 31691 from Keşiş dağ). The typical subspecies with a reduced habit is entirely alpine and has a later flowering period than subsp. virgatiforme which often forms mature fruit as early as June.

The /

The original _Aucher_ collection may be identified as var. _depressum_ Nyár. which according to the International Code (Article 26:1961) must be treated as a synonym of the typical subspecies.

subsp. virgatiforme (Nyár.) Dudley, stat. nov.

Syn.: A. peltarioides var. virgatiforme Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 84 (1949).

Lectotype: (Turkey, B7: Prov. Erzincan): Sipikordagh, 28 Jul. 1890, Sintenis 3126 (orig. JE, iso. G, G-BB, W, K, BM, E).

Distribution: N. Central and Central Anatolia, Armenian Highlands, Anti-Taurus and Amanus. The most westerly stations of the species are composed entirely of subsp. virgatiforme, however, in the Armenian Highlands and the Anti-Taurus and two subspecies are broadly sympatric. Map 30.

TURKEY. A4: Prov. Kastamonu, Inebolu-Küre, 914 m., 8 Jun. 1954, Davis 21654. A4/5: Prov. Kastamonu, Tossia (Tosya) nr. Schersch-Oghla, 15 Jul. 1892, Sintenis 4693. A6: Prov. Sivas, Yldisdagh (Yildiz dağ), Wiedemann 46. A/B8: Prov. Erzurum, Bayburt-Erzurum, above Kochaponar, May 1853, Huet. B7: Prov. Tunceli/Erzincan, Pülümür-Selepur, 1950 m., 23 Jul. 1957, Davis 31589; Prov. Erzincan, Keşiş dag above Cimin, 2500-2600 m., 26 Jul. 1957, Davis 31674. B/C6: Prov. Maraş, Maraş-Elbistan, 1829 m., May-Jun., 1865, Haussknecht. C6: Prov. Maraş, Beryt Dagh (Berit dağ), Jul. 1865, Haussknecht. C6: Prov. Hatay, Amanus Mts., May 1892, Post.

Habitat: N. facing igneous slopes; alt. 914-2600 m. This subspecies replaces the typical subspecies at lower altitudinal ranges. Fl. Jun.-Jul.

123. A. virgatum Nyár. in Bul. Grád. Bot. Cluj. 7, 115, pl. 10, t.4, f.60-62, t.6, f.61, t.8, f.92 (1927); Nyár. in Anal. Acad. Rep. Pop. Rom. Secț. Științe, Geol. Geog. Biol., ser. A, mem. 3, 1, 89 (1949).

Syn.: A. argenteum Wittm. var. chrysanthum Boiss., Fl. Or., 1, 271 (1867), pro parte quoad plantam Phrygiam a Balansa lectam!
A. virgatum var. validius Nyár. in Bul. Grád. Bot. Cluj. 7, 117, pl. 11 as subsp. vallidiore and var. validiore (1927)!

Type: (Turkey, A/B 6: Prov. Sivas/Tokat): Pontus australis in m. Tchamlii-bel (Çamlibel dağ), alt. 1600 m. (1500 m.) 31 May (1 Jun.) 1890, Bornmüller 1947 (holo. CL n.v., iso. G-BB, W, K, BM).

Distribution: Endemic to a few mountains in North Central and Central Anatolia. Map 31.

TURKEY. A4: Prov. Çankiri, Çankiri-Ilgaz, 1524 m., 9 Jun. 1954, Davis 21745; ibid., 172 km. from Ankara, road N. of Çankiri, 29 Jun. 1958, Markgraf 10587; Prov. Kastamonu, nr. Küre, 4 May 1892, Sintenis 3775 (holo. A. virgatum var. validius BP n.v., iso. G-BB, W, K). A/B 6: Prov. Sivas/Tokat. dist. Artova, Çambelet dağ (Çamlibel), Artova-Yildizeli, 3 km. N. of high pass, 1450 m., 25 Jun. 1955, Huber-Morath 13094, B2: Prov. Kütahya, Mourad Dagh (Murat dağ), 28 Jun. 1857, Balansa 1249 (372) (orig. synt. of A. argenteum var. chrysanthum, C-B, G, W); ibid., above Gedis, Kisit Sögüt, 1900-2100 m., 5 Jul. 1962, Davis 36841; ibid., Hamam, 1400 m., 5 Jul. 1962, Davis 36685

Habitat: Serpentine, igneous and metamorphic slopes and eroded banks of W. exposure, often in Pinus nigra woods and Quercus scrub; alt. 1400-2100 m. Fl. May-Jul.

A. virgatum/

A. virgatum may be confused with A. peltarioides subsp. virgatiforme or with A. floribundum, all of which are partially sympatric. The congested basal cauline leaves, the smaller plicate leaves, and the shortly branched inflorescence of A. virgatum clearly distinguish it from its two closest allies. It may, additionally, be separated from A. floribundum by the different type and density of leaf indumentum, and the larger differently shaped fruit.

Only one of the varieties (var. validius) described by Nyárády represents true A. virgatum. The other varieties (var. mutabile: 1927 and var. pinardi: 1949) have no relationship with Subsect. Samarifera, but on account of their pubescent ovaries and other correlated characters can only be treated as synonyms of A. cypricum. Nyárády allies var. validius to A. obtusifolium, a view which cannot be accepted when the species of Subsect. Samarifera are regarded as forming a natural taxonomic group.

The specimens cited by Boissier comprising A. argenteum var. chrysanthum are divisible into two unrelated species, A. virgatum and A. murale sensu lat., the Balansa collection from Murat dağ representing the former.

124. A. caricum Dudley & Huber-Morath, sp. nov. Pl. 16. Fig. 6, 1-11. Map 31.

Syn.: A. floribundum Boiss. & Bal. var. latifolium Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 82 (1949)!

Affinis A. peltarioidi Boiss. et A. trapeziformi Bornm. ex Nyar., sed ab ambobus fructibus dissimilibus leviter obcordatis vel late obovatis, stylo longiore tenuiore, habitu magis ramoso, surculis sterilibus crassioribus fere maioribus differt; insuper a priore fructu minus undulato obscure nervoso et ramulis corymbis longis rigidis ascendentibus minus laxis recedit; a posteriore forma pilorum stellatorum dissimile divergit.

Frutex perennis, supra basin multiramosus, base lignosa efoliata 3-13 cm. alta. Planta ex toto (imprimis folia caulium sterilium) indumento albo-argenteo e pilis stellatis radiis (10-) 15-25 (-35) undulatis delicatulis longis vel brevibus saepe ramosis composito dense vestita. Caules floriferi erecti-ascendentes, e basi parce ramosi, parce foliati, 17-30 (-37) cm. alti, basi rubro-purpurei, pilis stellatis appressis multiradiatis superne densioribus tecti. Surculi steriles erecti, e parte inferiore caulium floriferorum ascendentes, rare longiores caulibus floriferis (2.5-) 5-13 cm. alti (subinde multiramosi et efoliati, ramis 25-30 cm. altis), dense foliati, Folia caulium floriferorum anguste oblanceolata vel oblongo-obovata, acuta vel obtusa, 10-15 (-20) mm. longa, 1.5-2 (-3) mm. lata, petiolis 3-5 (-7) mm. longis; summa basi ramulorum inflorescentia e bracteata, 7-10 (-15) mm. longa, 1-2 (-3) mm. lata. Folia caulium sterilium bene evoluta bicolora, obovati-oblanceolata, spatulata, basi cuneata, obtusa vel rare subacuta, (7-) 10-20 mm. longa, (3-) 5-7 mm. lata, petiolis 5-10 mm. longis; pagina superioris indumento 3-4-plo minore eo paginae inferioris et radiis paucioribus brevioribus /

brevioribus obtecta. Corymbi magni, multiramosi, 5-10 (-15) cm. alti et lati, ramulis ultimis rigidis stricte ascendentibus 5-10 (15) mm. longis corymbis ultimis umbelliformibus fructibus 4-10 (-15). Pedicelli fragillimi, tenues, flexuosi, deflexi, (3-) 4-5 (-5.5) mm. longi pilis stellatis appressis vel subappressis 10-15-radiatis pauce vel dense obsiti. Sepala lanceolata vel ovata, acuta, apice cucullata, 2-2.5 mm. longa, (0.5-) 0.8-1 mm. lata, margine angusta hyalina et pilis stellatis multiradiatis radiis ± brevibus parcis vel copiosis provisa. Petala obovata, spatulata, integra vel subretusa, 3-3.5 mm. longa, 1-1.5 mm. lata, glabra vel rare in ungue pilis stellatis paucis provisa. Filamenta longa 2.5-3 mm. longa, ala unilaterali in dimidio inferiore connata, apice libro 1-2-dentato 0.3-0.5 (0.7) mm. longo. Filamenta brevia 2 mm. longa, appendice lata libra lanceolata vel oblanceolata acuta vel minute denticulata, (1-) 1.5-2 (-2.5) mm. longa, 0.4-0.5 mm. lata praedita. Ovula una per loculum. Ovarium 1-1.5 mm. longum, 0.5-1 mm. latum, glabrum, transparens, infirme obcordatum, retusum, subflavoviride. Glandulae minutae. Stylus glaber, tenuis, inaequaliter insertus, 1-1.5 (-2) mm. longus. Silicula uni-duo-seminata, brunneo-viridia, late obovata vel leviter obcordata, retusa vel rare truncata, basi breve attenuata (5-) 6-7.5 (-8) mm. longa, 4.5-6 (-6.5) mm. lata, saepe pendula, margine parce papillosa imprimis apicem versus, valvis membranaceis glabris laevigatis haud undulatis ad medium subinflatis inconspicue nervosis. Semina in aqua limosa, oblonga compressa, 2.5 mm. longa, 1.5 mm. lata, ala 0.1-0.2 (-0.3) mm. lata. Fl. Apr.-Iun., fr. Jun.-Jul.

TURKEY. C2: Prov. Muğla, Muğla-Fethiye, Kalkgeröll linkes Ufer des Namlam Çay, 42 km. südöstlich Muğla, 100 m., 20 Jun. 1954, Huber-Morath 12824 (holo. Hub.-Mor., iso. E); ibid., Muğla-Fethiye, route 6, 8 miles from Muğla, 590 m., forming /

forming dense compact clumps, common in roadside scree and serpentine outcrops, 29 May 1962, Dudley (D. 35132, E); ibid., 25 miles from Muğla, roadsides serpentine ledges and scree, 70 m., 29 May 1962, Dudley (D. 35137, E); ibid., Muğla-Marmaris, Poterium macchie, 45 km. südlich Muğla, 20 km. nördlich Marmaris, 40 m., 19 Jun. 1954, Huber-Morath 12823 (Hub.-Mor., E); ibid., 20 km. from Marmaris, 60 m., very dry roadside, and serpentine outcrops, forming dense suffruticose, saxatile, spreading clumps, often leafless up to 2 ft.; 5 Jun. 1962, Dudley (D. 35390, E); ibid., Kara böyurtleri köyü, 30 Apr. 1958, Kayacik & Yaltirik (E); ibid., Sandras dağ, above Ağla on serpentine, 1219 m., 22 Jul. 1947, Davis 13563 & 13621 (E); ibid., Muğla-Fethiye, rechtes Ufer des Namlam Çay, Macchie, 42 km. südöstlich Muğla, 7 Jun. 1938, Huber-Morath 5149 (synt. A. floribundum f. latifolium Hub.-Mor.); ibid., Pinetum 116 km. südöstlich Muğla, 6 km. ob Gölük, 300 m., 7 Jun. 1938, Huber-Morath 5566 (synt. A. floribundum f. latifolium Hub.-Mor.); ibid., Kale-Tavas-Muğla, Pinus brutia-Wald, 47 km. nach Kale, 5 Jun. 1938, Huber-Morath 5567 (synt. A. floribundum f. latifolium, Hub.-Mor.); ibid., Muğla-Kale, 35 km. from Muğla, 900 m., serpentine outcrops in deep gorge, open Pinus nigra woods, 28 May 1962, Dudley (D. 35128, E); ibid., 30 km. from Muğla, 850-870 m., steepest descent on road, serpentine outcrops and scree, dominant plant in shade of Pinus brutia-Pinus nigra overlap, 28 May 1962, Dudley (D. 35123, E); ibid., 30 miles from Muğla, c. 25 miles from Kale, 460 m., serpentine outcrops and scree, saxatile on cliffs and ledges, 9 Jun. 1962, Dudley (D. 35531, E).

Habitat: Saxatile on serpentine outcrops, cliffs, ledges and scree; often in Quercus scrub and Pinus brutia or P. nigra woods; alt. (40-) 100-900 (-1219) m.

A. /

A. caricum shows the closest affinity with A. peltarioides and A. trapeziforme, from which it is readily distinguished by its distinctive obcordate fruits, shorter styles, extremely woody and branched base (often leafless from the base for a foot or more) and the dense cushion of sterile shoots (often 3-4 feet across).

The author has observed that A. caricum grows with A. corsicum in the lowland areas of Caria in S.W. Anatolia, but is restricted to serpentine outcrops and completely replaces A. corsicum in montane and alpine regions. Whereas A. caricum has a very restricted distribution of about 100 square miles, A. corsicum has a much wider range in Western Anatolia and is primarily a plant of neglected fields and disturbed areas.

Nyárády erroneously described this plant as a variety of A. floribundum (var. latifolium) to which A. caricum is not closely allied, differing in the shape and indumentum of the leaves and in the strikingly dissimilar fruits.

125. A. pinifolium (Nyár.) Dudley, comb. nov.; Schulz in Nat. Pflanzenfam., 17b, 492 as Triplopetalum (1936). Fig. 1B, c, r.

Syn.: Triplopetalum pinifolium Nyár. in Mag. Bot. Lap., 24, 97, t.1, f.1-14 (1925)!

Type: (Turkey, A1 (A): Prov. Çanakkale): in monte Ulu Dagh prope Renkoi (Erenköy) Anatoliae, 24 Apr. 1883, Sintenis 292 (holo. LD n.v., iso. G-B, G, UW, W, W-Hal., K, BM, E).

Distribution: An Anatolian endemic collected only twice from the Dardanelles. Map 31.

TURKEY. A1(A): Prov. Çanakkale, valley of Rhodius, Giaur Hissar (Çanakkale-Kirazli), Apr. 1856, Kirk (E).

The decision to regard this taxon, originally described as the type of the monotypic genus, Triplopetalum, as a species of Alyssum was difficult. Apart from the problem of assessing the value of the characters used to delimit Triplopetalum in a generic and specific sense, the material extant in the numerous herbaria visited consisted only of duplicates of the type collection, all without fruits. Unfortunately, the only other collection (Kirk) made many years earlier was also in the flowering state. It was established by over-all resemblances and floral morphology, however, that Triplopetalum falls within a natural species complex containing all the taxa of Sect. Odontarrhena with indehiscent silicules and brittle, deflexed or sigmoid pedicels.

The characters distinguishing A. pinifolium from the other species of the complex are essentially those which characterized the genus Triplopetalum; i.e. the consistent presence of "sphaeroid crystals" appearing/

appearing as pellucid dots on the sepals, petals, filaments and ovary, the unusual needle-like almost cylindrical leaves, and the basal appendages on the petals (giving the name of the genus).

Clearly A. lesbiacum with its samaroid indehiscent fruits and fragile sigmoid pedicels must be considered in close relationship with such species as A. samariferum, A. peltarioides, A. dubertretii, etc. The fact that A. lesbiacum possesses consistently appendaged petals as noted originally by Candargy - "petala ... unguiculata basi bialata", cannot be ignored when determining the fate of Triplopetalum. Without a doubt the wings or appendages of A. lesbiacum are homologous with those of Triplopetalum. To consider Triplopetalum as a distinct genus would defeat the purposes of the proposed natural grouping of Subsect. Samarifera, and would cause it to be separated from those species with which it is very closely allied. Further, it would be equally unsatisfactory to regard A. lesbiacum as a species of Triplopetalum, thereby cleaving it from its closest allies. It is necessary, then, to include Triplopetalum pinifolium in the complex of Sect. Odontarrhena - i.e. Subsect. Samarifera - which contains the closely allied A. lesbiacum and A. virgatum. The habit, petal shape and pubescence, filament appendages, type of stellate hair, and congestion of the lower cauline leaves into a distinct zone shown by these three species are remarkably similar. The leaves of A. virgatum show a resemblance to those of A. pinifolium but are broader and less involute and cylindrical.

Nyárády commented that the sepals of Alyssum are always covered with a dense indumentum and that those of Triplopetalum were glabrous or/

or almost entirely so. Although the sepals of most species of _Alyssum_ are covered with a more or less dense indumentum, the sepal pubescence of a number of species in Subsect. _Samarifera_ is often very sparse. Nyárády (1925 and 1927) further claims that the appendages on the petals of _Triplopetalum_ are not a proliferation of the claw margins, a phenomenon which accounts for the occasional production of appendages or teeth on petals in some species of _Alyssum_ (i.e. _A. borzaeanum_) and which he probably correctly considers an "atavism", but originate as individual vertical laminae from the _inner_ surface of the claw and are probably equivalent to the ligule formation in some _Caryophyllaceae_ or _Boraginaceae_ corollas. As the respective appendages are analogous structures, _Alyssum_ and _Triplopetalum_ must represent different genera (_fide_ Nyárády).

It is not the intention of the author to present ontogenetic or phylogenetic arguments regarding the homology of petal appendages or the significance of crystals, but it is clear on the basis of the general resemblances listed above, that _Triplopetalum_ should be included in _Alyssum_.

126. A. samariferum Boiss. & Hausskn. in Boiss., Fl. Or., 1, 272 (1867); Hooker, Ic. Pl., 15, 62, t.1477 (1885); Nyár. in Anal. Acad. Rep. Pop. Rom. Secţ. Ştiinţe Geol. Geog. Biol., ser. A, mem. 5, 1, t.6, f.12, 13 (1949).

Type: (Turkey, C6: Prov. Maraş): in monte Berydagh Cataoniae (Berit dağ), 1829- 2338 m., 8 Aug. 1865, Haussknecht (holo. G-B, iso., W, K, BM).

Distribution: Endemic to E. Anatolia, Anti-Taurus, Amanus and N. Syria. Map 31.

TURKEY. B7: Prov. Erzincan, Refahiye-Erzincan, 1800 m., 26 Aug. 1957, Davis 32690; Prov. Tunceli, Pülümür, 1900 m., 18 Aug. 1961, Karamanoğlu 2. C6: Prov. Hatay, Amanus Mts., forest road from Ersin, 1200-1800 m., 13 Oct. 1957, Kühne 1415; ibid., valley of Durdakan (N. of Iskenderun), 11 Sept. 1887, Post. 25; Prov. Adana/Hatay, Baki, Ergani (Osmaniyi) - Guleman, Aug. 1944, Birand; ibid. Ceyhan-Osmaniye-Yaglipinar, S. of Yarpus, 1430-1500 m., 1 Jul. 1959, Huber-Morath 16225.

Habitat: In woods and on igneous rocky slopes; alt. 1200-2338 m. Fl. Jul.-Aug.

The extremely large fruits, long pedicels, short styles, large seeds and concolorous plicate linear-oblanceolate leaves of the sterile shoots of A. samariferum are clear morphological discontinuities which distinguish this species from its closest ally, A. peltarioides with which it is sometimes confused, especially in the eastern part of its range.

With the large samaroid fruits A. samariferum is one of the most distinctive species of Alyssum and is regarded as the type species of the subsection. It illustrates a common Anatolian pattern of distribution, /

bution, extending from the Armenian Highlands diagonally south-westwards into the Anti-Taurus, the Amanus and N. Syria. The eastern collections (Davis 32690 and Karamanoglu 2) have smaller fruits (the smallest measuring c. 7 x 7 mm.) than specimens from the Anti-Taurus and Amanus whose fruits measure c. 10-20 mm. long and broad. This diminishing size of the fruit may have some correlation with a change in habitat; yet, the other specific characters remain unchanged.

127. A. dubertretii Gomb. in Mém. Soc. Bot. Fr., 33, 4 (1952). Fig. 7, 1-6.

Type: (Turkey, C6: Prov. Hatay): dans l'Amanus au-dessus de Beylan (Belen), Frère Louis (holo. P, n.v.).

Distribution: Endemic in Anatolia from the Amanus. Map 31.

TURKEY. C6: Prov. Hatay, Saouk-Olouk (Souluk, 3 km. W. of Belen), Delbès; ibid., Belen-Iskenderun, 14 Jul. 1884, Post.

This endemic, confined to the Amanus, occurs within the range of A. samariferum, but appears to be more closely related to A. floribundum. A. dubertretii is clearly distinguished from this species by the presence of pubescence on the fruits, the concolorous oblanceolate to obovate larger leaves, sparser indumentum of longer and fewer rayed stellate hairs, and longer styles.

The specimens cited by Gombault were not seen; however, the Post specimen fits the type description exactly.

128. A. lesbiacum (Cand.) Rech. fil., Fl. Aegaea, 226 (1943); Nyár. in Anal. Acad. Rep. Pop. Rom. Soc. Ştiinţe Geol. Geog. Biol., ser. A, mem. 3, 1, 81, t. 6, f. 9 (1949).

Syn.: Odontarrhena lesbiaca Cand. in Bull. Soc. Bot. Fr., 44, 153 (1897) & in Rev. Gén. Bot., 11, t. 14, f. c-g (1899).

Type: (Aegean Islands, Bl: Mytilene (Lesbos)); in reg. inf. et sup. micaschistica et ophitica Maleae Olympiaeque, Candargy (Candargy's types have not been located; fide Rech. fil., op. cit., 852).

Distribution: Endemic to Lesbos. Map 31.

AEGEAN ISLANDS. Bl: Mytilene (Lesbos), between Ajassos and Magali Limni, 200-300 m., 18-24 May, 1934, Rechinger 5507; ibid., Hagios Marina, Malea (Mt. Amali), c. 200 m., 18-24 May, 1934, Rechinger 5494.

Habitat: Restricted to serpentine; alt. 200-300 m., Fl. May.

Candargy distinguishes this species from A. elatum, a species referred in this study to Subsect. Compressa. An examination of all the Odontarrhena indicates that the taxa most closely allied to A. lesbiacum are to be found in Subsect. Samarifera. The very short style and the orbicular or transversely elliptic and deeply emarginate fruits are clear-cut morphological discontinuities separating A. lesbiacum from A. dubertretii and A. samariferum. The glabrous and much larger fruits and the different filament configurations of the latter could not be confused with those of A. lesbiacum. A. dubertretii and A. lesbiacum are the only species in the subsection possessing indumentum on the fruit; but the longer style, smaller and differently shaped fruits and the sparser leaf indumentum of the former should preclude the two species being misidentified.

The /

The petals of all specimens of A. lesbiacum consistently have lateral denticulate appendages or wings at the base of the petal claw. This is a feature unique to Subsect. Samarifera and is present only in this species and A. pinifolium, from which A. lesbiacum may be distinguished by the size and shape of its fruits, the lack of formation of crystals on the floral parts and the flat oblanceolate leaves (the leaves of A. pinifolium being needle-like and strongly involute).

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I N D E X E S

(1) Index to Genera, Sections, Subsections, Series and other Infra-generic groups

Sect. /

Sect. /

(2) Index to Accepted Specific and Infra-specific Epithets

ALYSSUM

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APPENDIX

(1) Figures

No. 4: A. blepharocarpum & A. davisianum.

5: A. harputicum & A. sulphureum.

6: A. caricum & A. trichocarpum.

7: A. dubertretii & A. huber-morathii.

8: A. discolor.

(2) Plates

No. 1: Aurinia saxatilis subsp. megalocarpa.

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3. A. strigosum subsp. strigosum.

4. A. hirsutum var. caespitosum (holotype).

5: A. trichocarpum (holotype).

6: A. stribrnyi.

7: A. corningii (holotype).

8: A. sulphureum (holotype).

9: A. sulphureum.

10: A. harputicum (holotype).

11: A. niveum (holotype).

12: A. corsicum.

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14: A. discolor.

15: A. huber-morathii (holotype).

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(3) Distribution Maps

No. 1: Distribution of Aurinia saxatilis subsp.

saxatilis /

saxatilis, subsp. orientalis & subsp. megalocarpa.

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12 /

12: Distribution of _A. hirsutum_ var. _hirsutum_, var. _caespitosum_ & _A. stapfii_.

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15: Turkish distribution of _A. pseudo-mouradicum_, _A. artwinense_ & _A. erosulum_.

16: European and Turkish distribution of _A. stribrnyi_, _A. ochroleucum_ & _A. armenum_.

17: Turkish distribution of _A. mouradicum_, _A. praecox_ var. _praecox_ and var. _albiflorum_.

18: Turkish distribution of _A. argyrophyllum_ _A. bornmuelleri_ & _A. lepidotum_.

19: Turkish distribution of _A. aizoides_, _A. aurantiacum_, _A. caespitosum_ & _A. propinguum_.

20: Turkish distribution of _A. paphlagonicum_, _A. thymops_, _A. lycaonicum_, _A. harputicum_ & _A. niveum_.

21: Turkish distribution of _A. baumgartnerianum_, _A. corningii_, _A. lepidoto-stellatum_, _A. sulphureum_ & _A. tetrastemon_.

22 /

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23: Turkish distribution of <u>A. davisianum</u>, <u>A. discolor</u>, <u>A. constellatum</u>, <u>A. masmenaeum</u> & <u>A. oxycarpum</u>.

24: Turkish distribution of <u>A. callichroum</u>, <u>A. eriophyllum</u>, <u>A. huber-morathii</u> & <u>A. longistylum</u>.

25: European and Oriental distribution of <u>A. borzaeanum</u>, <u>A. cassium</u>, <u>A. gehamense</u>, <u>A. pateri</u> subsp. <u>pateri</u>, subsp. <u>prostratum</u> & intermediates.

26: Oriental distribution of <u>A. condensatum</u> subsp. <u>condensatum</u>, subsp. <u>flexibile</u> and intermediates.

27: Turkish distribution of <u>A. anatolicum</u>, <u>A. cypricum</u>, <u>A. filiforme</u>, <u>A. haussknechtii</u> & <u>A. syriacum</u>.

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29: Turkish distribution of <u>A. corsicum</u>, <u>A. crenulatum</u>, <u>A. cilicicum</u>, <u>A. giosnanum</u> & <u>A. elatum</u>.

30: Turkish distribution of <u>A. trapeziforme</u>, <u>A.</u> /

A. peltarioides subsp. _peltarioides_
& subsp. _virgatiforme_.

31: Turkish distribution of _A. caricum_, _A. dubertretii_, _A. floribundum_, _A. lesbiacum_, _A. pinifolium_, _A. samariferum_ & _A. virgatum_.

(4) _Separate of_ "Some New _Alyssa_ From the Near East".

Fig. 4. A. blepharocarpum (1-13): 1) silicule (side view), X 6. 2-5) silicules indicating variability of indumentum (face view), X 6. 6) seed, X 6. 7) sepals, X 9. 8) long filaments, X 9. 9) short filaments, X 9. 10) petals, X 9. 11 & 12) leaves of two different gatherings, X 2. 13) stellate hairs from upper surface of a leaf, X 40.

A. davisianum (14-22): 14) silicule (face view), X 6. 15) silicule (side view, X 6. 16) long filaments, X 9. 17) short filaments, X 9. 18) petal, X 9. 19) sepal, X 9. 20) cauline leaf, X 2. 21) stellate hairs from upper surface of a cauline leaf, X 40. 22) woody base of plant with a sterile shoot, X 1.

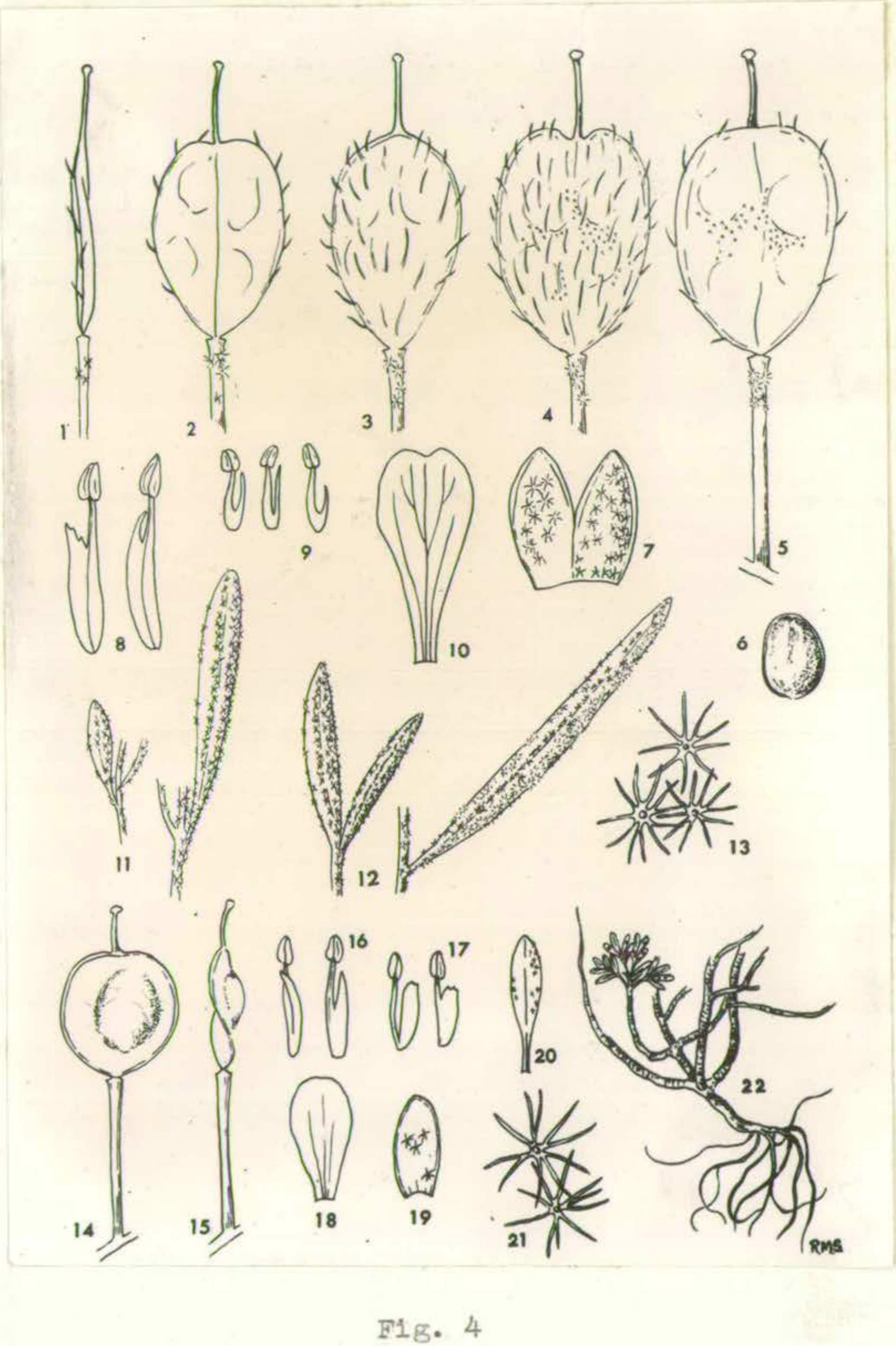


Fig. 4

Fig. 5. A. harputicum (1-12): 1) silicule (immature), X 9. 2) lepidote hair from silicule, X 40. 3) short filament, X 9. 4) long filaments, X 9. 5) petal, X 9. 6) sepals, X 9. 7) ventral surface of a sepal with stellate hairs, X 9. 8) stigma, X 16. 9) sterile shoot, X 2. 10) lower cauline leaves, X 2. 11) upper cauline leaf, X 2. 12) lepidote scale from upper surface of a lower cauline leaf, X 40. A. sulphureum (13-26): 13) ultimate inflorescence, X 1. 14) silicule (face view), X 6. 15) silicule (side view), X 6. 16) stellate hair from silicule, x 40. 17) short filaments, X 9. 18) long filaments, X 9. 19) petal, X 9. 20) sepals, X 9. 21) ventral surface of a sepal with stellate hairs, X 9. 22) tuberculate and divergent rayed stellate hair from apex of a sepal, X 40. 23) sublepidote stellate hair from exterior of a sepal, X 40. 24) seed, X 6. 25) sterile shoot, X 2. 26) cauline leaf, X 2.

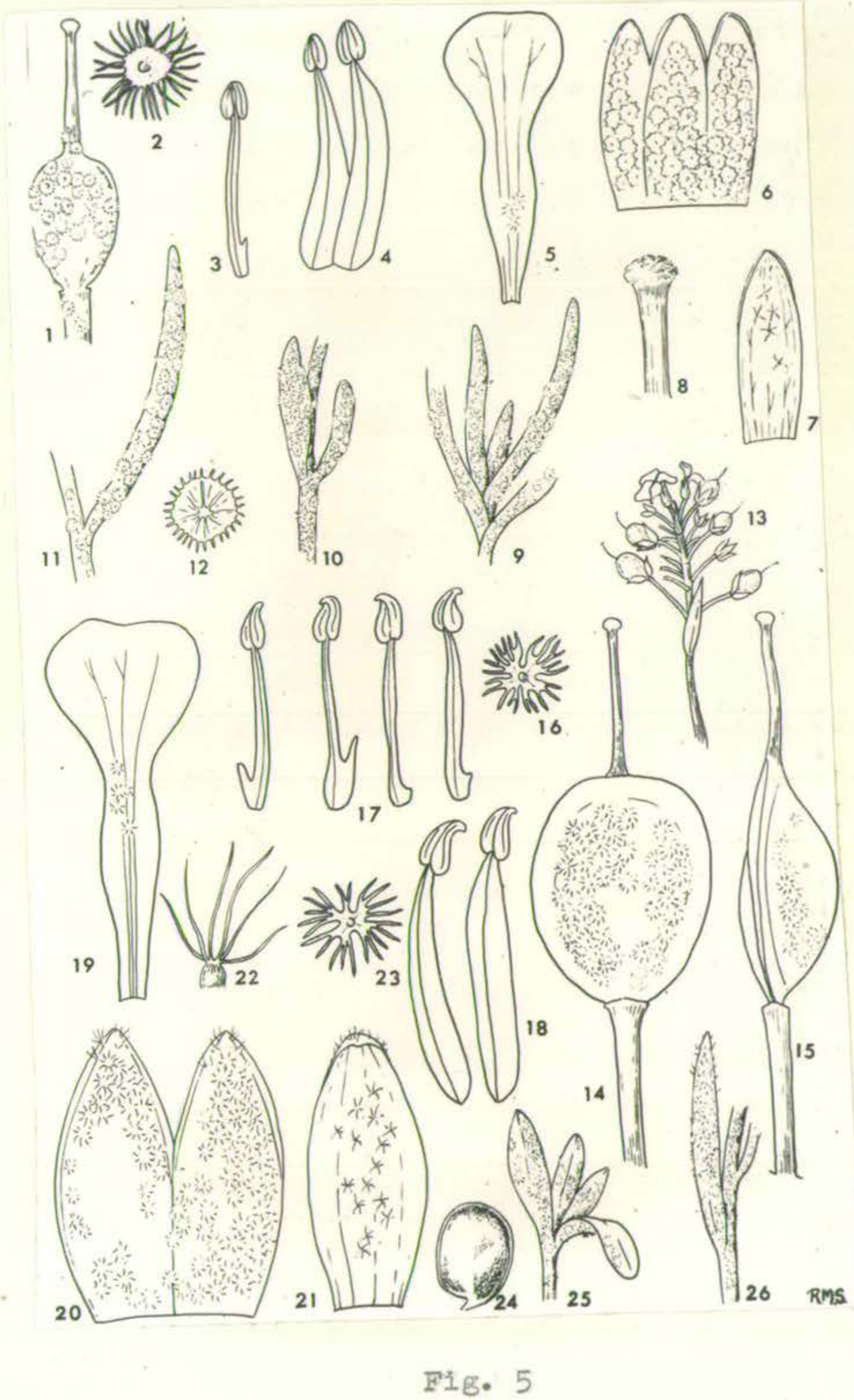


Fig. 5

Fig. 6. A. caricum (1-11): 1) ultimate inflorescence, X 1. 2) silicule (face view), X 6. 3) silicule (side view), X 6. 4) seed, X 6. 5) long filaments, X 9. 6) short filaments, X 9. 7) petal, X 9. 8) sepals, X 9. 9) leaf of sterile shoot, X 2. 10) cauline leaf, X 2. 11) stellate hair from upper surface of a cauline leaf, X 40.

A. trichocarpum (12-22): 12) silicule (face view), X 6. 13) silicule (side view), X 6. 14) stellate hair from silicule, X 40. 15) tuberculate hairs from silicules, X 12. 16) seed, X 6. 17) long filaments, X 9. 18) short filaments, X 9. 19) petal, X 9. 20) sepal, X 9. 21) leaf, X 2. 22) stellate hairs from upper surface of a leaf, X 40.

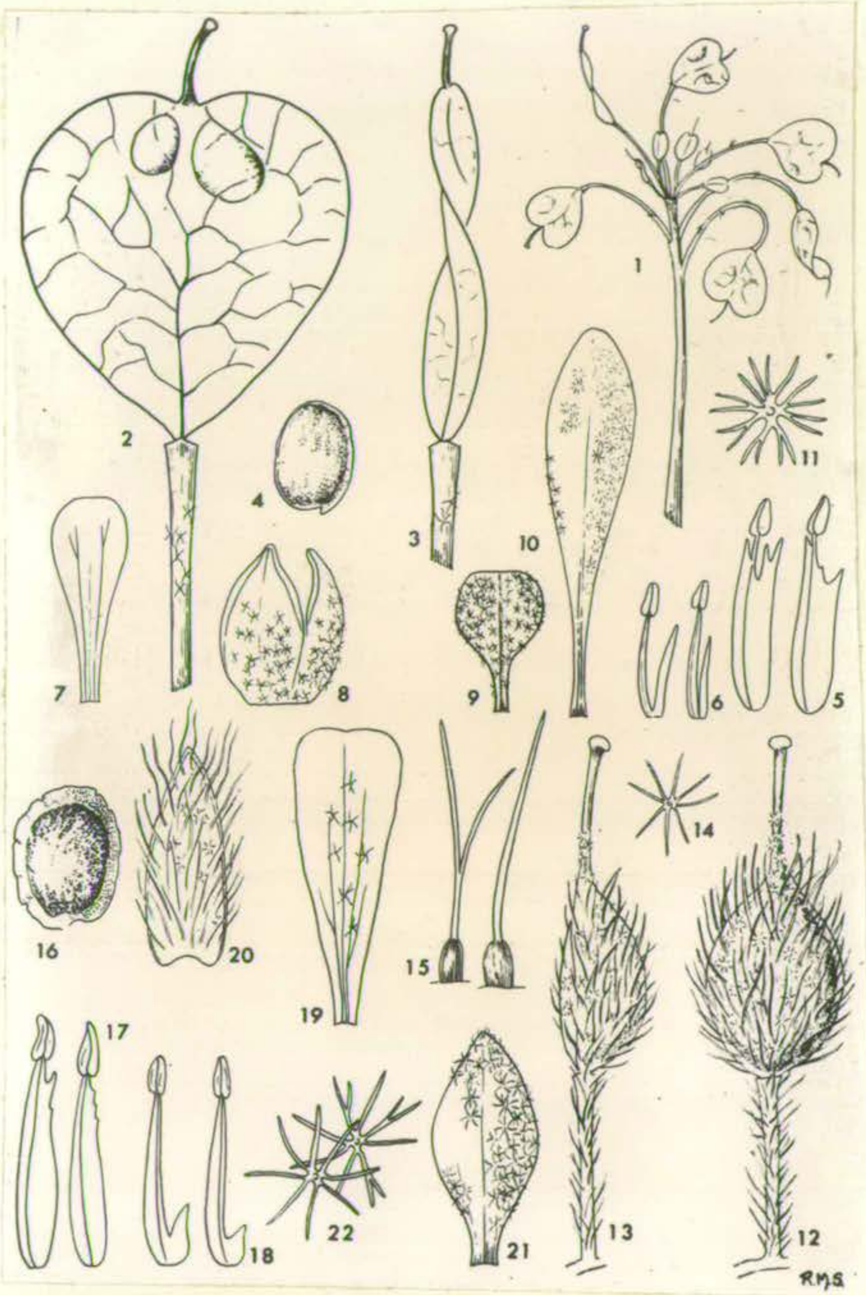


Fig. 6

Fig. 7. A. dubertretii (1-6): 1) silicule (face view), X 8. 2) ultimate fruiting branch, X 15. 3) stellate hairs from silicule, X 125. 4) silicule (side view), X 8. 5) cauline leaf, X 3. 6) stellate hairs from upper surface of cauline leaf, X 95.

A. huber-morathii (7-18): 7) sepals, X 14. 8) petals, X 10. 9) short filaments, X 16. 10) long filaments, X 10. 11) silicule (face view), X 9. 12) silicule (side view), X 9. 13) stellate hairs from silicule, X 40. 14) largest leaf of a sterile shoot, X 2. 15) medium leaf of a sterile shoot, X 2. 16) smallest leaf of a sterile shoot, X 20. 17) stellate hair from upper surface of a leaf of a sterile shoot, X 20. 18) seed, X 26.

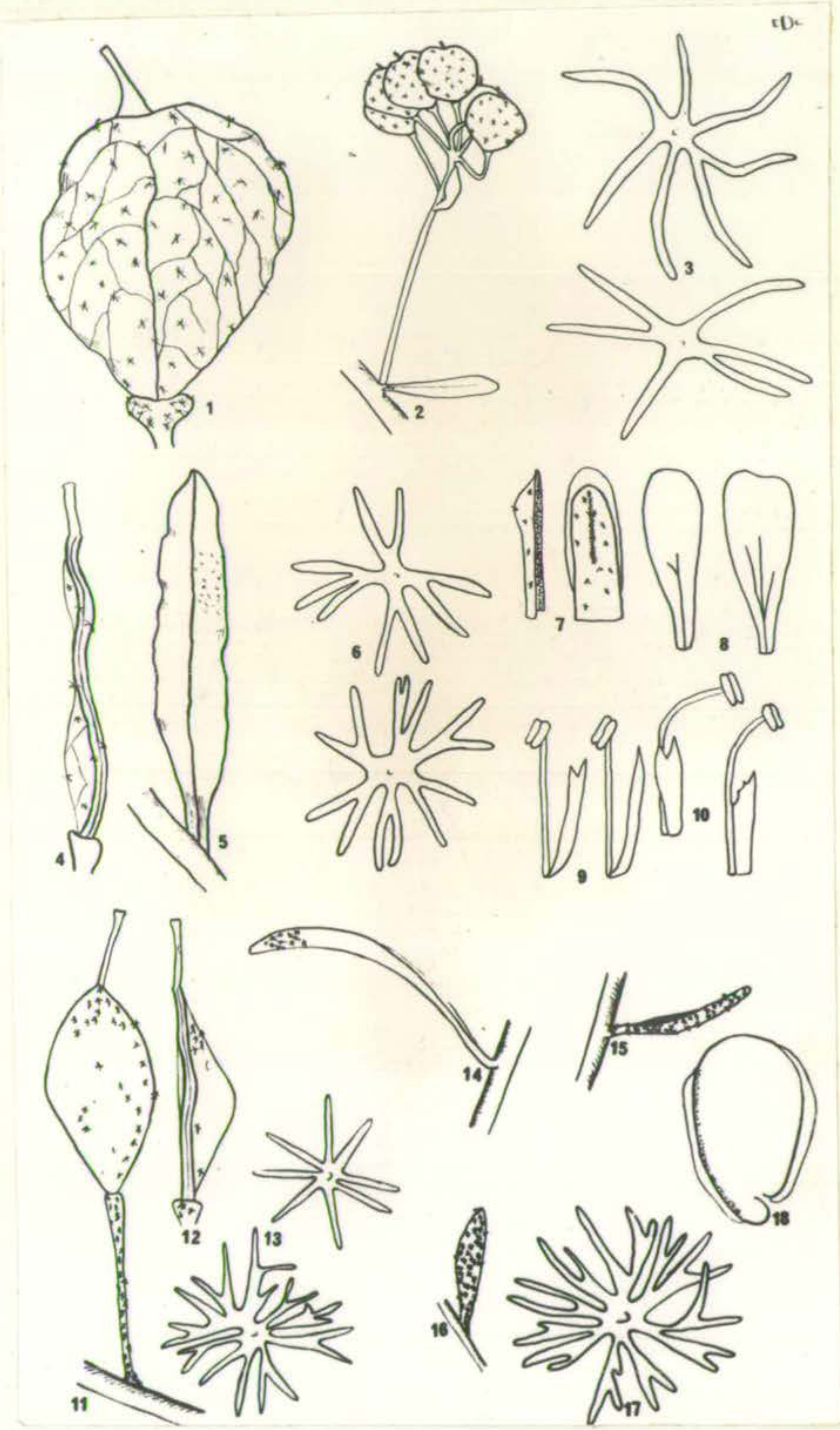


Fig. 7

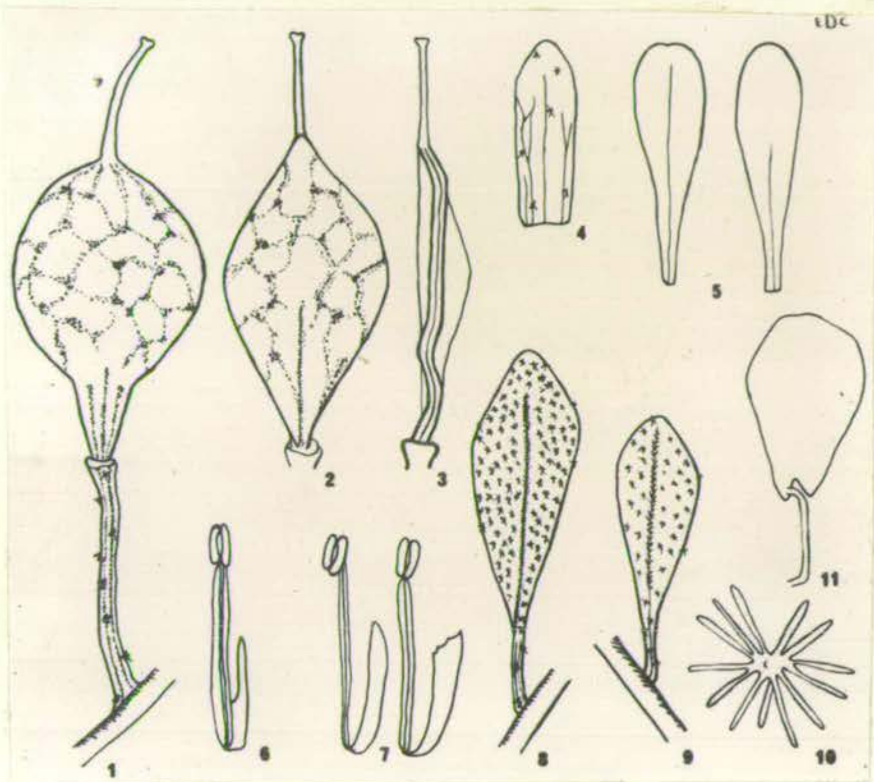


Fig. 8. A. discolor (1-11): 1 & 2) silicules (face views), X 7. 3) silicule (side view), X 7. 4) sepal, X 9. 5) petals, X 9. 6) long filaments, X 8. 7) short filaments, X 12. 8) cauline leaf (lower surface), X 2. 9) leaf of a sterile shoot (upper surface), X 3. 10) stellate hair from upper surface of cauline leaf, X 95. 11) seed, X 26.

Plate 1. Aurinia saxatilis subsp. megalocarpa (Hausskn.) Dudley, growing in the ruins of Priene. (Turkey, C1: Prov. Aydin, Dudley, D. 34972a).

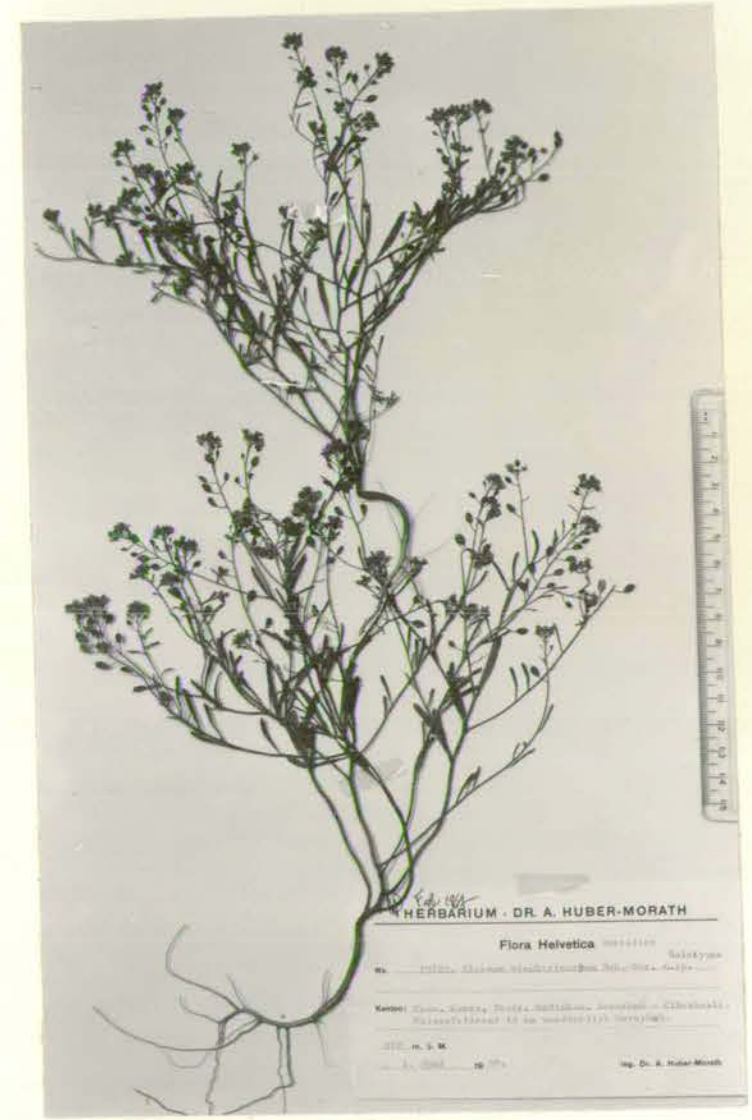


Plate 2. A. blepharocarpum Dudley & Huber-Morath, (holotype, Huber-Morath 13722).

Plate 3. A. strigosum Banks & Sol. subsp. strigosum. growing in sand dunes. (Turkey, A1: E, Prov. Istanbul, Dudley, D. 34669).

Plate 4. A. hirsutum var. caespitosum Dudley, (holotype, Huber-Morath 5150).

Plate 5. A. trichocarpum Dudley & Huber-Morath, (holotype Huber-Morath 9253).

Plate 6. A. stribrnyi Velen., growing in sand dunes. (Turkey, A1: E, Prov. Istanbul, Dudley, D. 34558).

Plate 7. A. corningii Dudley, (holotype, Dudley, D. 35911).

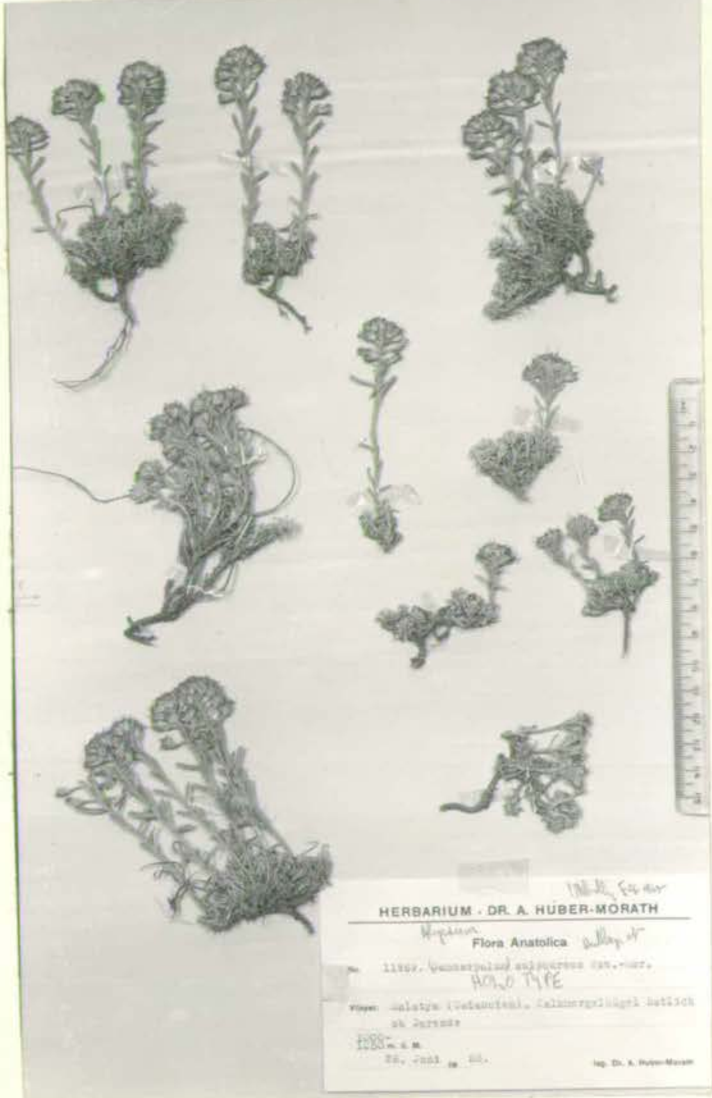


Plate 8. A. sulphureum Dudley & Huber-Morath, (holotype, Huber-Morath 11969).

Plate 9. _A. sulphureum_ Dudley & Huber-Morath, close-up of silicules, persistent sepals and a sterile shoot. (Turkey, C9: Prov. Hakâri, _Nábělek_ 1264).

Plate 10. <u>A. harputicum</u> Dudley, (holotype, <u>Sintenis</u> 323).

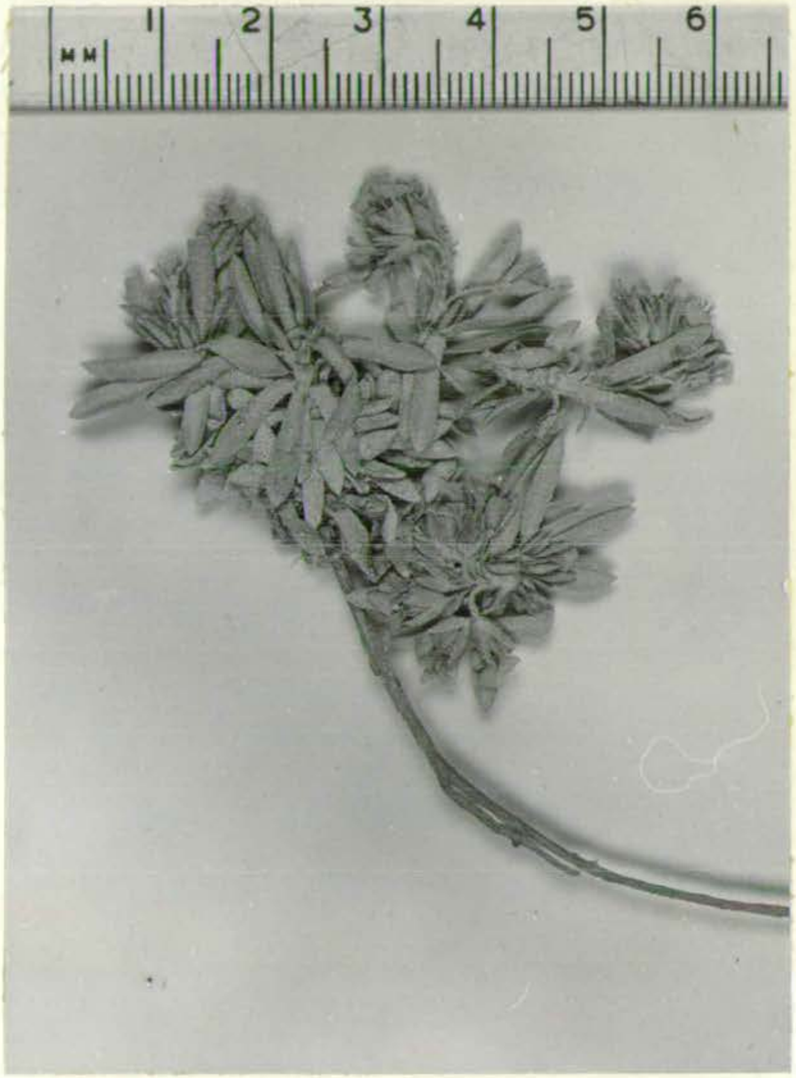


Plate 11. A. niveum Dudley, (holotype, Romieux).

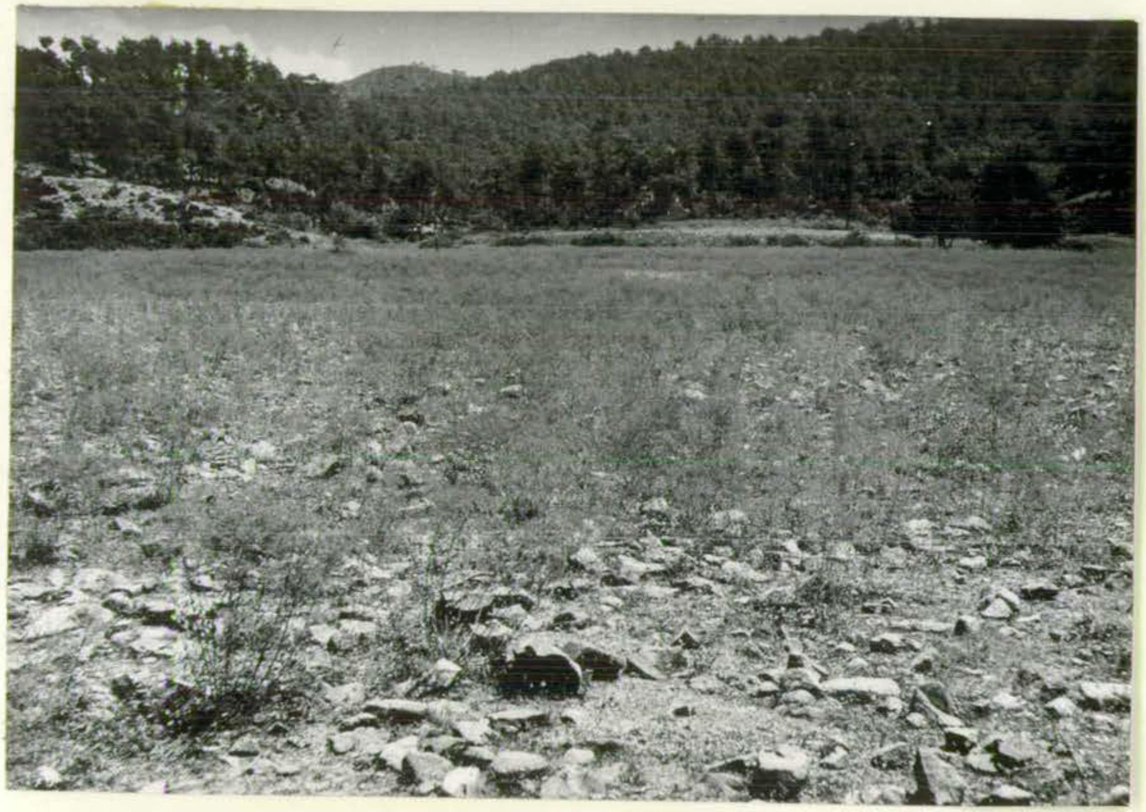


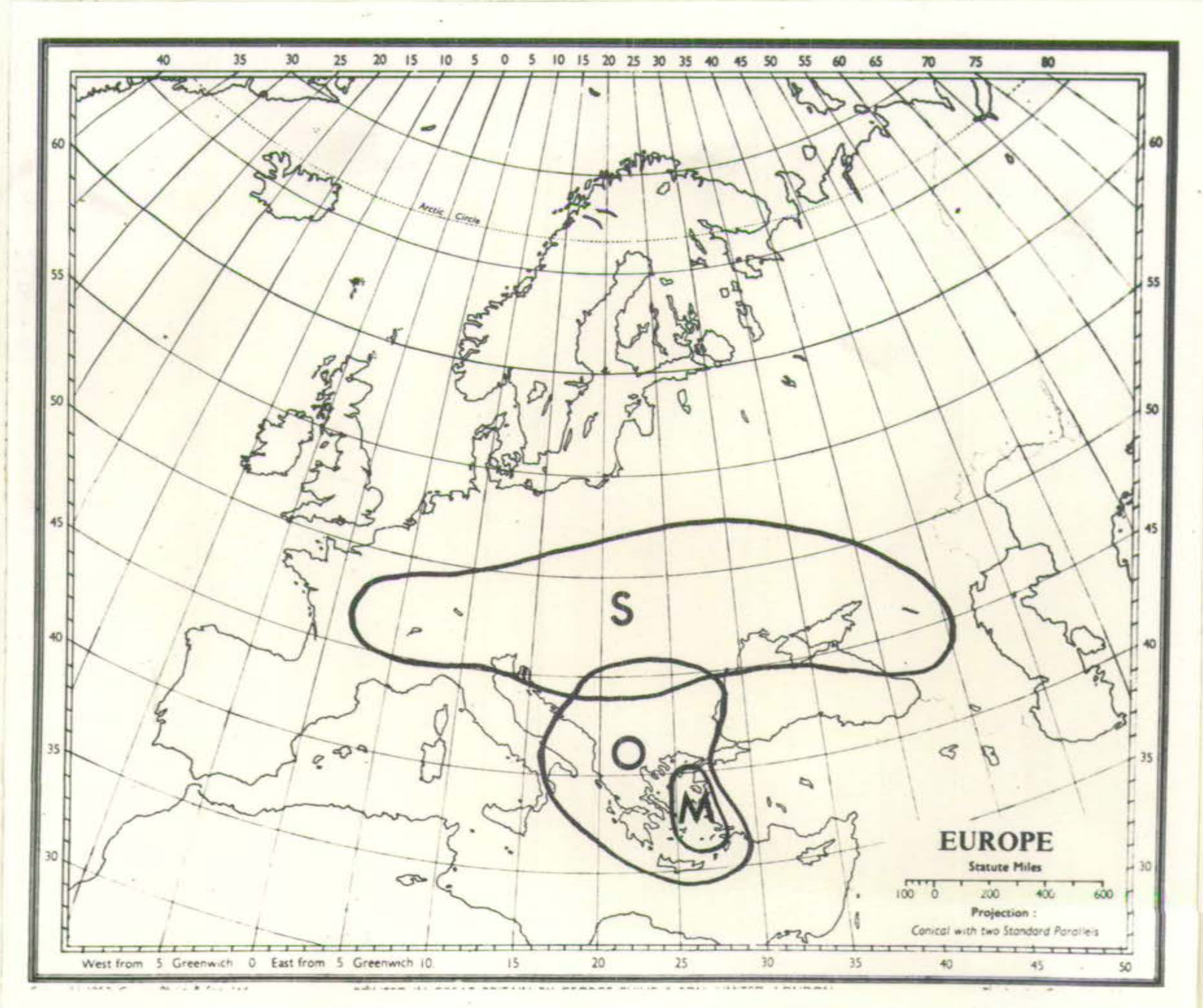
Plate 12. A. corsicum Duby, growing in large masses in stony abandoned fields. (Turkey, C2: Prov. Muğla, Dudley, D. 35131).

Plate 13. A. discolor Dudley & Huber-Morath, (holotype, Huber-Morath 1755).

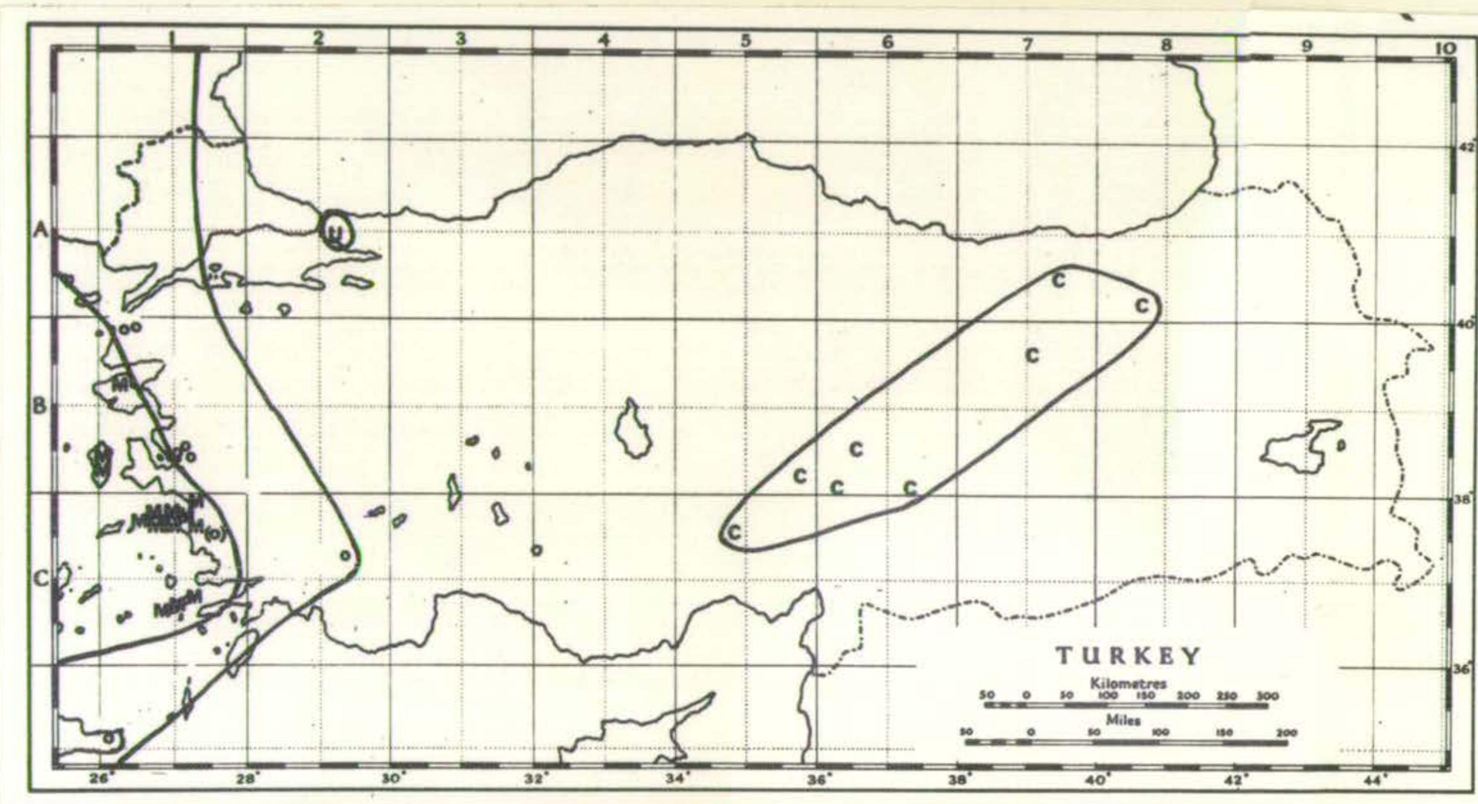
Plate 14. A. discolor Dudley & Huber-Morath, with mature fruit. (Turkey, C2: Prov. Mugla, Dudley, D. 35391).

Plate 15. <u>A. huber-morathii</u> Dudley, (holotype, Khan <u>et.al</u>. 256).

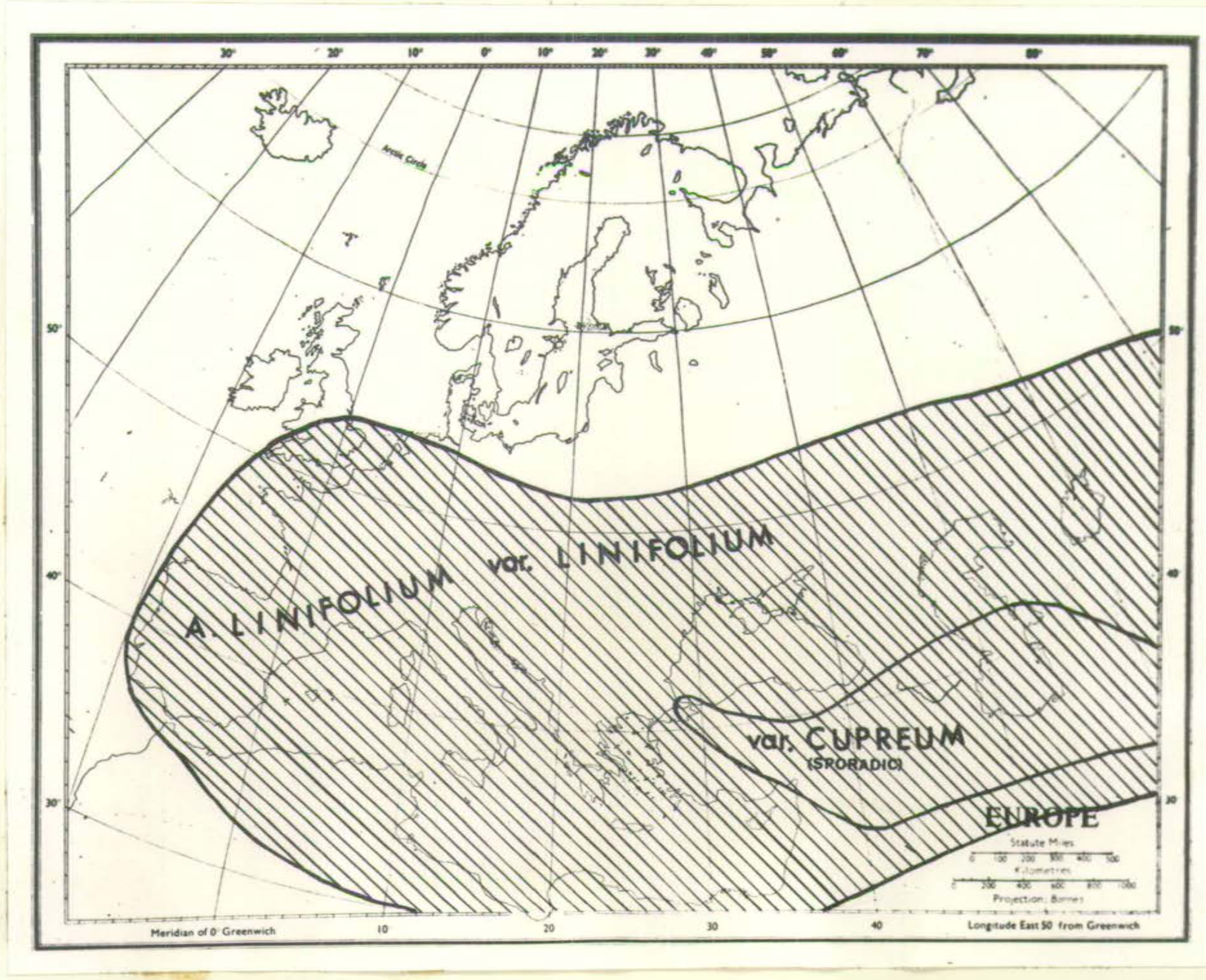
Plate 16. A. caricum Dudley & Huber-Morath, (holotype, Huber-Morath 12824).



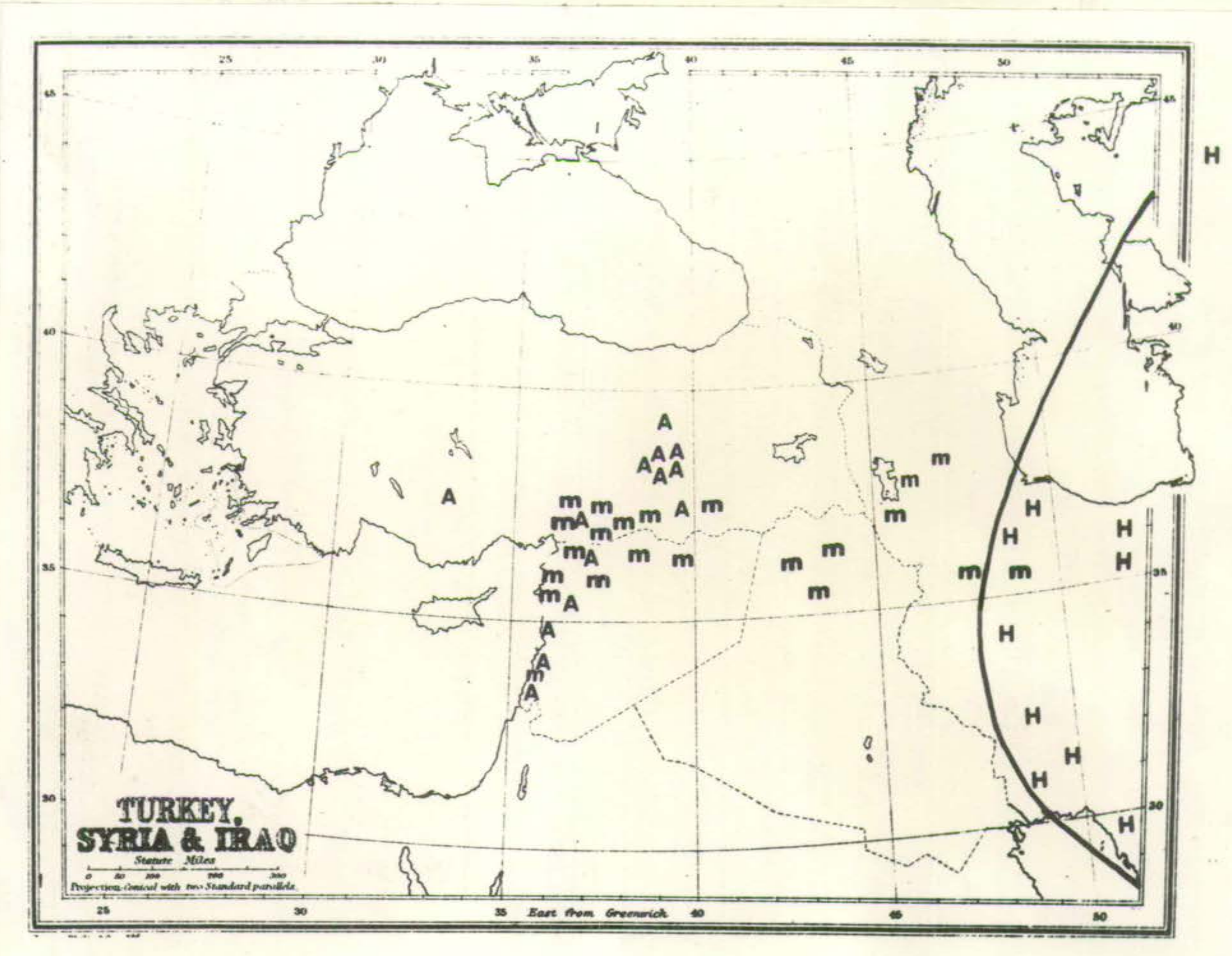
Map 1. Distribution of <u>Aurinia saxatilis</u>: S-ssp. saxatilis; O- ssp. <u>orietalis</u>; M- ssp. <u>megalocarpa</u>.



Map 2. Distribution of Aurinia in Turkey: o- Au. saxatilis subsp. orientalis; M- Au. saxatilis subsp. megalocarpa; (o)- intermediate Au. saxatilis subsp. orientalis & subsp. megalocarpa; C- Au. rupestris subsp. cyclocarpa; U- Au. uechtritziana.



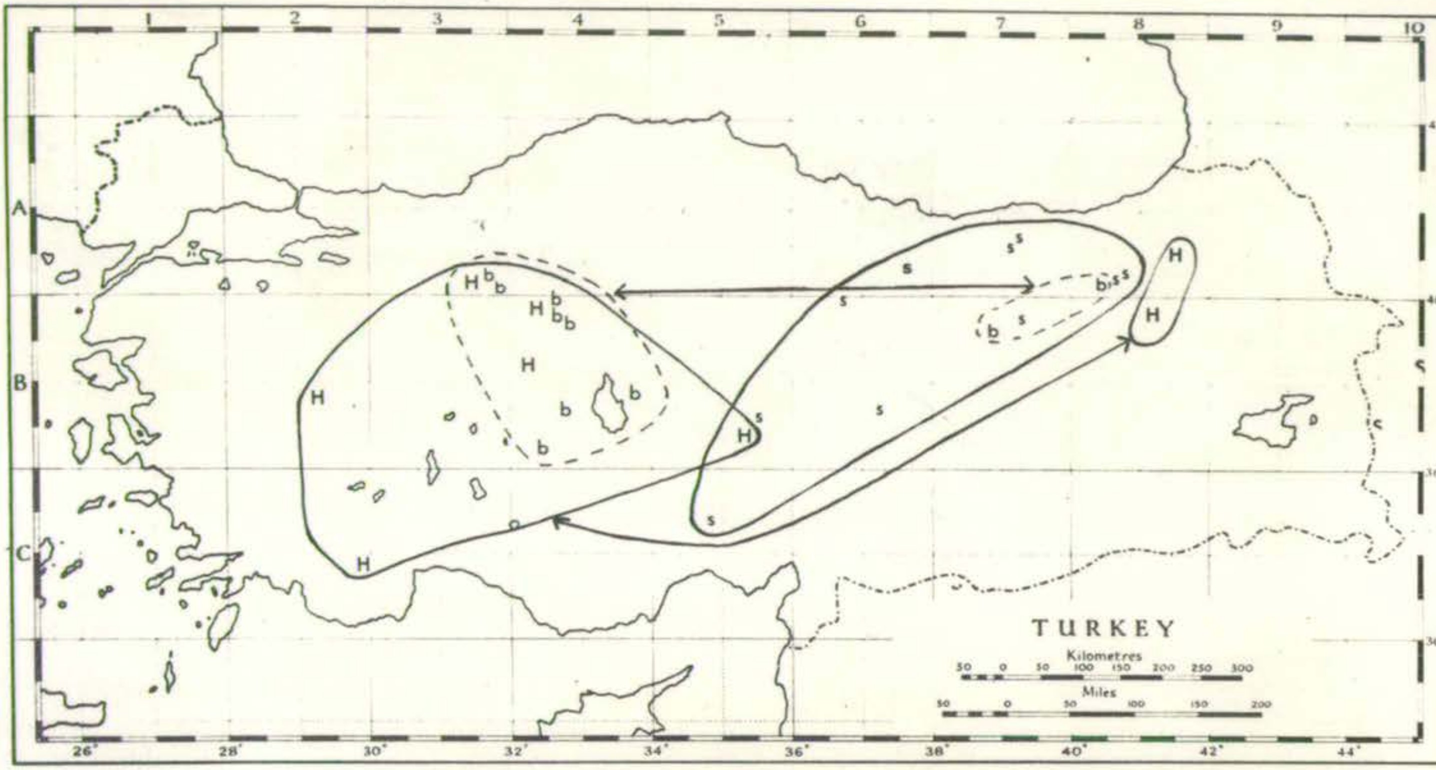
Map 3. Distribution of A. linifolium var. linifolium & var. cupreum.



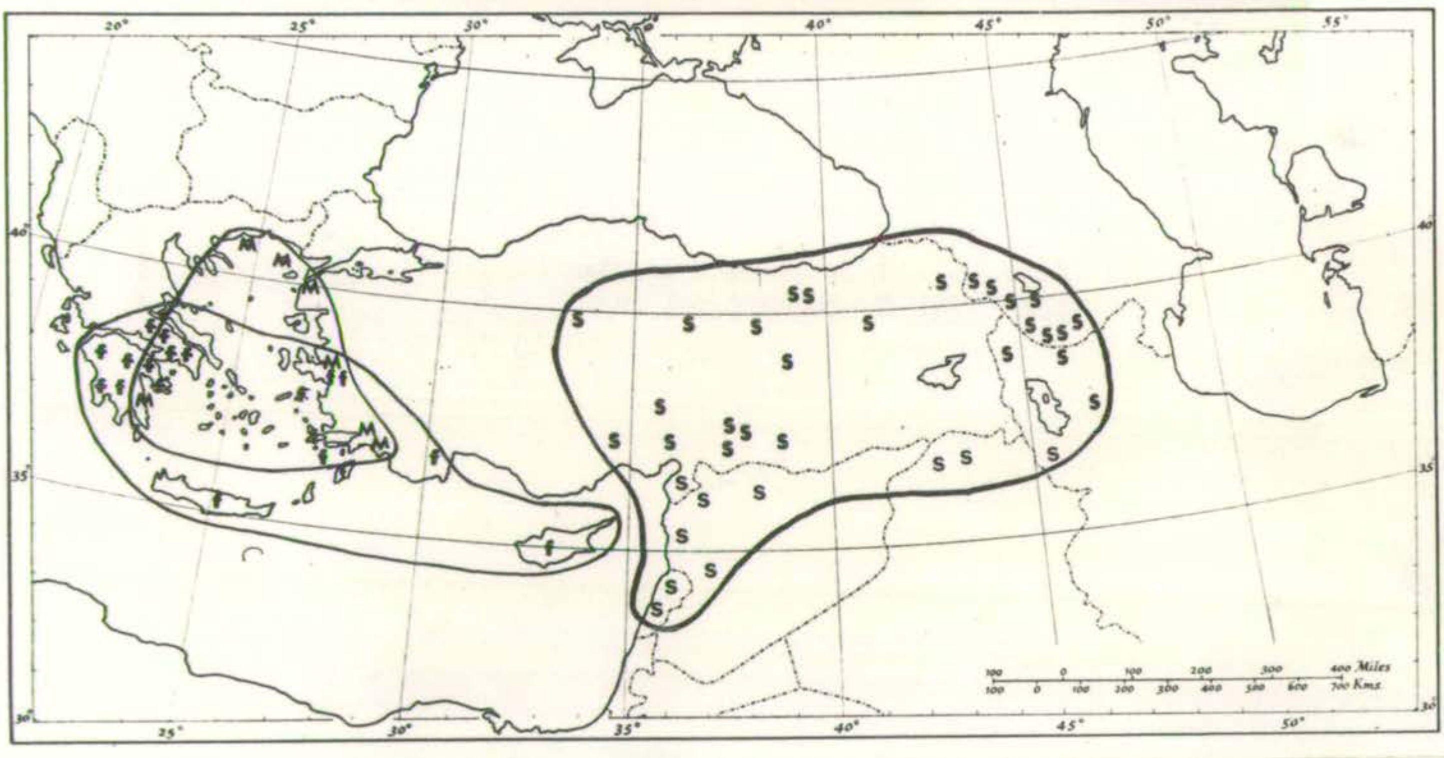
Map 4. Oriental distribution of: A- *A. aureum*; m- *A. meniocoides*; H- *A. heterotrichum*.

Map 5. Distribution in Turkey of: H- A. huetii; b- A. blepharocarpum; s- A. stylare.

Map 6. Oriental and European distribution of: f- A. foliosum var. foliosum; M- A. foliosum var. megalocarpum; S- A. strictum.


TURKEY
Kilometres
50 0 50 100 150 200 250 300
Miles
50 0 50 100 150 200

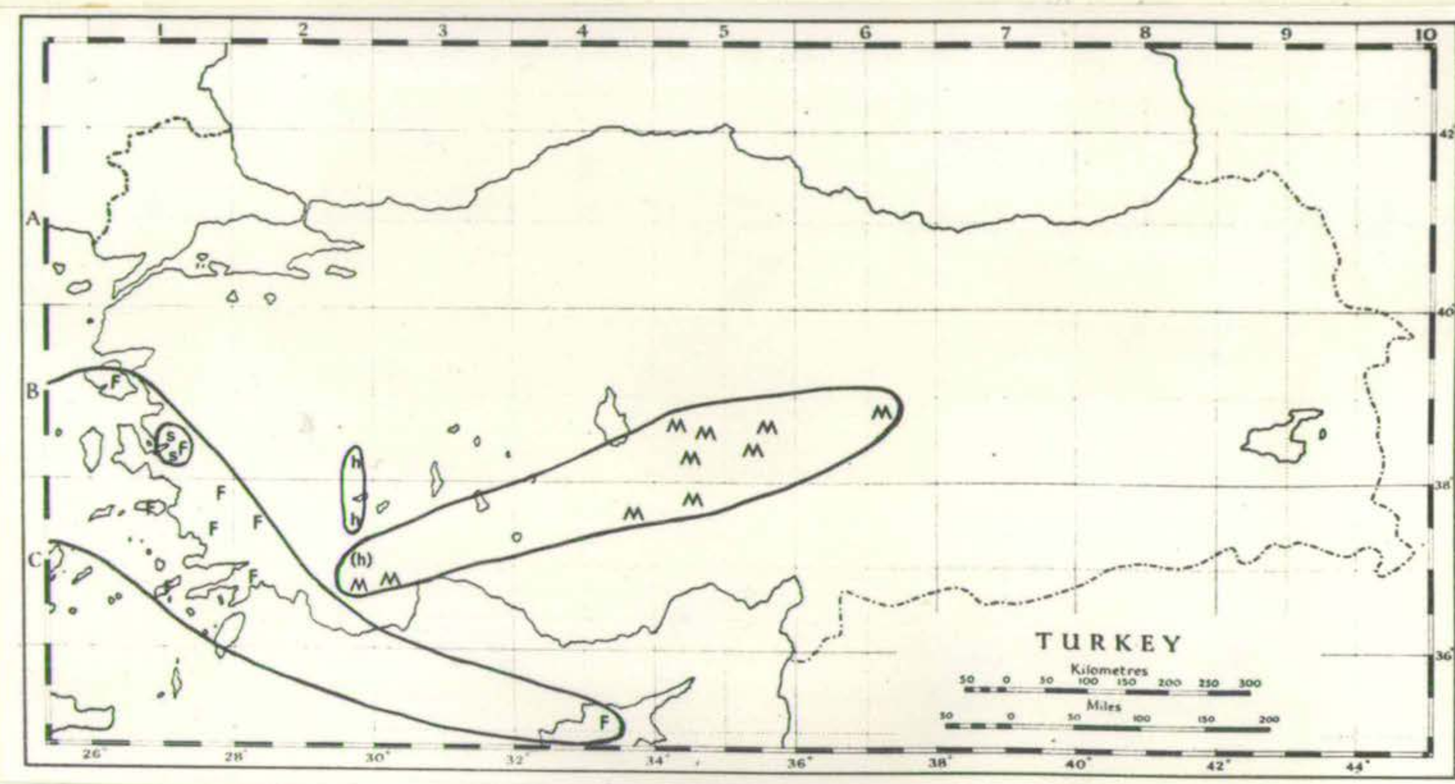
Map 5.


100 0 100 200 300 400 Miles
100 0 100 200 300 400 500 600 700 Kms.

Map 6.

Map 7. Distribution in Turkey of: F- <u>A. fulvescens</u> var. <u>fulvescens</u>; s- <u>A. fulvescens</u> var. <u>stellatocarpum</u>; M- <u>A. macropodum</u> var. <u>macropodum</u>; h- <u>A. macropodum</u> var. <u>heterotrichum</u>; (h)- intermediate <u>A. macropodum</u> var. <u>macropodum</u> & var. <u>heterotrichum</u>.

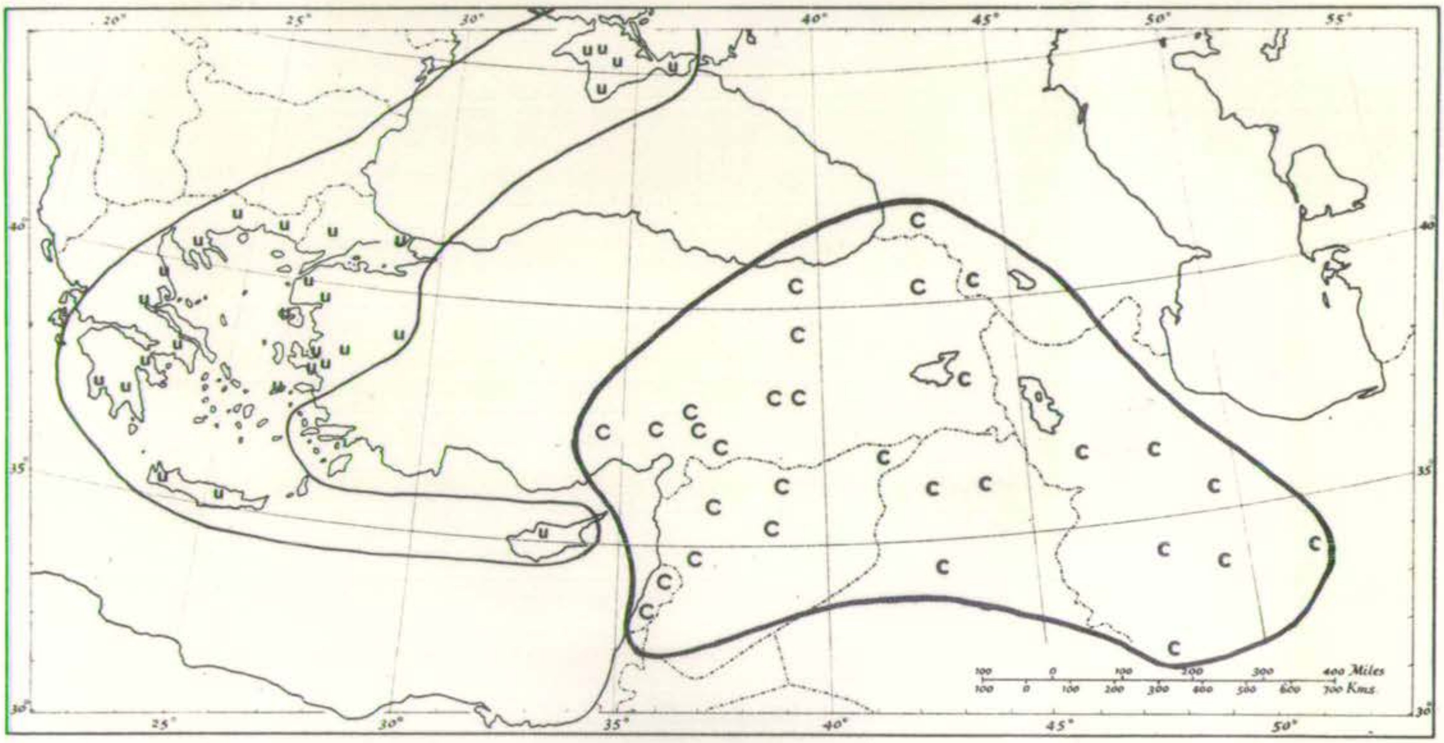
Map 8. Oriental distribution of: <u>A. smyrnaeum</u> & <u>A. szowitsianum</u>.


TURKEY
Kilometres
Miles
A
B
C

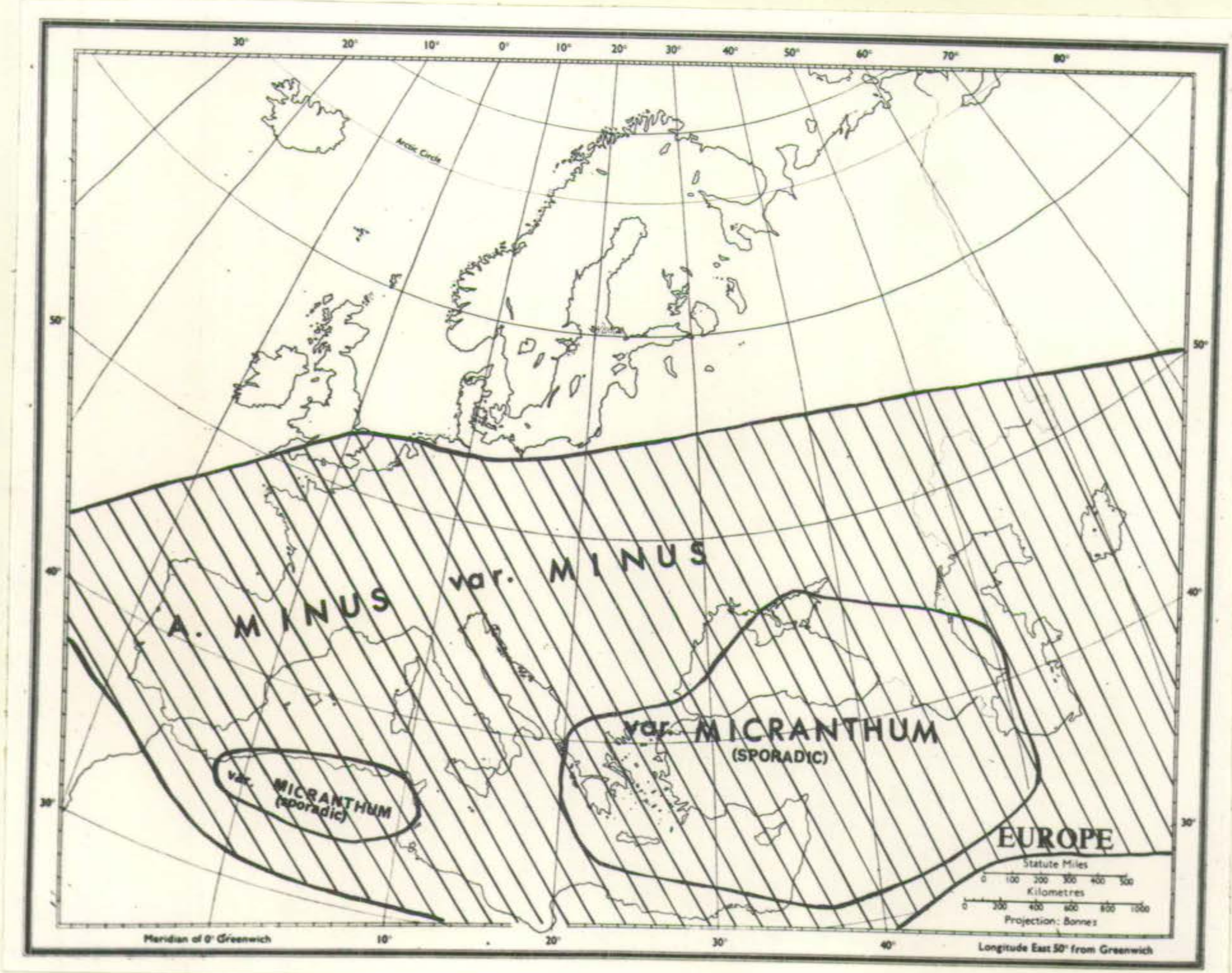
Map 7.


A. smyrnaeum
A. SZOWITSIAUM
Miles
Kms.

Map 8.



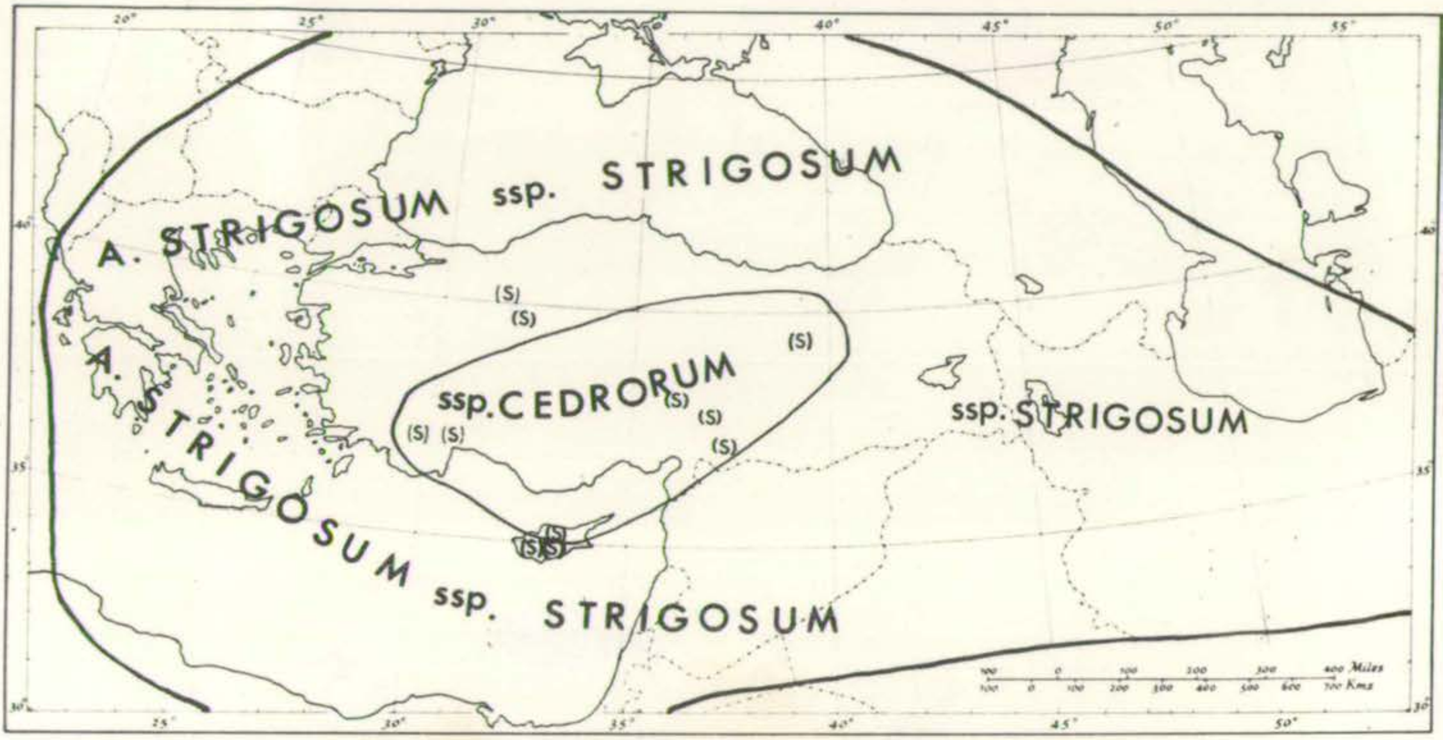
Map 9. Oriental and European distribution of: u- A. umbellatum; C- A. contemptum.



Map 10. Distribution of A. minus var. minus & var. micranthum.

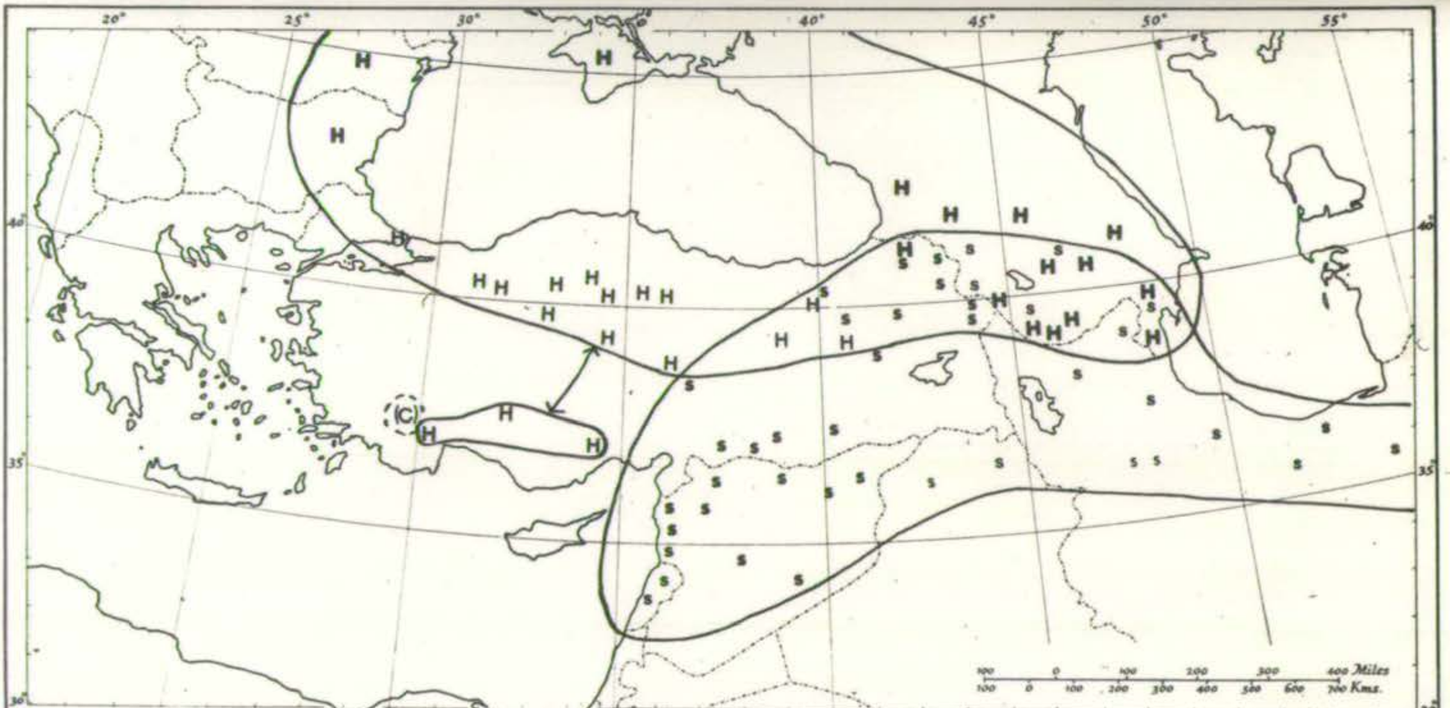
Map 11. Oriental and European distribution of _A. strigosum_ subsp. _strigosum_ & subsp. _cedrorum_; (SC)- intermediates between two subspecies.

Map 12. Oriental and European distribution of: H- _A. hirsutum_ var. _hirsutum_; (C)- _A. hirsutum_ var. _caespitosum_; s- _A. stapfii_.



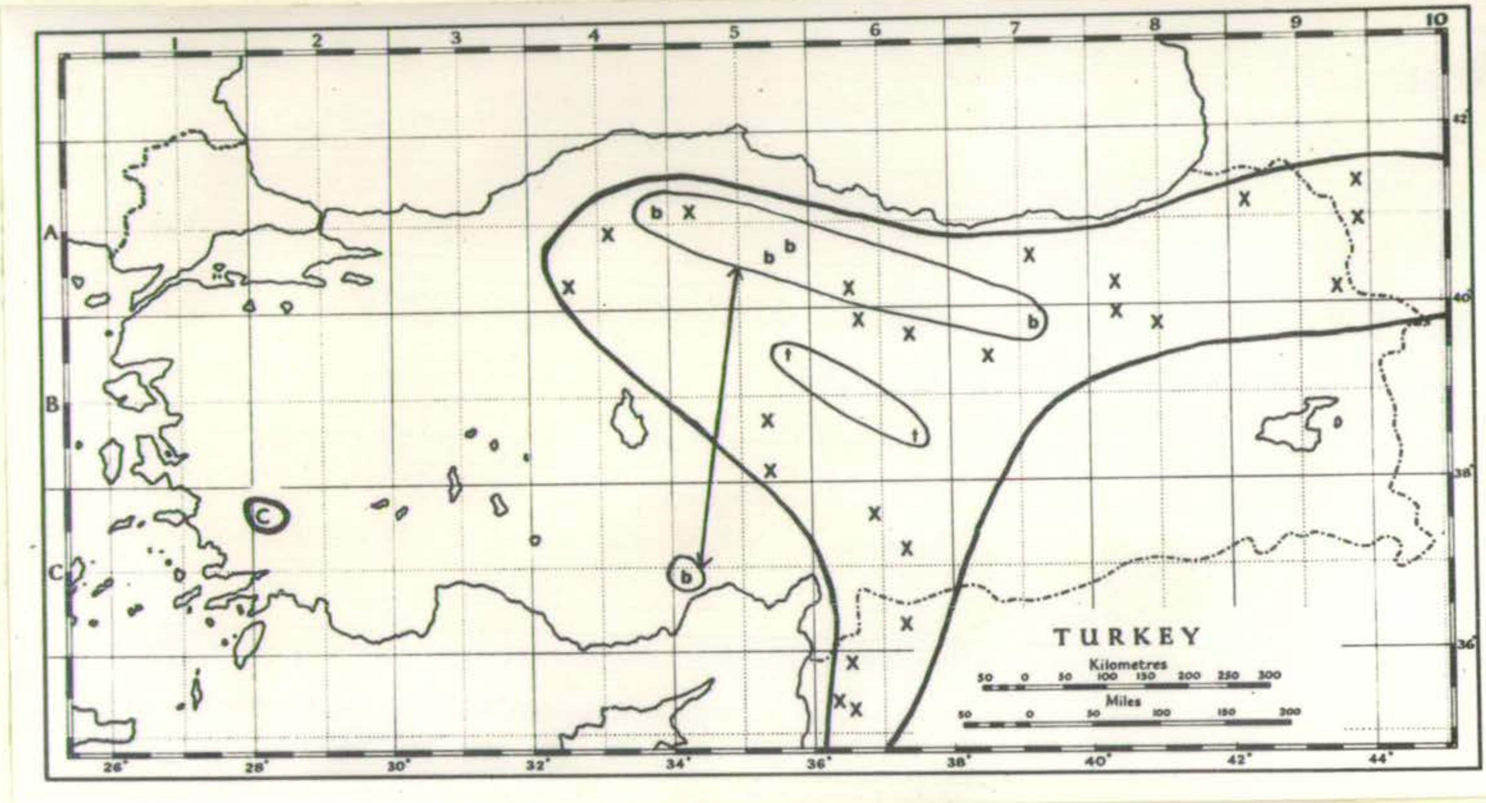
A. STRIGOSUM ssp. STRIGOSUM
A. STRIGOSUM ssp. STRIGOSUM
ssp. CEDRORUM
ssp. STRIGOSUM
(S)
400 Miles
700 Kms

Map 11.

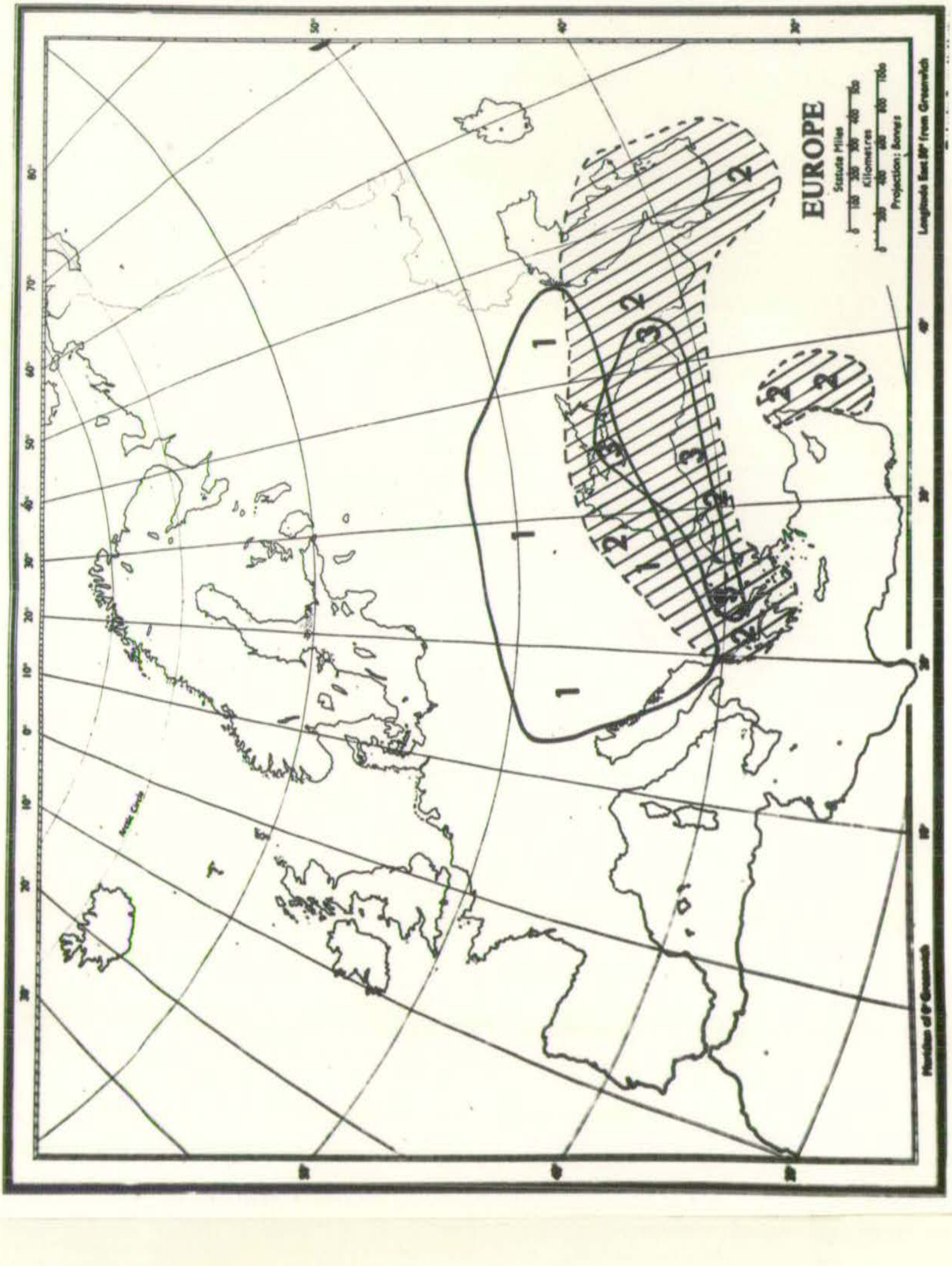


H
S
(C)
400 Miles
700 Kms.

Map 12.



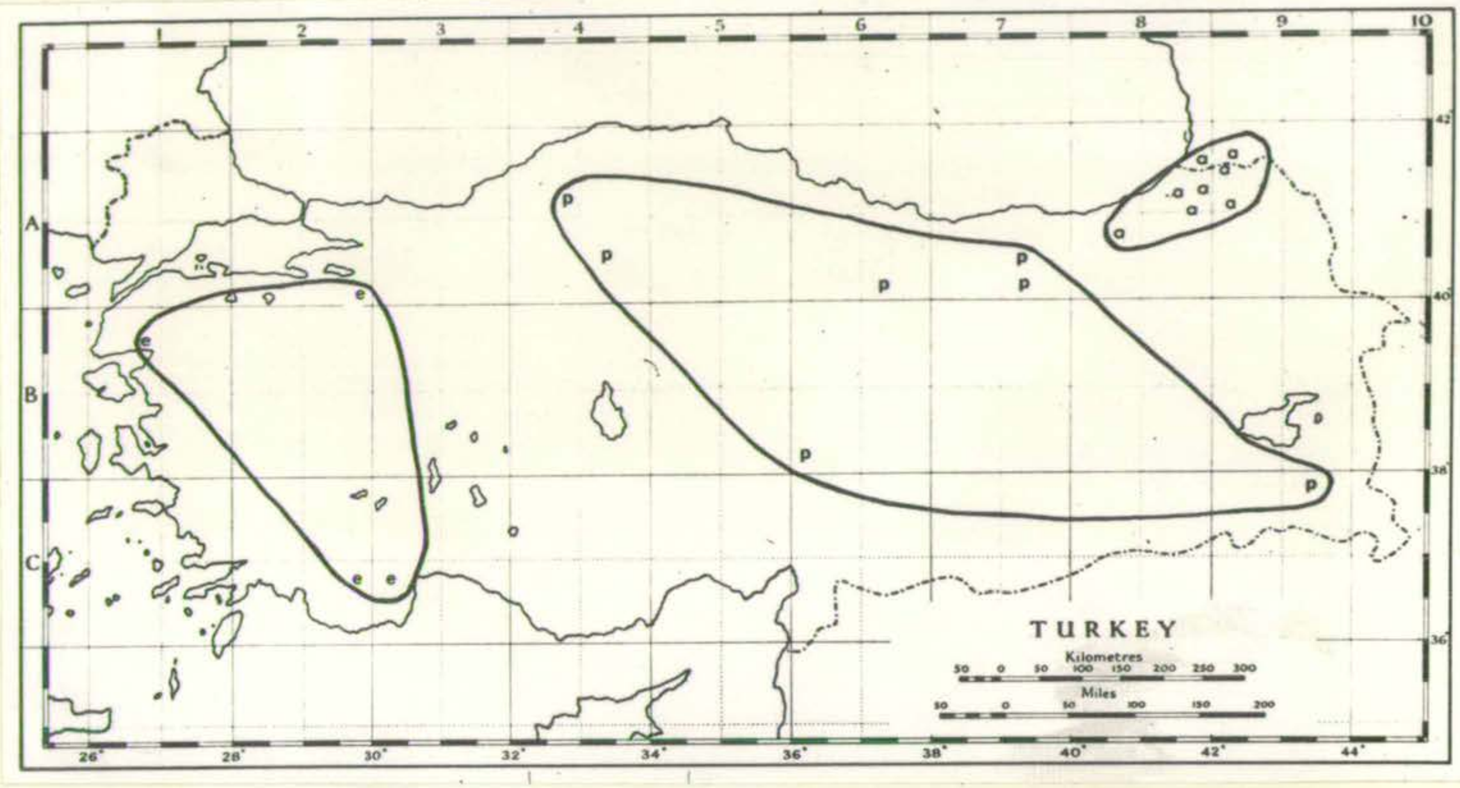
Map 13. Distribution in Turkey of: X- *A. xanthocarpum*; C- *A. cephalotes*; b- *A. bulbotrichum*; t- *A. trichocarpum*.



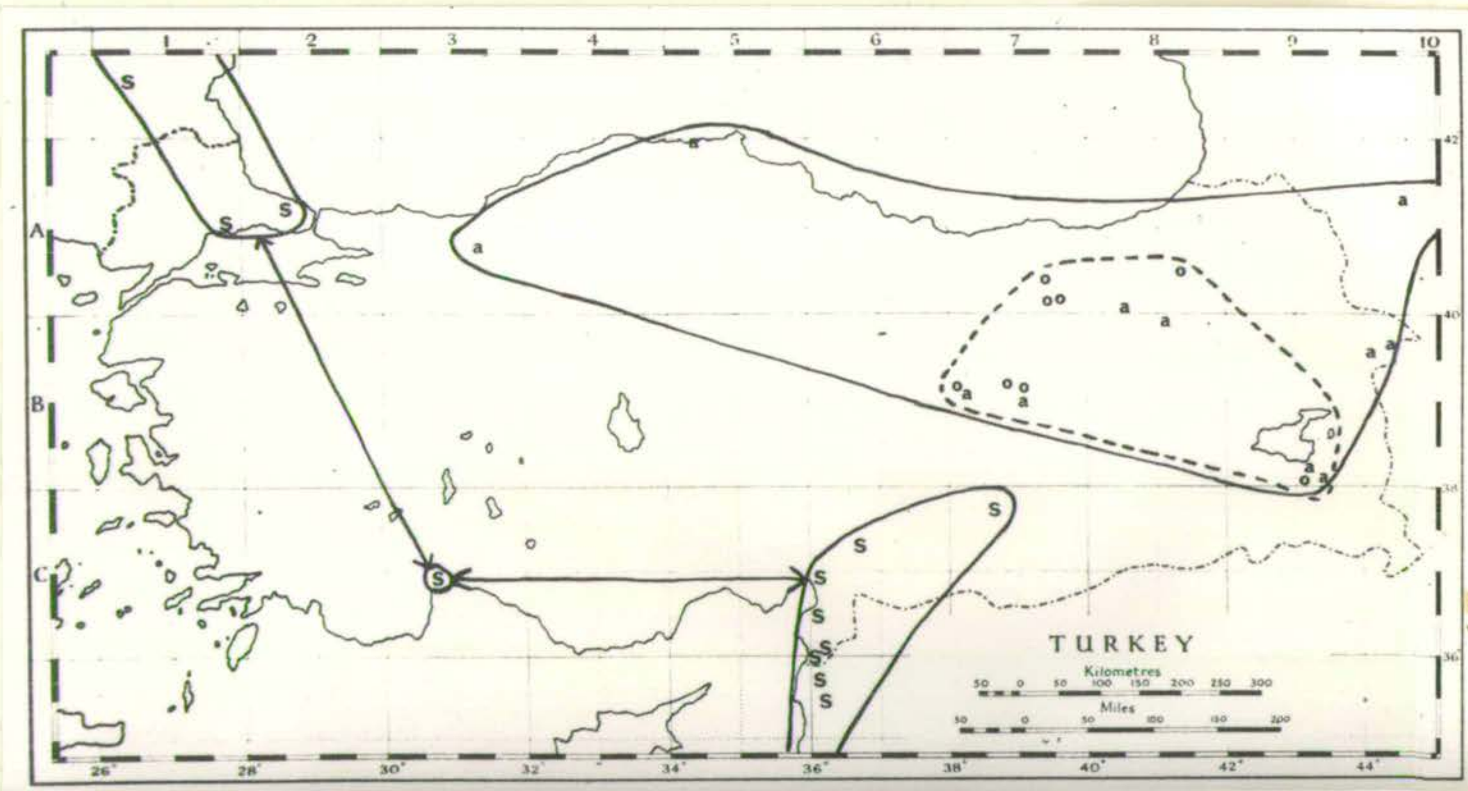
Map 14. Distribution of A. repens; 1- subsp. repens; 2- subsp. trichostachyum var. trichostachyum; 3- subsp. trichostachyum var. stenophyllum.

Map 15. Distribution in Turkey of: p- A. pseudo-mouradicum; a- A. artwinense; e- A. erosulum.

Map 16. Oriental and European distribution of: S- A. stribrnyi; o- A. ochroleucum; a- A. armenum.



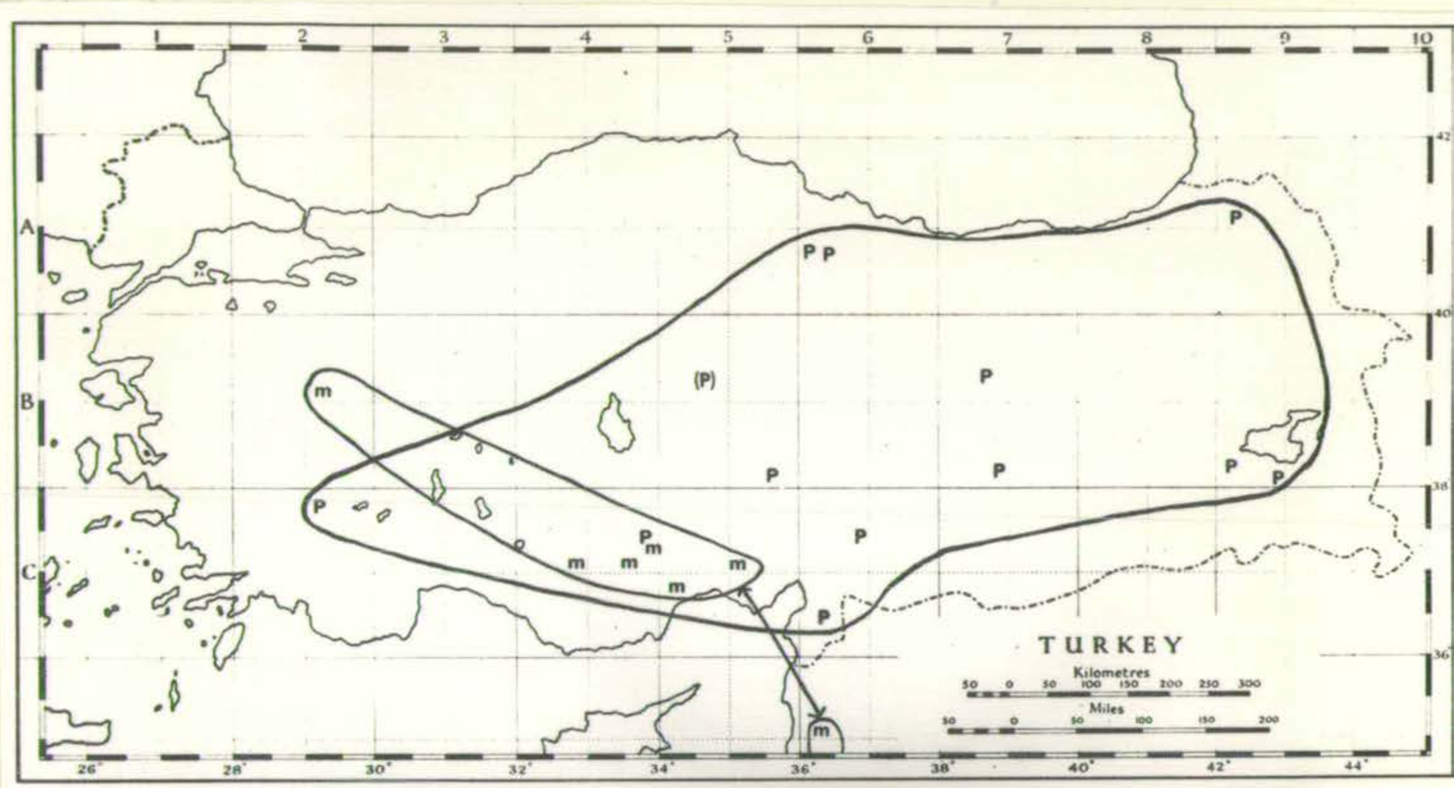
Map 15.



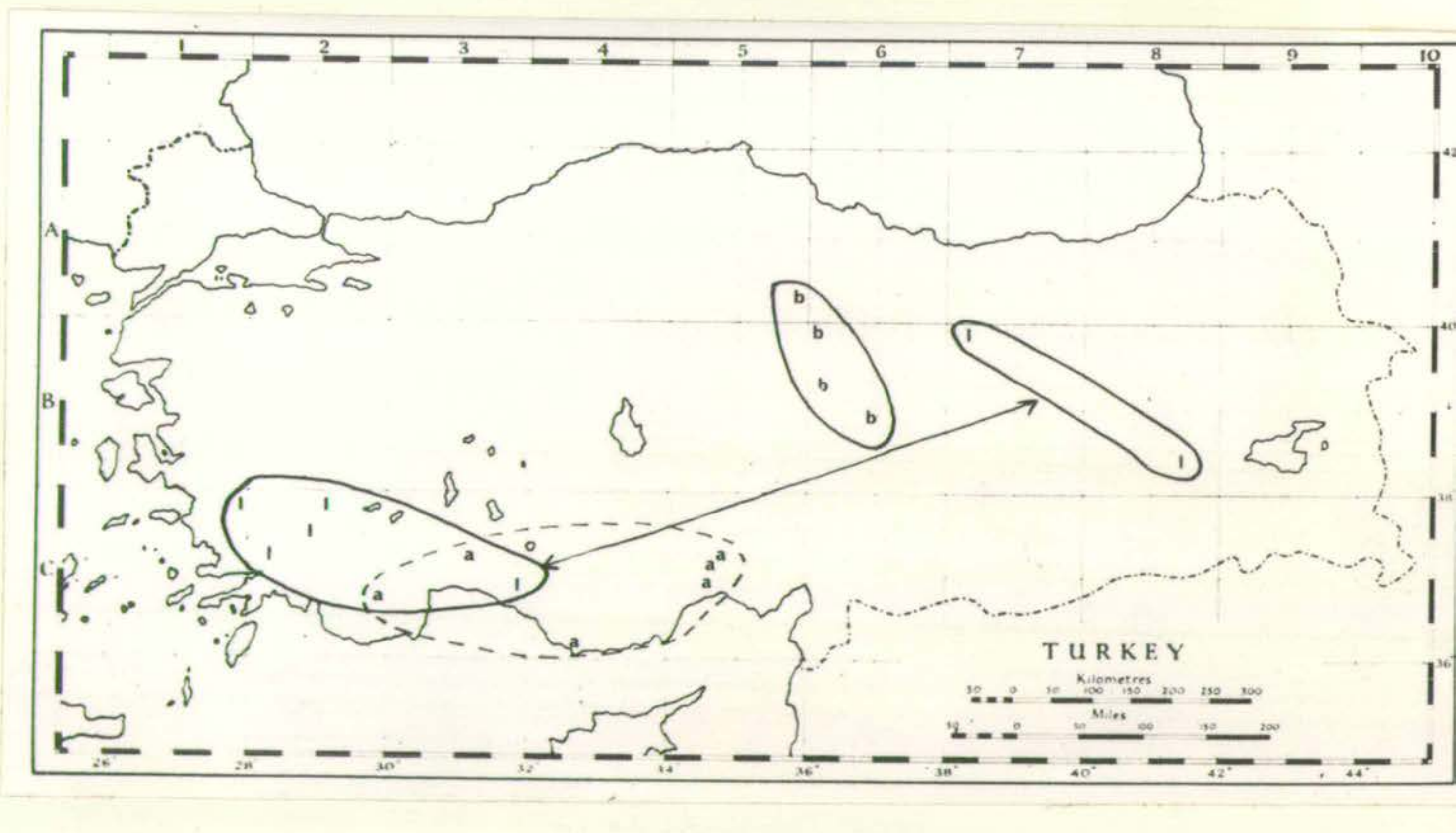
Map 16.

Map 17. Distribution in Turkey of: m- *A. mouradicum*; P- *A. praecox* var. *praecox*; (P)- A. praecox var. *albiflorum*.

Map 18. Distribution in Turkey of: a- *A. argyrophyllum*; b- *A. bornmuelleri*; l- *A. lepidotum*.


TURKEY
Kilometres
50 0 50 100 150 200 250 300
Miles
50 0 50 100 150 200

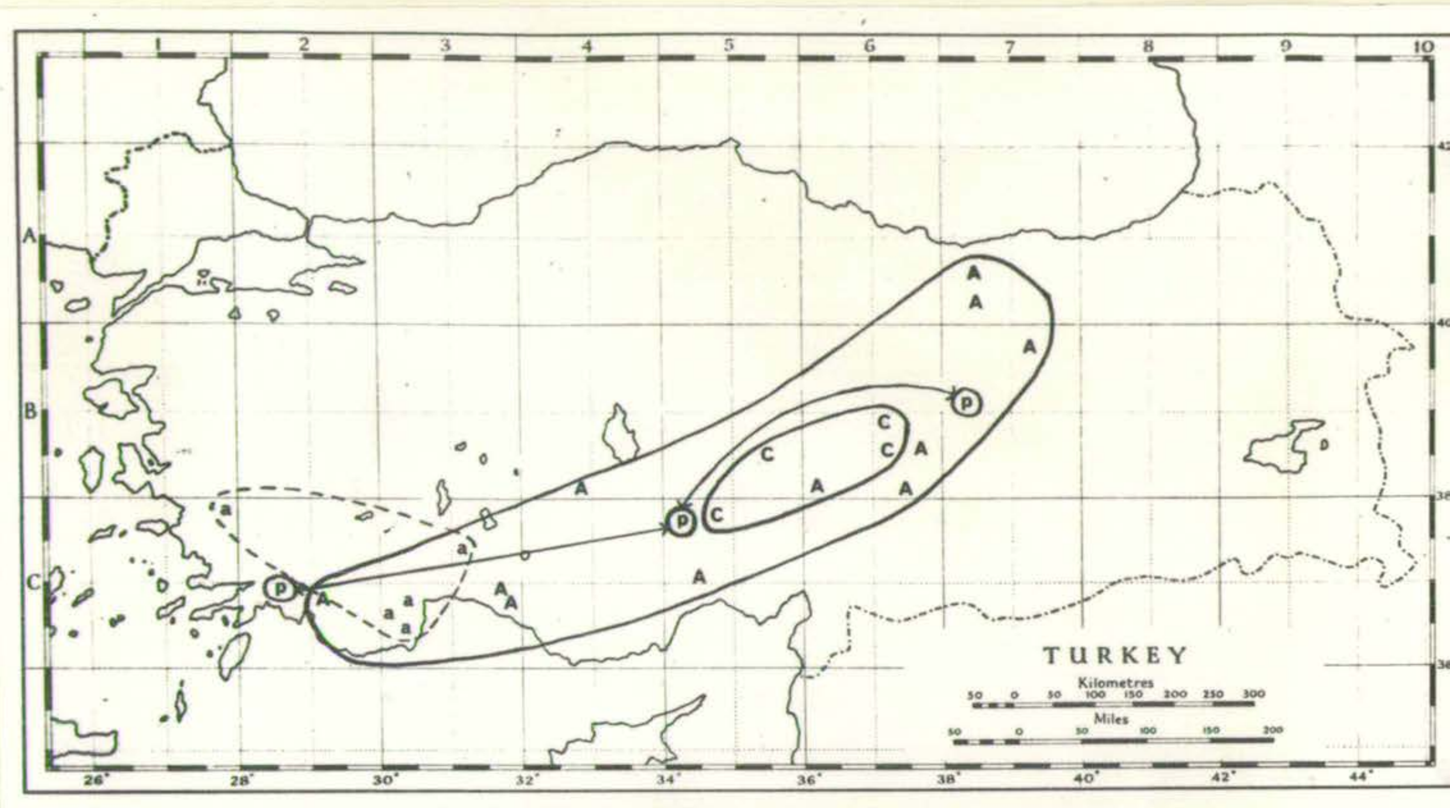
Map 17.


TURKEY
Kilometres
50 0 50 100 150 200 250 300
Miles
50 0 50 100 150 200

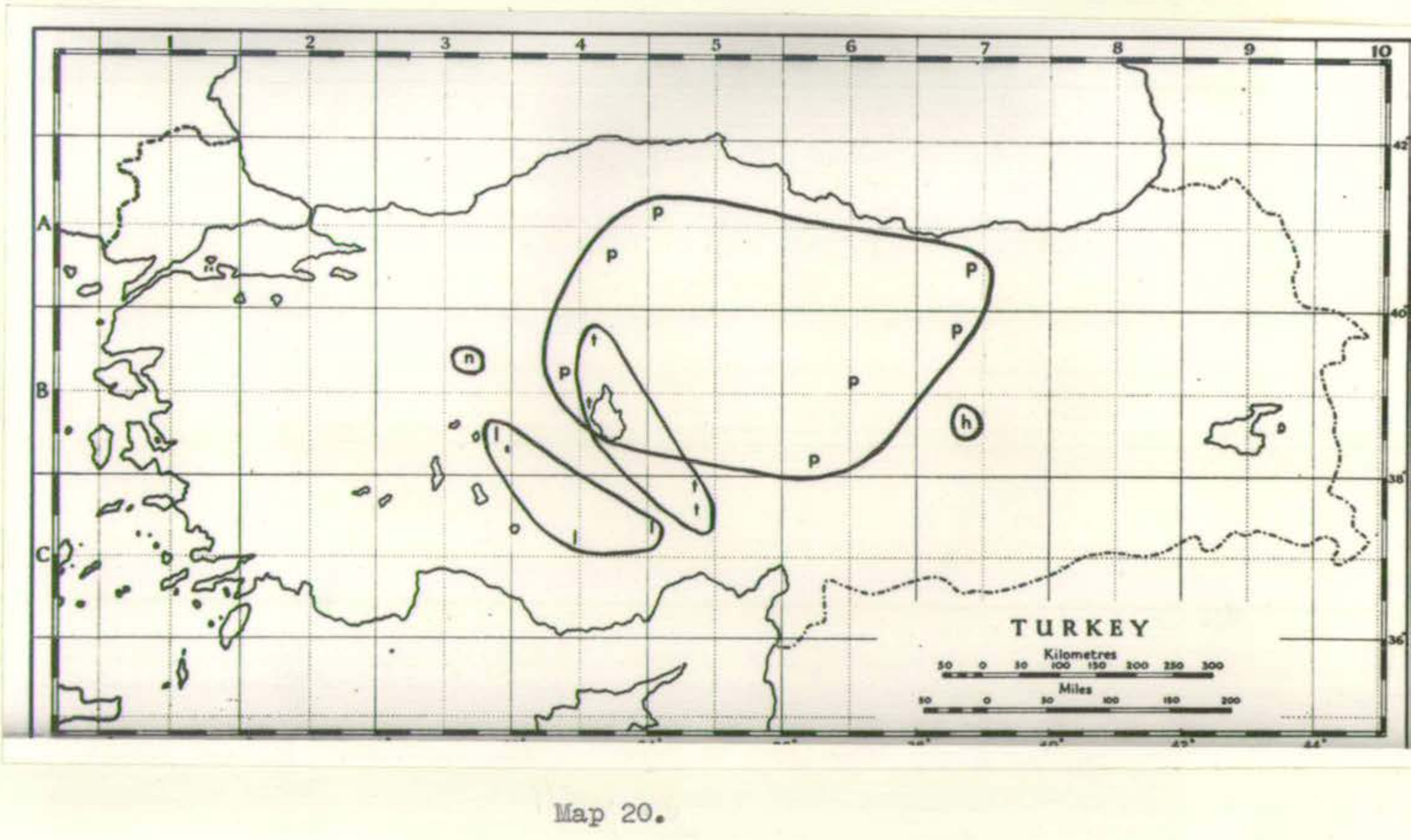
Map 18.

Map 19. Distribution in Turkey of: A- _A. aizoides_; a- _A. aurantiacum_; C- _A. caespitosum_; p- _A. propinquum_.

Map 20. Distribution in Turkey of: p- _A. paphlagonicum_; t- _A. thymops_; l- _A. lycaonicum_; h- _A. harputicum_; n- _A. niveum_.


TURKEY
Kilometres
50 0 50 100 150 200 250 300
Miles
50 0 50 100 150 200

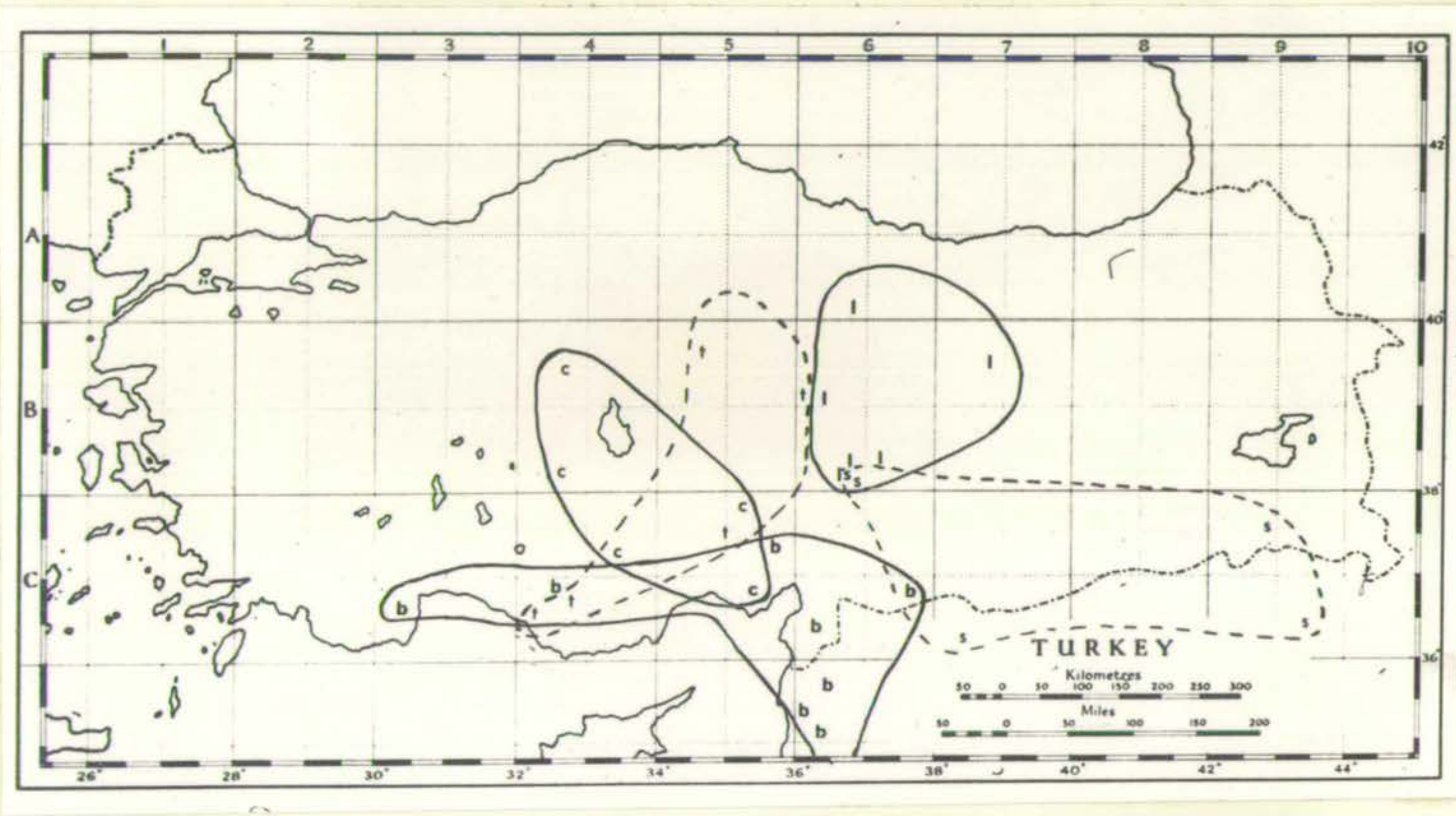
Map 19.


TURKEY
Kilometres
50 0 50 100 150 200 250 300
Miles
50 0 50 100 150 200

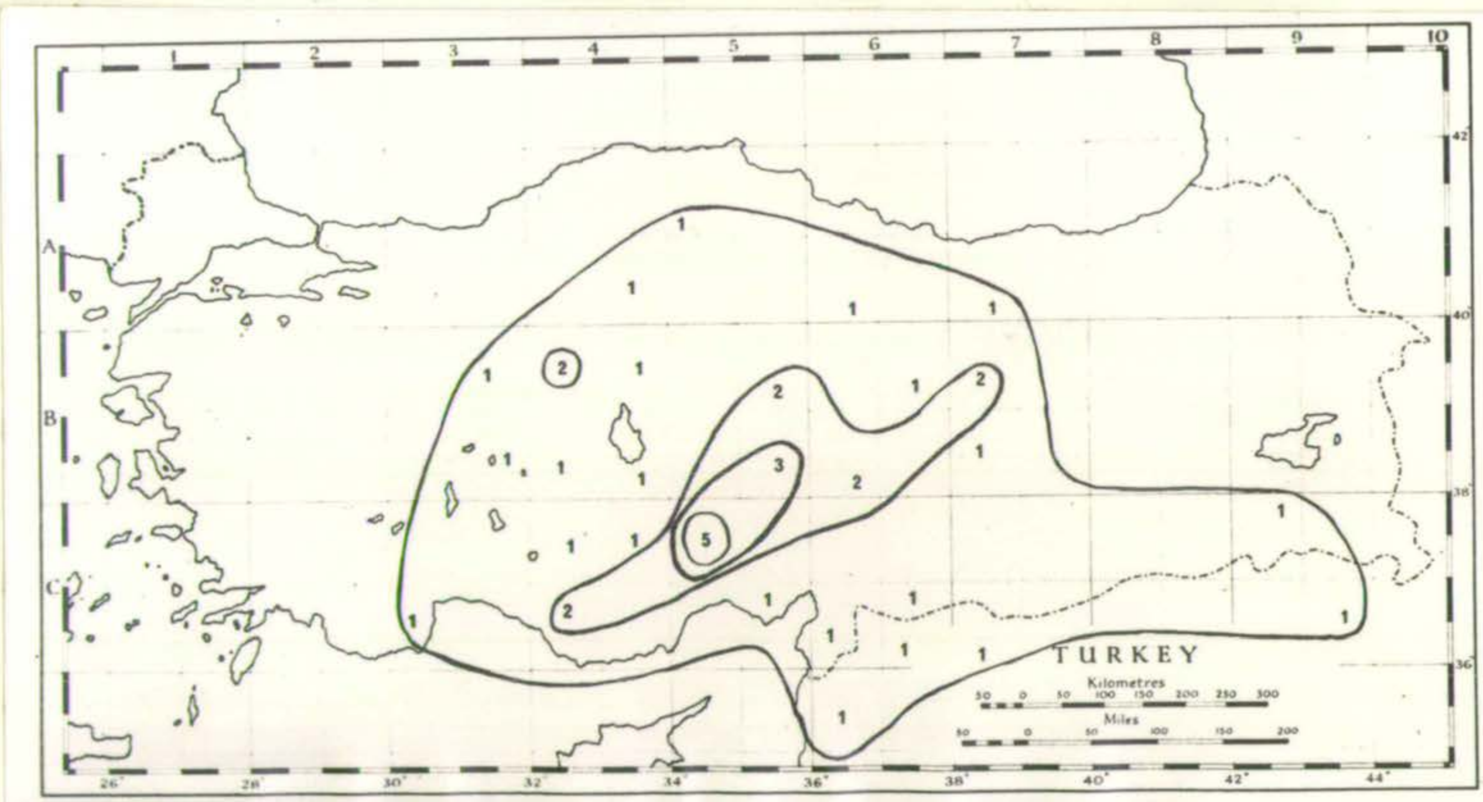
Map 20.

Map 21. Distribution in Turkey of: b- _A. baumgartnerianum_; c- _A. corningii_; l- _A. lepidoto-stellatum_; s- _A. sulphureum_; t- _A. tetrastemon_.

Map 22. Isoflor of the Sect. _Gamosepalum_: 1- only one species occurring per square; 2- two species occurring per square; 3- three species occurring per square; 5- five species occurring per square. Presumed centre of distribution in Turkey in the Cappadocian steppe.



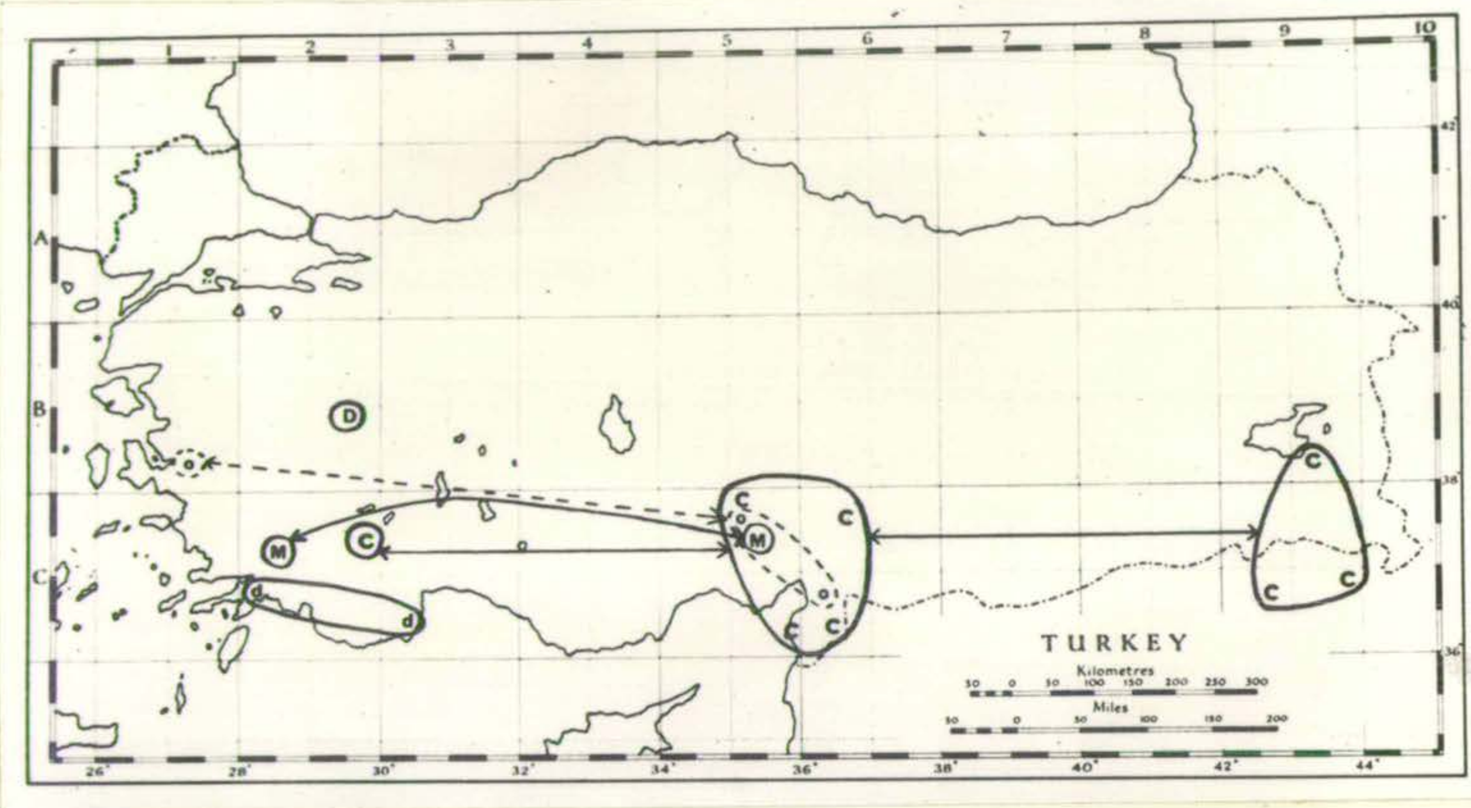
Map 21.



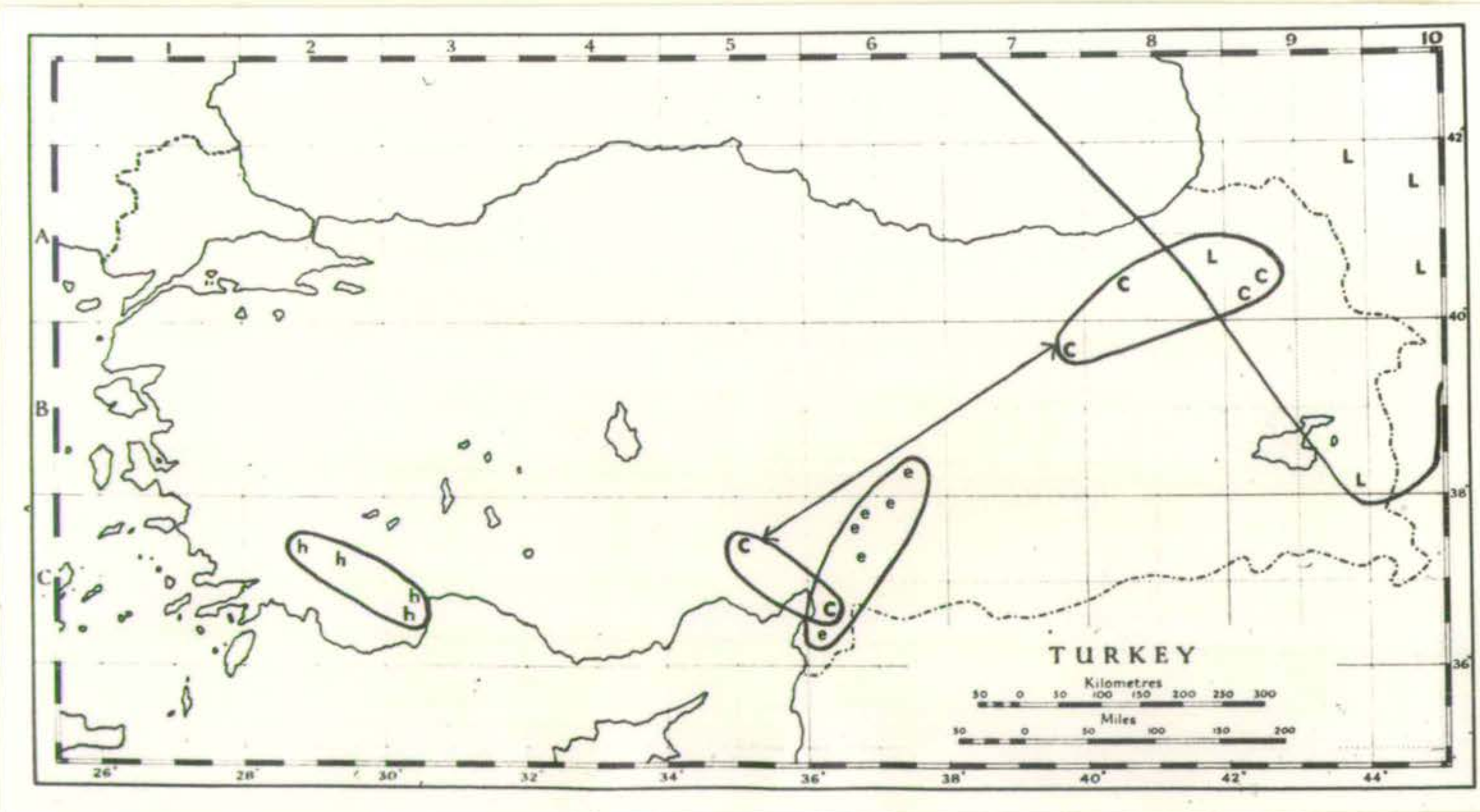
Map 22.

Map 23. Distribution in Turkey of: D- *A. davisianum*; d- *A. discolor*; C- *A. constellatum*; M- *A. masmenaeum*; o- *A. oxycarpum*.

Map 24. Distribution in Turkey of: C- *A. callichroum*; e- *A. eriophyllum*; h- *A. huber-morathii*; L- *A. longistylum*.



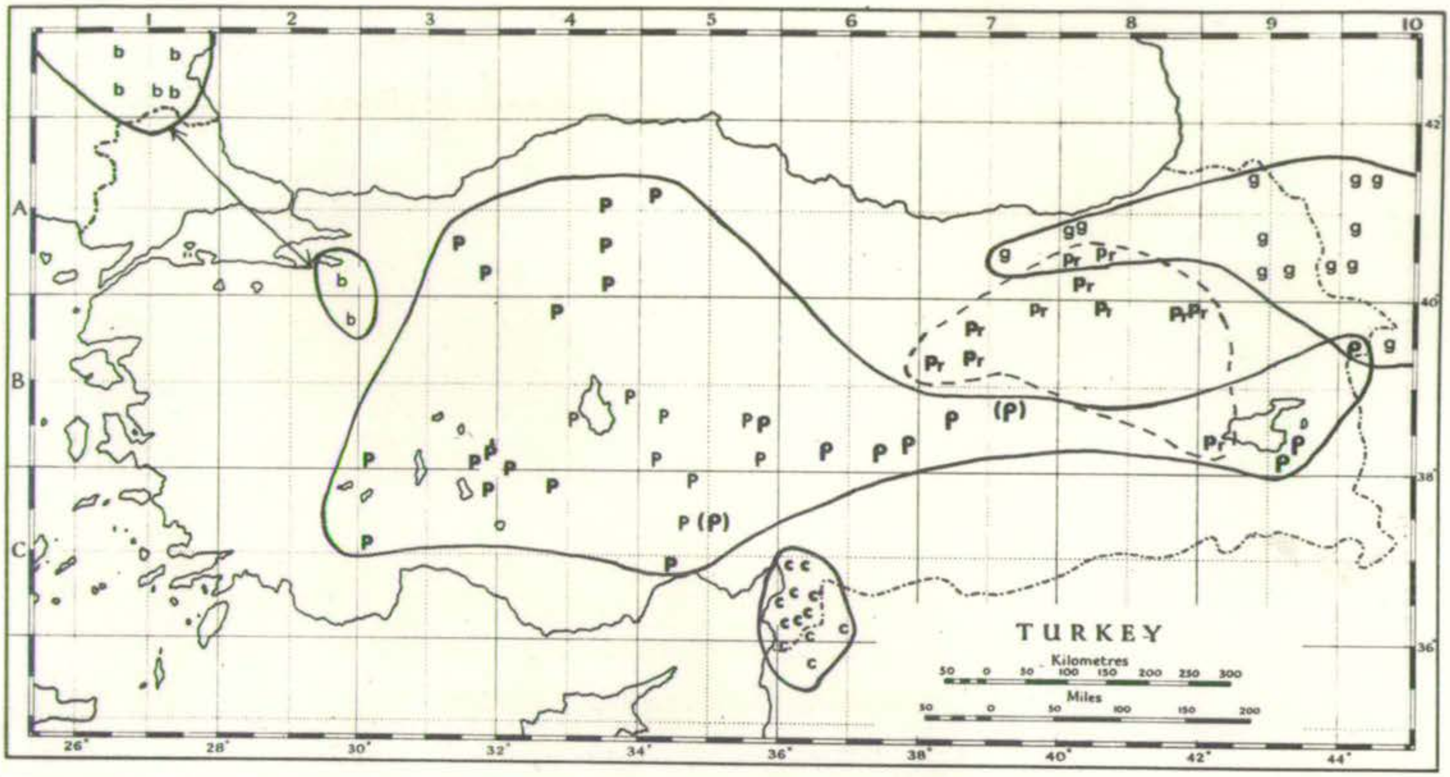
Map 23.



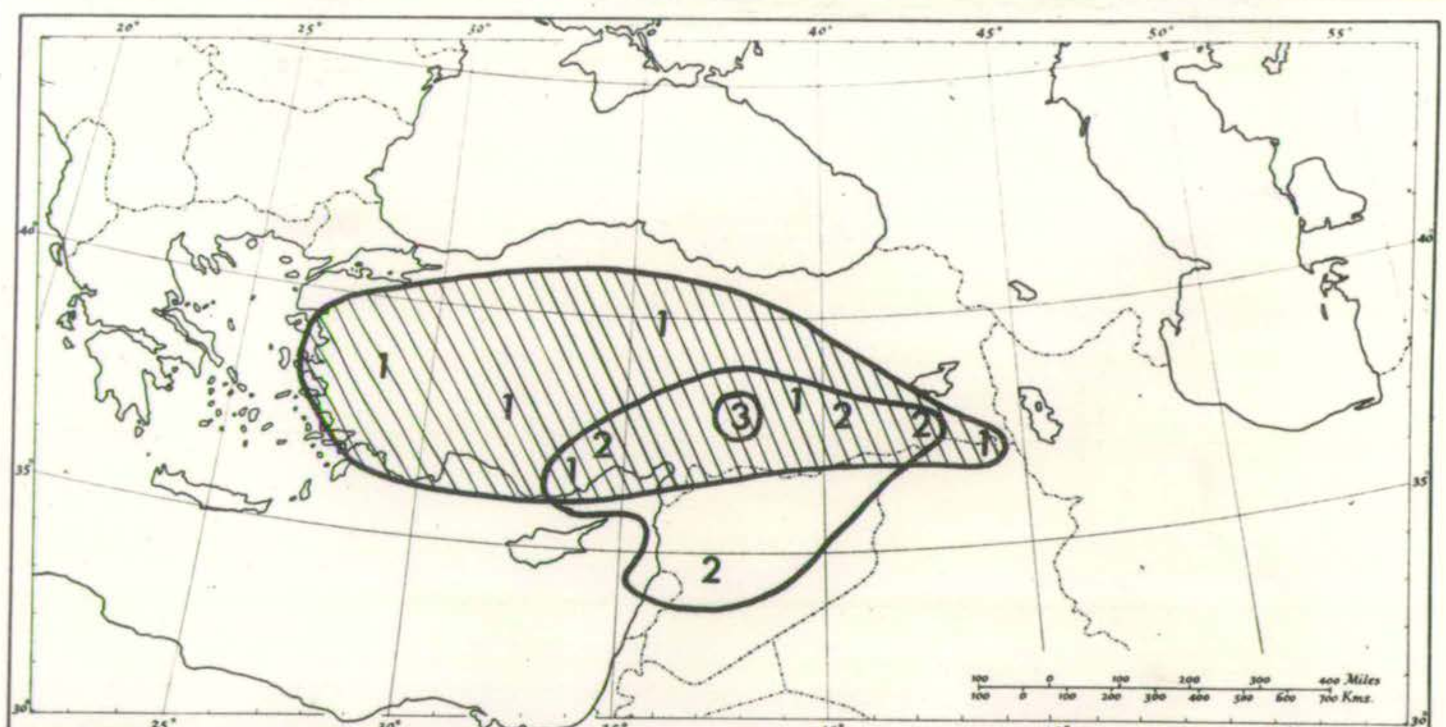
Map 24.

Map 25. Oriental and European distribution of: b- A. borzaenum; c- A. cassium; g- A. gehamense; P- A. pateri subsp. pateri; pr- A. pateri subsp. prostratum; (P)- intermediates between A. pateri subsp. pateri & subsp. prostratum.

Map 26. Distribution in the Orient of A. condensatum: 1- subsp. condensatum; 2- subsp. flexibile; 3- intermediates between subspecies.


TURKEY
Kilometres
50 0 50 100 150 200 250 300
Miles
50 0 50 100 150 200

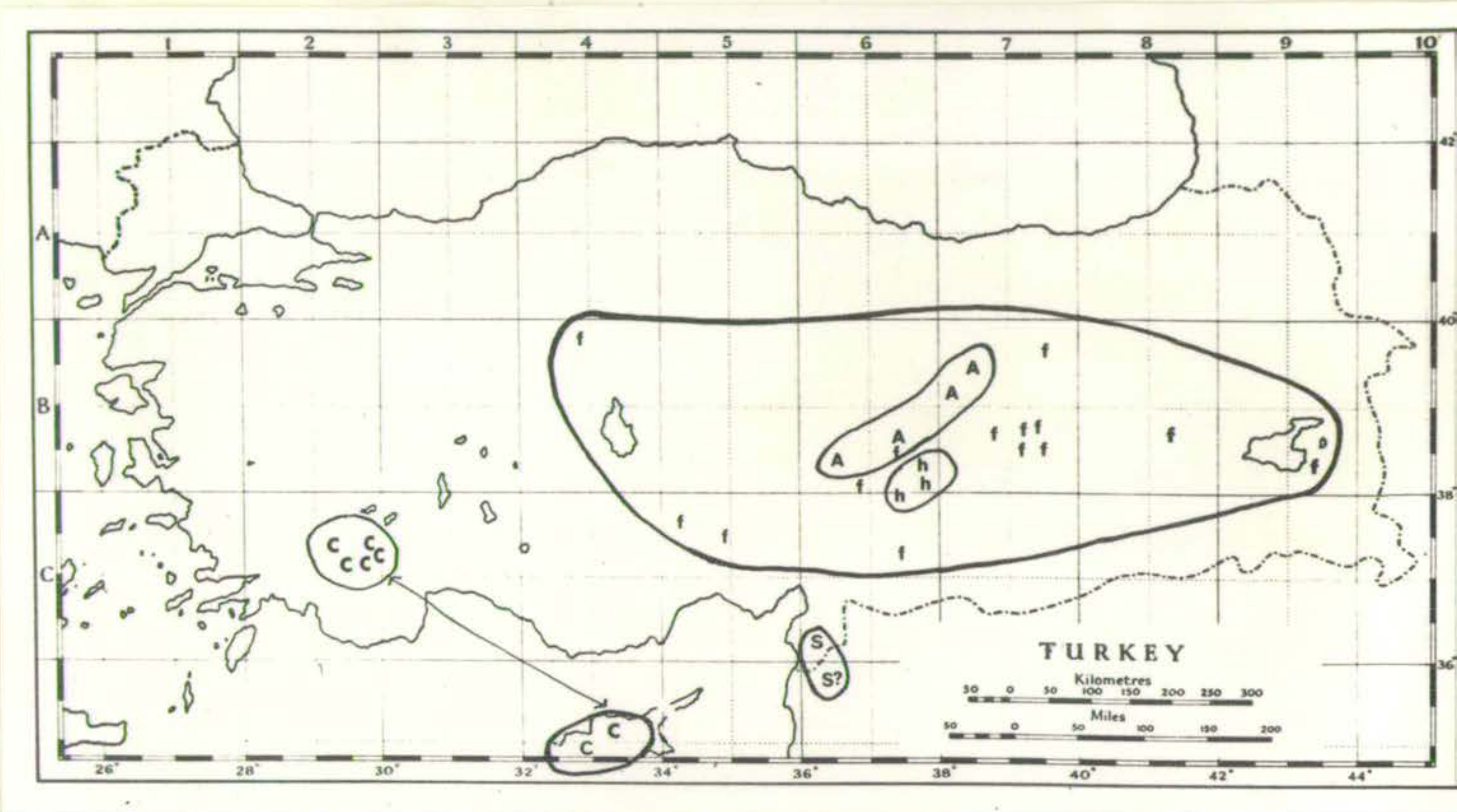
Map 25.


100 0 100 200 300 400 Miles
100 0 100 200 300 400 500 600 700 Kms.

Map 26.

Map 27. Distribution in Turkey: A- _A. anatolicum_; C- _A. cypricum_; f- _A. filiforme_; h- _A. haussknechtii_; S- _A. syriacum_.

Map 28. Oriental and European distribution of _A. murale_ subsp. _murale_ and related taxa: A- _A. akamasicum_; T- _A. tenium_; S- _A. subspinosum_; d- _A. murale_ subsp. _stoianoffii_; p- _A. murale_ subsp. _murale_ var. _pichleri_; h- _A. murale_ subsp. _murale_ var. _haradjianii_; AL- _A. murale_ subsp. _murale_ var. _alpinum_.

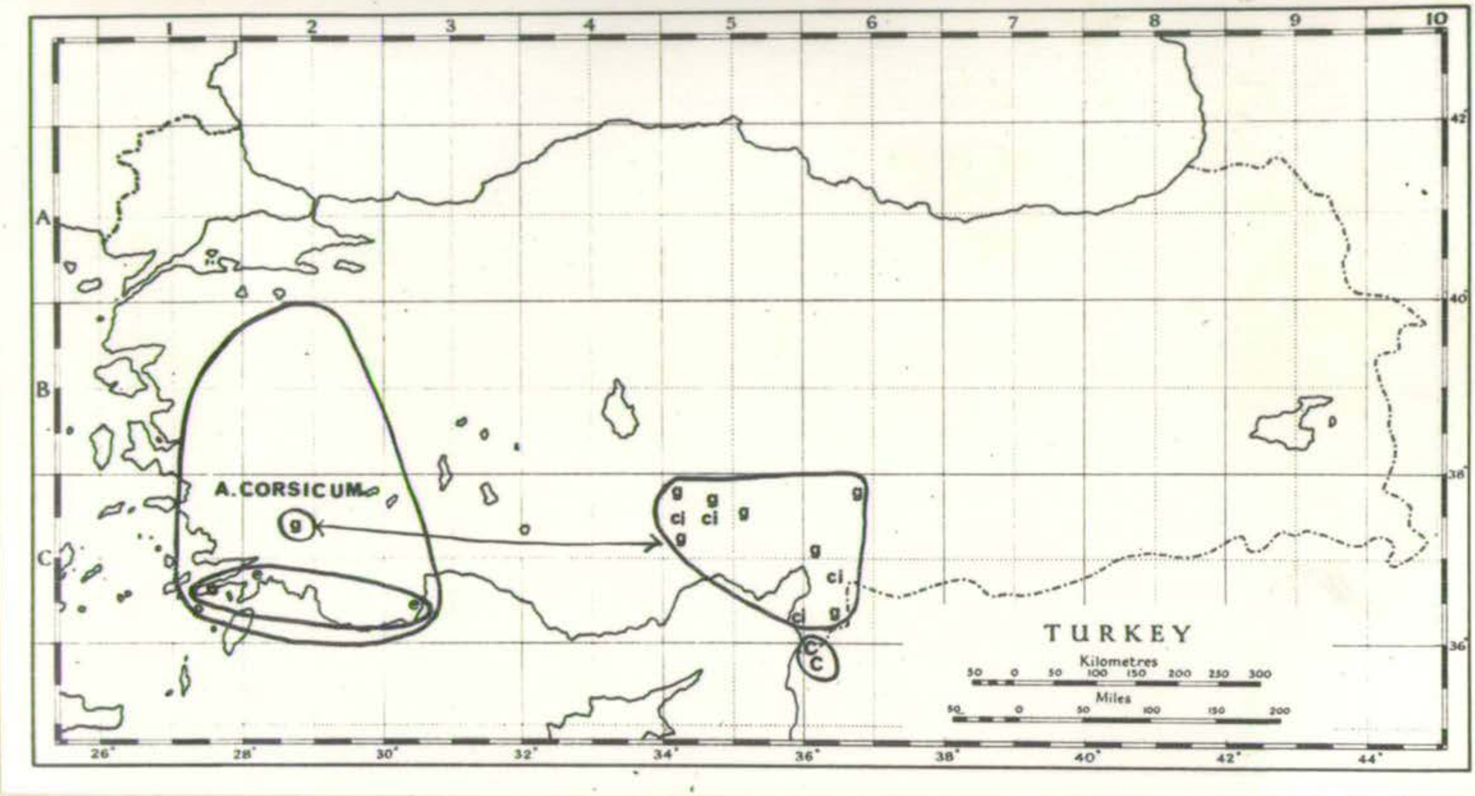


Map 27.

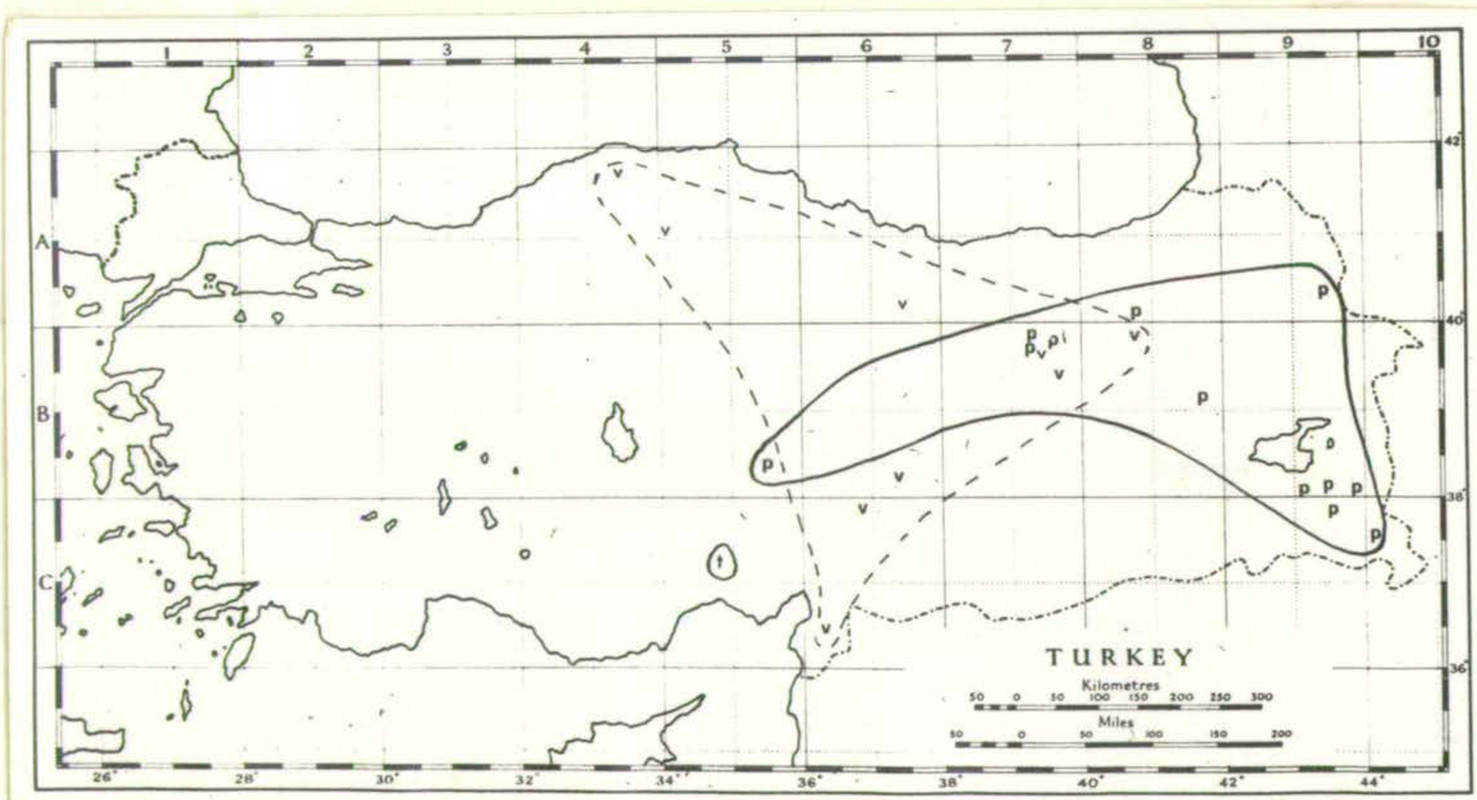
Map 28.

Map 29. Distribution in Turkey of: *A. corsicum*; C- *A. crenulatum*; ci- *A. cilicicum*; g- *A. giosnanum*; e- *A. elatum*.

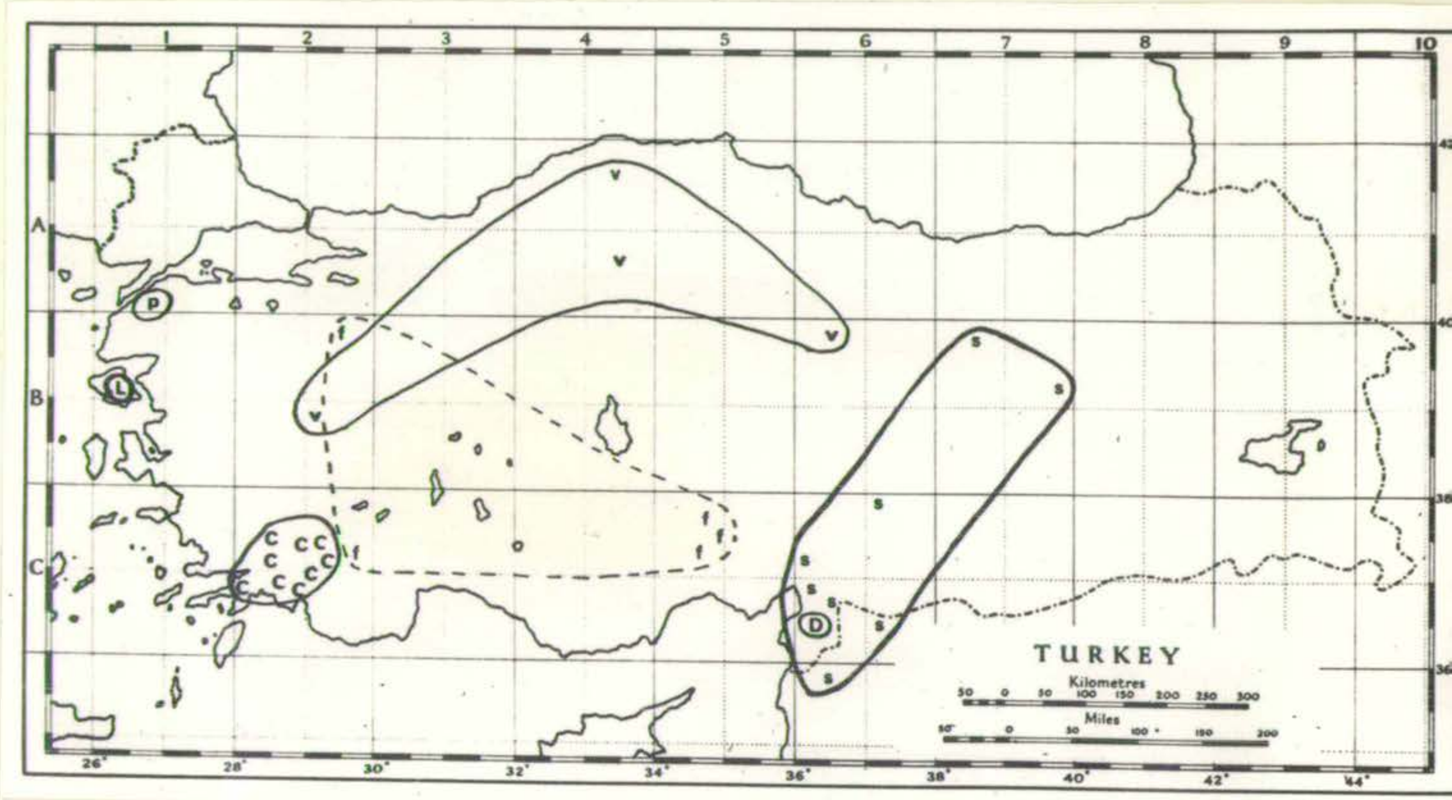
Map 30. Distribution in Turkey of: t- *A. trapeziforme*; p- *A. peltarioides* subsp. *petlarioides*; v- *A. peltarioides* subsp. *virgatiforme*.


A.CORSICUM
TURKEY
Kilometres
50 0 50 100 150 200 250 300
Miles
50 0 50 100 150 200

Map 29.


TURKEY
Kilometres
50 0 50 100 150 200 250 300
Miles
50 0 50 100 150 200

Map 30.



Map 31. Distribution in Turkey of: C- A. caricum; D- A. dubertretii; f- A. floribundum; L- A. lesbiacum; p- A. pinifolium; s- A. samariferum; v- A. virgatum.

(4) Separate of " Some New Alyssa from the Near East".

Extract from

NOTES FROM THE
ROYAL BOTANIC GARDEN
EDINBURGH

VOL. XXIV No. 2
1962

SOME NEW ALYSSA FROM THE NEAR EAST

T. R. DUDLEY
(*University Department of Botany, Edinburgh*)

In the course of a study of this genus from Turkey, the author had occasion to examine much material from other areas in the Orient. The three new species and three new varieties described in this paper are the direct conclusions of this auxiliary study of extra-Turkish material. Acknowledgement is especially due Dr. P. H. Davis for his advice and patience, and Miss Rosemary Smith for so skilfully executing the illustrations.

Sect. PSILONEMA (C. A. Meyer) Hooker fil.

A. dasycarpum Steph. in Willd. Sp. Pl., **3**(1), 469 (1800).

var. **dasycarpum** (Fig. 1B)

Syn.: *Psilonema dasycarpum* (Steph.) C. A. Meyer in Ledebour, Fl. Alt., **3**, 50 (1831)!

Isotype—Russia: in Siberia ad Kamam et Volgam fluvium, *Stephen* (K!BM!).

var. **minus** Bornm. ex Dudley, **var. nov.** (Fig. 1A).

Syn.: *A. dasycarpum Steph.* var. *minus* Bornm. in exsicc.

A typo caulibus valde reductis fragilibus e basi ramosis, caulibus floriferis arcuatis vel ascendentibus pumilis 2·5–5 cm. longis, corymbis paucifloris vix elongatis, foliis minutis orbiculato-spatulatis (nec oblanceolato-obovatis) 2–3–plo minoribus 5–10 mm. longis 2–5 mm. latis, floribus et siliculis duplo minoribus recedit. Fl. Mar.

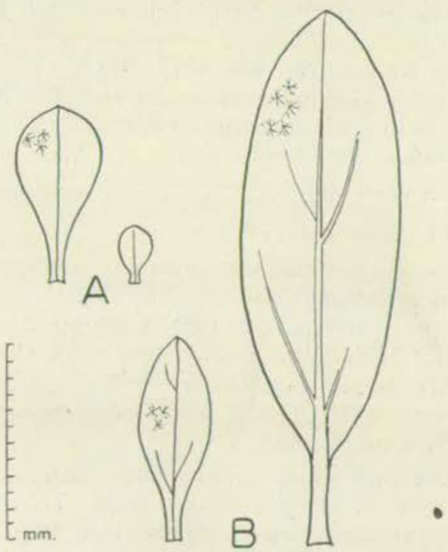


FIG. 1. *Alyssum dasycarpum* Steph. A, largest and smallest leaf of *A. dasycarpum* Steph. var. *minus* Bornm. ex Dudley. B, largest and smallest leaf of *A. dasycarpum* Steph. var. *dasycarpum*.

IRAN. Inter Ispahan et Hamadan, ad pagum Mohammedi, 1800 m., 17 Mar. 1892, *Bornmüller* 2174 (holo. E, iso. K, BM, OXF, W, G). Inter Ispahan et Yesd ad Bambis, 1900 m., 26 Mar. 1892, *Bornmüller* 2173 (G). Ad Kom, 1100 m., 4 Mar. 1892, *Bornmüller* 2175 (E, K, BM, OXF, W, G). In collibus prope Dalechi, Mar. 1842, *Kotschy* 181 (K, BM, G-Herb. Boiss. as *A. szowitsianum* pro parte). In arid. collibus Uenak pr. Teheran, 24 Apr. 1843, *Kotschy* 64 (W). Karawanseri, Kaswin, Iter Polak, 30 Apr. 1892, *Pichler* (K, W, G). Hills south of Tabriz, 9 Apr. 1926, *Gilliat-Smith* 1356 and 1381 (K); *ibid.*, May 1927, *Gilliat-Smith* 1783 (K).

SYRIA. Desert, Nebk to Quaryatein, 5 Apr. 1890, *Post* (BM).

This variety was apparently growing under similar environmental conditions to *A. desertorum* var. *prostratum* in the same area of Iran, and accordingly the general comments given under the latter apply also to *A. dasycarpum* var. *minus*.

Sect. ALYSSUM

A. desertorum Stapf in Denksch. Math-Naturwiss. Classe Kaiser. Akad. Wissen., **51** (2), 34 (1886).

var. **desertorum** (Fig. 2B)

Syn.: *A. minimum* Willd., Sp. Pl., **3** (1), 464 (1800) pro parte, non Linnaeus, Sp. Pl., **2**, 651 (1753)!
A. vindobonense Beck, Fl. Nieder Österr., 469 (1893).
A. minimoides Pau in Trab. Mus. Nat. Cienc. Nat. Madrid, ser. Bot., **14**, 15 (1918)!
A. desertorum var. *persicum* Prodan in Contrib. Bot. Cluj, **1**, (17), 4 (1930)!
A. desertorum var. *ponticum* Prodan, op. cit., 4!
A. desertorum var. *rossicum* Prodan, op. cit., 3!

Syntype—Persia: in desertis prope Jelizabethpol, Iter Polak, 5 Apr. 1882, *Pichler* (W!).

var. **himalayensis** Dudley, **var. nov.** (Fig. 3C).

Typo habitu et siliculorum forma similis, sed pilis stellatis minutissimis appressis (radiis 6–10 (–12) aequalibus brevibus 0·2–0·3 mm. diam.) serie singula ad marginem siliculi distinguitur. Fl. Mar.–Apr.; fr. Apr.–Mai.

TIBET. *Hügel* 1191 (holo W).

TURKESTAN. 1871, *Fedschenko* (W).

INDIA. Kashmir, Takht-i-Suliman Srinagar, 1704 m., 20 May 1940, *Pinfold* 101 (BM); Kashmir, *Falconer* 152 (W); in siccis ad summ. mt. Kashmir, *Jacquemont* 168 and 398 (W); Kashmir, 21 Apr. 1848, *Hooker fil. & Thomson* (K). Himal. Bor. Occid., Jsed, 1219–1829 m., *Hooker fil. & Thomson* (E, BM); Himal. Bor. Occid., Peshawin valley, 3–6 May 1848, *Hooker fil. & Thomson* (K); Himal. Bor. Occid. reg. temp. 1230–1845 m., *Hooker fil. & Thomson* (K, BM, W).

All of the above-cited sheets were originally determined as *A. minimum* Willd., a synonym of *A. desertorum* Stapf. The typical, completely glabrous-fruited var. *desertorum* extends from Western Europe to the Balkans, Turkey, Caucasus, the Russian steppes, Iraq, Iran, Afghanistan and Pakistan. A closely related taxon found only in Afghanistan, *A*, *afghanicum* Rechinger fil. (*A. turkestanicum* Regel & Schmalh.?), has a

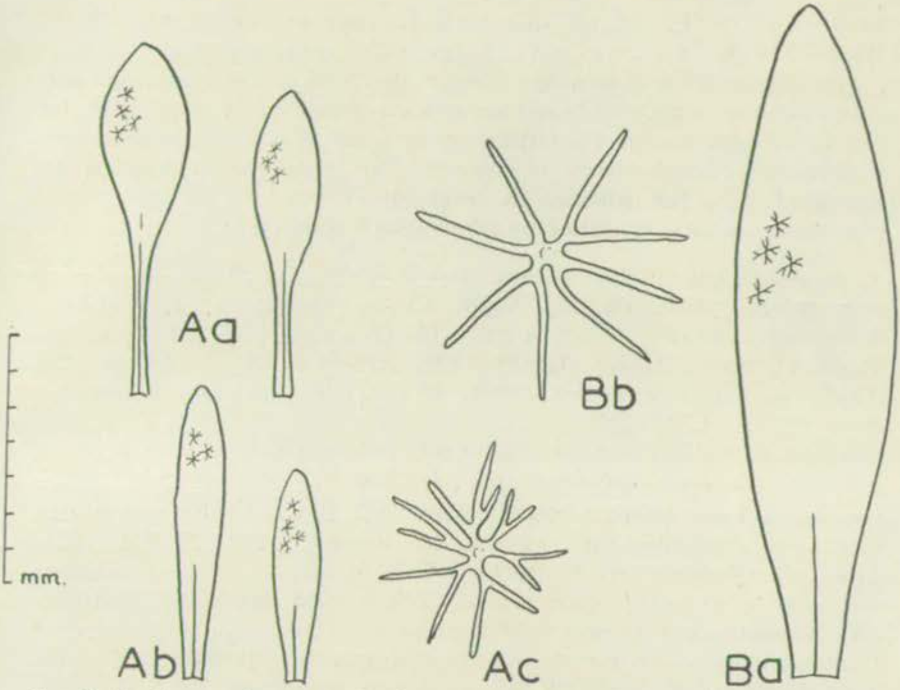


FIG. 2. A, *Alyssum desertorum* Stapf var. *prostratum* Dudley. Aa, lower leaves. Ab. upper leaves. Ac, stellate hairs of leaf (not to scale). B, *A. desertorum* Stapf var. *desertorum*. Ba, leaf. Bb, stellate hair of leaf (not to scale).

dense to sparse indumentum of short, few-rayed stellate hairs similar to var. *himalayensis*, but on the entire surfaces of both fruit valves. The row of delicate stellate hairs along the fruit margin of var. *himalayensis* is the most distinctive feature of this easterly extension of *A. desertorum*, and therefore morphologically links it to *A. afghanicum*.

var. **prostratum** Dudley, **var. nov.** (Fig. 2A)

Syn.: *A. desertorum* Stapf forma *prostrata* Bornm. in exsicc.

A typo habitu pumilo procumbenti, pluriramoso, caulibus 1·2–6 cm. longis, foliis inferioribus longipetiolatis spatulatis acutis (8–) 10–20 mm. longis 2·5–3 mm. latis, superioribus angustis oblanceolatis 3–6·5 mm. longis 1–1·5 mm. latis, corymbis valde confertis, indumento per totam plantam denso cinereo e pilis stellatis minoribus valde appressis composito, floribus et fructibus multo minoribus differt. Fl. Feb.–Mar.; fr. Mar.–Apr.

IRAN. Ad Teheran in desertis, c. 1200 m., 26 Feb. 1892, *Bornmüller* 2170 (holo E, iso. K, BM, OXF, W, G).

IRAQ. Near Shahraban, S. of Jebel Hamour, on dunes of blown sand, 11 Apr. 1957, *Hunting Technical Services Ltd.* 17 (K). Mt. Elwend, 2153 m., 1 Apr. 1929, *Cowan & Darlington* 373 (K). 39 miles west of Kermanshah, 1384 m., 29 Mar. 1929, *Cowan & Darlington* 2623 (K). 39 miles east of Kermanshah, 1384 m., 29 Mar. 1929, *Cowan & Darlington* 2620 and 2612 (K). Tak-i-Bustam, 1384 m., 27 Mar. 1929, *Cowan & Darlington* 2625 and 505 (K).

ARMENIA. Prov. Erivan, on stony hillsides near Erivan, 27 Mar. 1910, *Meyers* 579 (K); Erivan in rup., 13 Apr. 1916, *Schischkin* (K).

This variety of *A. desertorum* is associated with desert conditions and shows extreme vegetative reduction and a corresponding increase in the amount of indumentum. The latter gives the plant an ashy grey appearance, whereas the typical variety is greenish. Var. *prostratum* represents an ecological race, but whether its diagnostic characters are genetically controlled can only be settled by experimental cultivation.

A. densistellatum Dudley, **sp. nov.** (Fig. 3A)

A. praecox sensu Halácsy, Suppl. Consp. Fl. Graec., **1,** 9 (1908), *descr. latin.* Halácsy, Suppl. Consp. Fl. Graec., **2,** 12 (1912). Hayek, Prodr. Fl. Penin. Balcan., **1,** 435 (1925). Rechinger fil. Fl. Aegaea, 224 (1943); Rechinger fil. in Bot. Jahrb., **80** (3), 329 (1961)–non *A. praecox* Boiss. Fl. Or., **1,** 275 (1867).

Affinis *A. praecoci* Boiss. sed indumento foliorum diverso, siliculis dense lepidoto-squamosis, seminibus apteris recedit.

GREECE. Euboea: prope Limni, 18 Apr. 1902, *Leonis* 55 (holo. W-Herb. Hal. as *A. montanum* var. *graecum*, det. Baumg.); *ibid.*, 28 Apr. 1902, *Leonis* 21 (W-Herb. Hal.); septentrionalis in saxosis ad litus a Limni meridiem versus, substr. serpentino, 28 Mai. 1955, *Rechinger fil.* 16593 (W); septentrionalis in jugo inter Psachna et Achmet Aga (Prokopion) a Hagios septentrionem versus, substr. serpentino, c. 300–500 m., 27 Mai 1955, *Rechinger fil.* 16512 (W, K); pr. Limni, serpentine, 300–700 m., 21 Jul. 1956, *Rechinger fil.* 18236 (W, K); in cacumine Mt. Dirphys, 18 Mar. 1910, *Tuntas* 925 (W-Herb. Hal.).

The specimen chosen as holotype for this new species, in conjunction with the other *Leonis* sheet cited above, formed the basis of Halácsy's description. Superficially this taxon from Euboea resembles *A. praecox* Boiss. (originally described from the Cilician Taurus of Turkey) in habit and in the size and shape of leaves and fruit. The species name—*densistellatum*—aptly applies to the indumentum of the fruit (Halácsy writes "siliculis . . . lepidotis") which furnishes the major differential character between *A. praecox* Boiss. and the new species. The fruits of *A. praecox* bear sparse, few-rayed, and distinct stellate hairs (Boissier writes . . . "siliculis glabrescentibus . . ."), rather than a dense indumentum of overlapping, lepidote stellate hairs. The seed of *A. praecox* may have a membranous wing of varying width, but that of *A. densistellatum* is completely wingless, contrary to Halácsy's observation in his description. Another important difference between these two species illustrated in Fig. 3A is the different form of the stellate hairs on the leaves. The larger stellate hair of *A. densistellatum* is coarse and strongly punctuate with a diameter of 0·7–1 mm. and fewer, longer branches, whereas the lepidote scale of *A. praecox* has many, short branches and a diameter of 0·3–0·4 mm.

Sect. ODONTARRHENA (C. A. Meyer) Koch

A. subspinosum Dudley, **sp. nov.** (Pl. 6)

Ab omnibus aliis speciebus in Sectione *Odontarrhena* ("Elatiores") habitu fruticoso rigido ramulis ultimis subspinosis facile distinguitur. Ut videtur affinis *A. haradjianii* Rechinger fil. et *A. murali* W. & K. sed ab ambobus habitu diversissimo, foliis acutis utrimque ob indumento denso

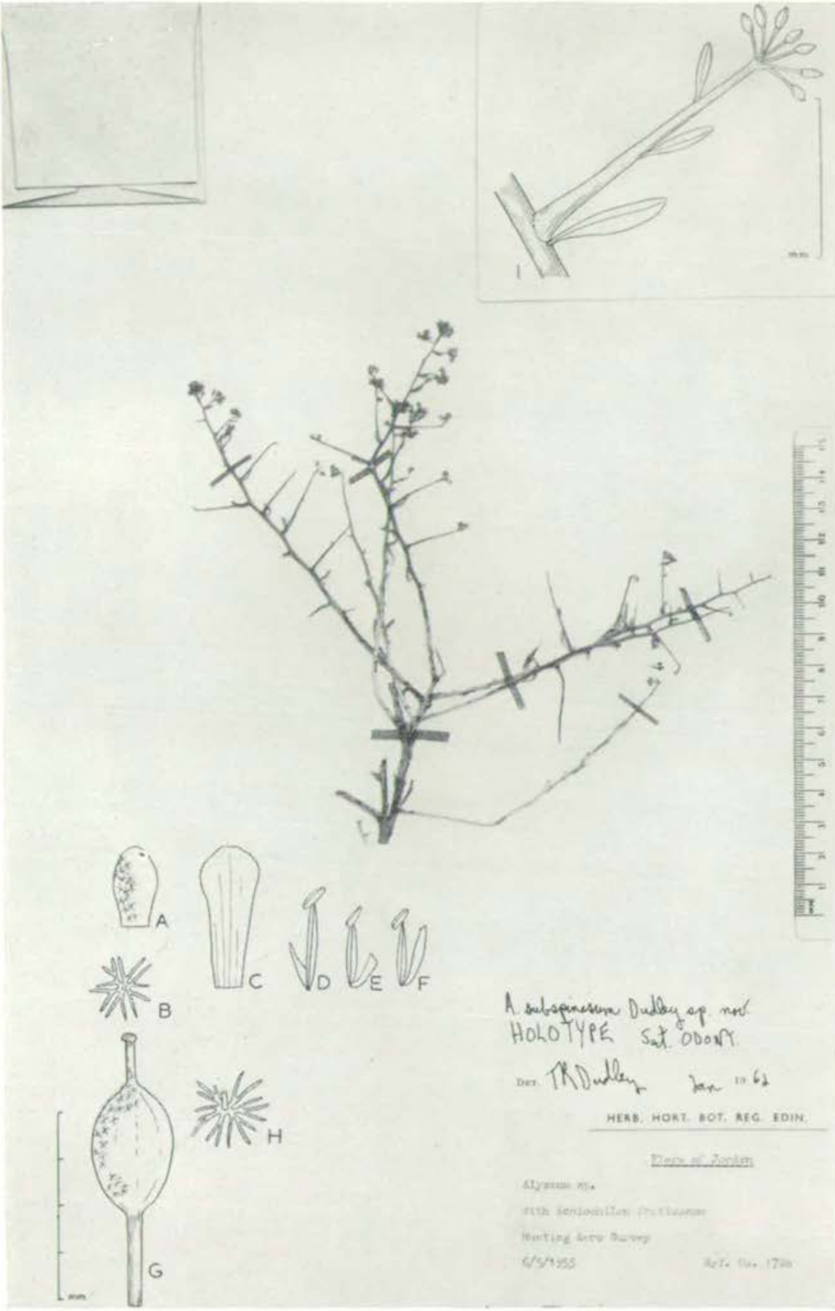


PLATE 6. *Alyssum subspinosum* Dudley, A, sepal. B, stellate hair on sepal (not to scale). C, petal. D, long stamen. E, short stamen. F, short stamen. G, fruit. H, stellate hair from fruit (not to scale). I, ultimate inflorescence in bud.

PLATE 7. *Alyssum penjwinensis* Dudley (holotype). Above, fertile stems; below, sterile rosette.

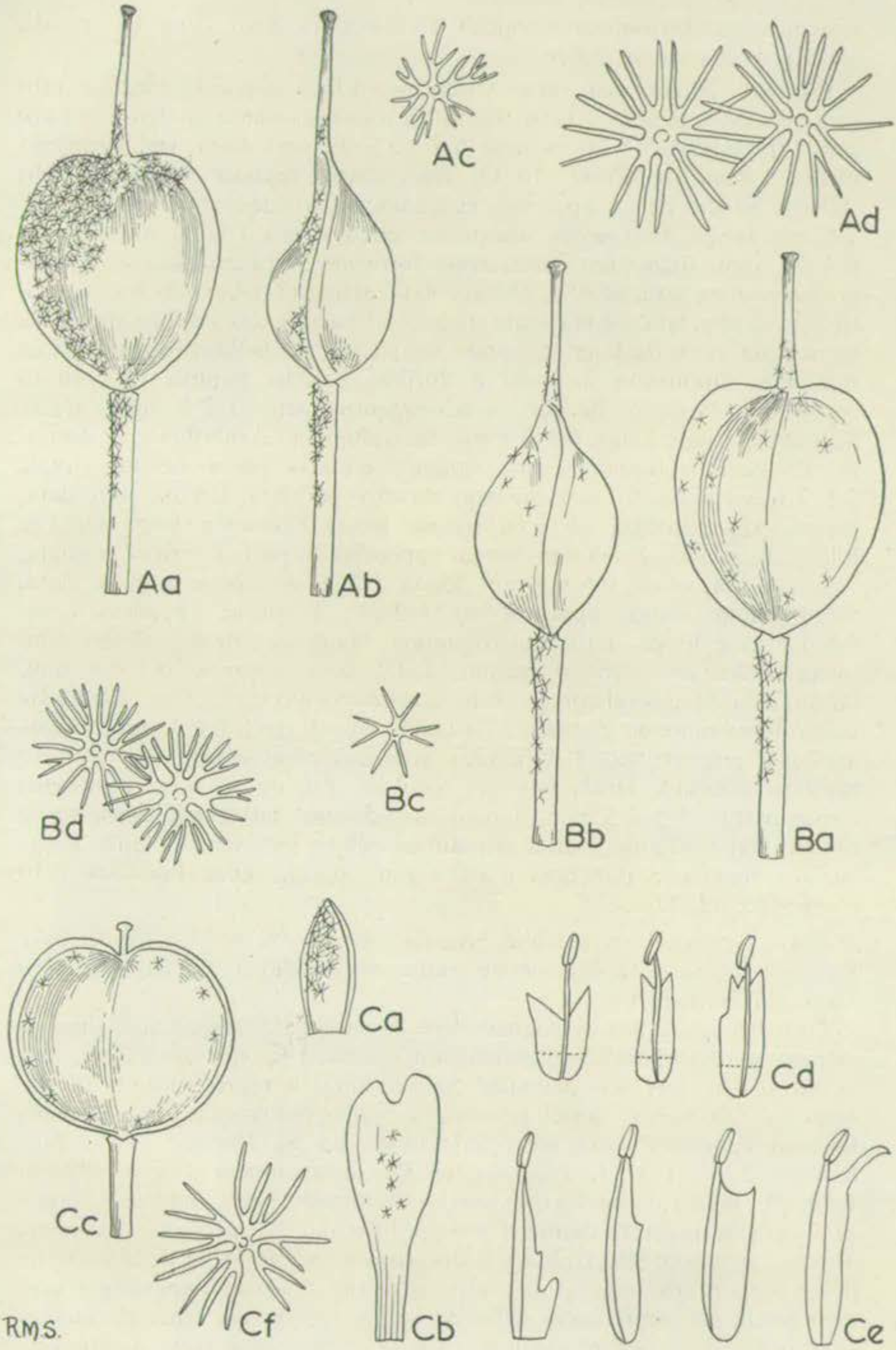


FIG. 3. *Alyssum densistellatum* Dudley, Aa, fruit, × 6. Ab, fruit, × 6. Ac, fruit stellate hair, × 40. Ad, stellate hair of leaves on sterile shoot, × 40. B, *A. praecox* Boiss. Ba, fruit, × 6. Bb, fruit, × 6. Bc, stellate hair of fruit, × 40. Bd, stellate hair of leaves on sterile shoots, × 40. C, *A. desertorum* Stapf var. *himalayensis* Dudley. Ca, sepal, × 9. Cb, petal, × 18. Cc, fruit × 6. Cd, short stamens, × 14. Ce, long stamens, × 14. Cf, stellate hairs on leaf, × 40.

concoloribus, turionibus sterilibus ad basin caulium confertis, petalis glabris, ovulis apteris differt.

Frutex c. 20 cm. alta, ramis stricte patentibus usque ad medium pilis stellatis albo-argenteis vestitis. *Planta* ex toto indumento ± dense stellato pilis appressis (9–) 15–20–radiatis (0·3–) 0·5–0·7 mm. diam. radiis ramosis obsita. *Rami penultimi* 10–13 cm. longi flexuose angulati pilis stellatis paucis parvis appressis subcanescenti-virides. *Rami ultimi* 1·3–2·5 cm. longi, divergentes subspinosi spiculo basi 1 mm. diam. apice 0·4–0·5 mm. diam. terminati. *Folia turionum sterilium* densissime disposita, caulina laxa, sessilia, oblanceolata, acuta, (2–) 4–6 (–9) mm. longa, (0·5–) 1–2 mm. lata, omnia dense stellato-pilosa argentea vel folia superiora virescentia mox decidua. *Corymbi* simpliciter umbelliformes ad apices ramosum ultimorum dispositi e floribus pallidis minutis (5–) 10–15 compositi. *Pedicelli* floriferi subdivergento-erecti, 2–2·5 mm. longi. *Sepala* 1·5–2 mm. longa, 0·5–0·7 mm. lata, elliptica vel subobovata, obtusa, membranaceo-marginata, pilis stellatis minutis parce obsita. *Petala* 2·5–3 mm. longa, 0·7–1 mm. lata, clavato-spatulata, lamina rotundata, glabra, apice integra in sicco pallide flava. *Filamenta longa* anguste bilateraliter alata, 2–2·5 mm. longa, appendice in parte inferiore connata, superne libra, acuta, 0·5–0·8 mm. longa. *Filamenta minora* anguste alata, 1·5–1·8 mm. longa, appendicibus 1–2-plo longiora; appendix libra, 0·8–1·5 mm. longa, acuta vel tridentata. *Antherae* luteae, 0·7–0·8 mm. longae. *Ovarium* elliptico-ovatum, 1–1·5 mm. longum, 0·5–0·8 mm. latum, subinflatum vel compressum, apice obtusum vel acutum. *Glandulae* nectariferae minutae globosae. *Stylus* in statu florendi 0·6–1 mm. longus ad basin pilis stellatis 1–4 minutis appressis obsitus, stigmate globoso capitato provisus. *Ovula* una per loculum. *Fructus* in statu immaturo uniseminatus, 1·5–2·5 mm. longus, 1–1·5 mm. latus, ellipticus, apice obtusus vel subacutus, valvis aequalibus inflatis indumento e pilis densis stellatis manifeste punctatis 0·3–0·4 mm. diam. radiis brevibus 7–10 composito. Fl. Mai.

JORDAN. South of Nagb Ishtar [Ashtar, 30° N, 35° 30′ E], almost bare Ram sandstone, with *Echiochilon fruticosum*, 6 May 1955, *Hunting Aero Survey* 172b (holo. E).

This distinctive woody chamaephyte from Jordan represents a line of extreme xeromorphic development not observed in *Alyssum* before, and is one of the very few perennial Saharo-Sindian representatives of the genus. *A. spinosum* L., which possesses a similar but more extreme branch-thorned condition, was correctly transferred by Boissier (Voy. Bot. Espagne **2**, 46, 1837) to *Ptilotrichum*. The indumentum of *A. haradjianii* Rech. fil., which occurs farther north in Lebanon, Syria and the Amanus of Turkey, is similar to that of *A. subspinosum* and indicates a close affinity. This is also true of the extremely widespread *A. murale* W. & K. though the floral parts of the new species, especially the filament appendages and their teeth, are significantly different, as are the several other characters cited in the diagnosis which distinguish *A. subspinosum* from its allies.

A. penjwinensis Dudley, **sp. nov.** (Pl. 7, fig. 4)

Syn.: *A. rhodopense* Form. ssp. *duristellatum* Nyárády, Synopsis Odontarrhenae in Anal. Acad. Repub. Popul. Romane Şect. Ştinte Geogr. Şc. Biol., ser. A, **1**, mem. 3, 77 (1949)!

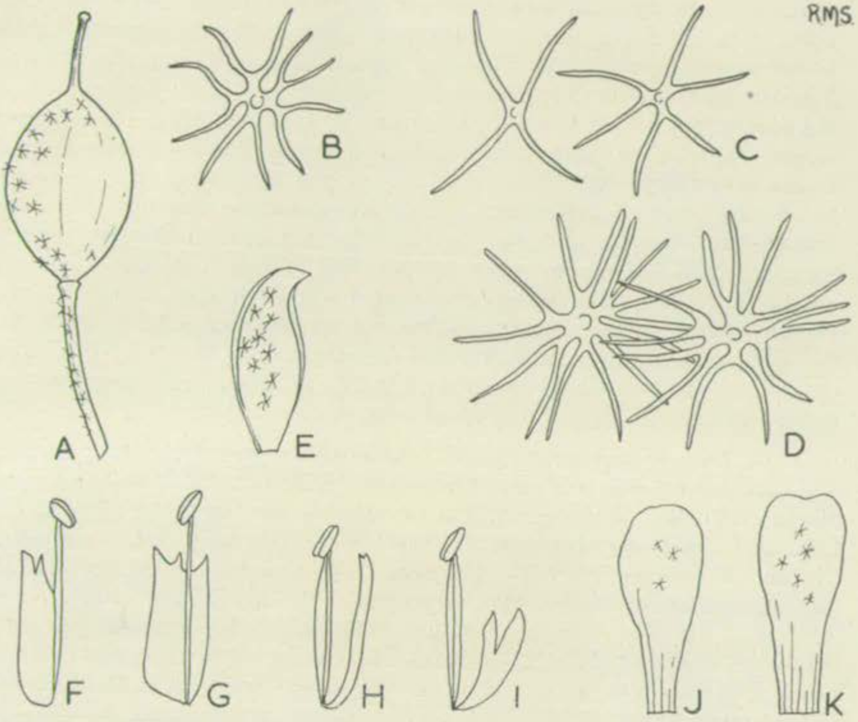


FIG. 4. *Alyssum penjwinensis* Dudley, A, fruit, × 6. B, stellate hair of fruit, × 40. C, stellate hair of leaf on fertile stem, × 40. D, stellate hair on leaf of sterile stem, × 40. E, sepal, × 8. F, G, long stamens, × 12. H, I, short stamens, × 12. J, K, petals, × 9.

Affinis *A. constellato* Boiss. sed habitu diverso, foliis surculorum sterilium orbiculato-spatulatis dense argenteo-incanis, corymbis majoribus laxe pyramidalibus multo ramosis ramulis ultimis subascendentibus, pedicellis distantibus patentissimis, petalis sparse stellato-pilosis (nec glabris), siliculis compressis latius ellipticis, ovulis apteris differt.

Herba perennis, suffrutescens, hemisphaerica, a basi multiramosa, 18–25 cm. alta et lata. *Caules floriferi* stricti patentim ascendentes, a basi rubro-purpureo pilis stellatis parcis tecti. *Surculi steriles* basales, insignes, breviter patentim rosuliferi. *Folia caulium floriferorum* virescentia, obovata vel oblanceolata, acuta, (10–) 15–20 mm. longa, (2–) 3–6 mm. lata, summum versus sensim increscentia, pilis paucis stellatis punctatis 0·4–0·5 mm. diam. e radiis longis delicatis 4–6 compositis obsita. *Folia surculorum sterilium* crassa; inferiora oblanceolata, 10–20 mm. longa, 4–7 mm. lata, pilis stellatis ± parcis 0·4–0·5 mm. diam. 6–10–radiatis radiis ramosis; superiora obovato-spatulata, 5–10 mm. longa, 3–6 mm. lata, pilis densis argenteo-lepidotis appressis manifeste punctatis 0·5–0·7 mm. diam. 10–20–radiatis radiis ramosis vestita. *Corymbi* laxi, magni, ob-pyramidales, 7–10 cm. alti et lati, ramulis ultimis subhorizontalibus 2·5–5 cm. longis. *Pedicelli* patentissimi vel deflexi, 3·5–4·5 mm. longi, inter se 3–5 mm. distantes, indumento eo fructuum simili. *Sepala* sub-persistentia, subcucullata, acuta, membranaceo-marginata, 2–2·5 mm. longa, 1–1·5 mm. lata, ovata vel elliptica, pilis stellatis parcis 4–6–

radiatis obsita. *Petala* obovato-clavata, 3–3·5 mm. longa, 1–1·5 mm. lata, apice rotundata, integra vel subretusa, pilis stellatis paucis e radiis brevibus 4–6– compositis. *Filamenta longa* c. 2 mm. longa, appendice in dimidio inferiore connata superne bi-tridentata. *Filamenta minora* c. 1·5 mm. longa, appendice 1–2–plo longiora; appendix libra, 0·7–1·5 mm. longa, minute vel grosse bidentata. *Antherae* 0·3–0·4 mm. longae. *Ovarium* late ellipticum versus basin et apicem attenuatum, 2 mm. longum, 1–1·5 mm. latum, compressum, pilis stellatis punctatis obsitum. *Glandulae* nectariferae minutae globosae. *Stylus* 1·5–1·8 (–2) mm. longus, glaber, tenuis, stigmate capitato globoso provisus. *Ovula* una per loculum, aptera. *Fructus* ovatus vel ellipticus, 4–4·5 mm. longus, 3 mm. latus, versum apicem et basin attenuatus, valvis aequalibus subinflatis virescentibus pilis stellatis punctatis asperrimis vel subappressis 0·4–0·5 (–0·6) mm. diam. e radiis 4–8 (–10) compositis etiam ad marginem valvarum ± dense obtectis. Fl. Jun.–Jul; fr. Jul–Aug.

N. IRAQ. Dist. Sulaimaniya (Kurdistan) in ditione pagi Penjwin in montibus denudatis, 1400–1600 m., serpentino, 19–20 Jun. 1957, *Rechinger fil.* 10446 (holo. W); Penjwin, 1550 m., stony mt. side, 20 Aug. 1953, *Guest* (*Rustam*) 12971 (K); Penjwin, 1280 m., *Rhus-Quercus* forest on hillside, 21 Jun. 1957, *Rawi* 22529 (K); Penjwin, 1600 m., 9 Jun. 1948, *Rawi* 12223 (K); near Penjwin, Kajan Mt., serpentine, 1590 m., 21 Jun. 1957, *Rawi* 2273 (K); Penjwin, 1600 m., 19 Jun. 1948, *Rawi* (K); Penjwin, 700 m., 9 Jun. 1948, *Rawi* 12270 (K). Avroman Mt., north of Halabja (on Persian border), 1500–1830 m., 18 Jun. 1957, *Rawi* 22083 (K). Dist. Erbil (Kurdistan), Mons Helgurd (Arl Gird Dagh) ad confines Persiae, c. 36° 40′N, 44° 50′E, in valle supra pagum Nowanda, c. 2000–2600 m., 10–14 Aug. 1957, *Rechinger fil.* 11361 (W); Arl Gird Dagh, Gasharm, 1829 m., 21 Jul. 1932, *Guest* (*Rustam*) 2818 (K); valley east of Arl Gird Dagh, 2100 m., *Astragalus* thorn cushion on igneous or metamorphic rock, *Gillett* 9502 (K). Erbil liwa, Mergadereija near Haji Omran, 1800–1900 m., 21 Jun. 1947, *Rawi* 9145 (K); valley between Gundashar and Darbad, 1400 m., 25 Aug. 1948, *Gillett* 12402 (K). Gara Dagh, 1500–1700 m., near *Quercus libani*, 26 Jun. 1947, *Rawi* 9263 (K).

Blackelock in the Kew Bulletin 1955, p. 521, cites many of the specimens of *A. penjwinensis* under *A. singarense*. He points out, however, that "Gillett and Rawi's specimens are not a perfect match for Haussknecht's gathering which has a denser indumentum on all parts". His illustration of the fruit is definitely of *A. singarense* Boiss. & Hausskn. and could not be interpreted to represent *A. penjwinensis*. Earlier, in the enumeration of the Rustam herbarium (Kew Bulletin 1948, p. 384), Blackelock cited the sheets collected by Guest as "Alyssum sp.", and commented that the silicules resemble those of *A. lanigerum* DC but the racemes are longer and more slender; he considered it to be probably a form of that species.

This author feels that any affinity which *A. penjwinensis* shows to *A. lanigerum* or *A. singarense* is remote, even though the three species may occur in the same general area of northern Iraq. However, Nyárády's conclusion of a close affinity to *A. rhodopense* Form. seems equally unlikely. Quite apart from morphological details, this theory is weakened by the fact that *A. rhodopense*, originally described from the Rhodope mountains of Bulgaria, has never been recorded east of the Bosphorus.

Examination of the holotype of *A. rhodopense* ssp. *duristellatum* from the Herb. Haussknecht in Jena (Mt. Avroman, 1580 m., July 1867, *Haussknecht*) has clearly indicated that Nyárády intended the subspecific name to be *duristellatum* not "*duristellalum*" which appeared in his *Synopsis Odontarrhenae*. Nyárády noted on his label that this was perhaps a separate species, but more material was needed. Haussknecht determined this specimen as "*A. anatolicum* mihi", which, however, was certainly not what he considered as *A. anatolicum* from Turkey, a name later validated by Nyárády.

The collections from Iraq are all copiously branched from the base, have a lax obpyramidal inflorescence, and distinctive, silvery, rosulate sterile shoots, and clearly represent a new species in Section *Odontarrhena*. Its closest affinity is with *A. constellatum* Boiss. which occurs rarely in the same area and extends westwards to the Amanus and Cilician Taurus.

Present status	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Proposed status
	a b c	a b c	a b	a b c	a b	a b	a b	a b c	a b c	a b	a b	a b	a b c		a b	
Alyssum creticum	+	+	+	+	+	+	+	+	+	+	+	+	+	4	+	Alyssoides
Vesicaria utriculata	+	+	+	+	+	+	+	+ +	+ +	+	+	+	+	4	+	Alyssoides
Alyssum sinuatum	+	+	+	+	+	+	+	+	+	+	+	+	+	6–8	+	Alyssoides
Alyssum macrocarpum	+	+	+	+	+	+	+	+	+	+	+	+	+	4–6	+	Alyssoides
Fibigia	+	+ +	+	+	+	+	+	+	+	+	+	+	+	2–9	+	unchanged
Ptilotrichum reverchonii	+	+	+	+	+	+	+	+	+	+	+	+	+	2–3	+	Hormathophylla
Ptilotrichum pyrenaica	+	+	+	+	+	+	+	+	+	+	+	+	+	4	+	Hormathophylla
Ptilotrichum longicaule	+	+	+	+	+	+	+	+	+	+	+	+	+	2	+	Hormathophylla
Berteroa spathulata	+	+	+	+	+	+	+	+	+	+	+	+	+	2	+	Hormathophylla
Degenia	+	+	+	+	+	+	+	+	+	+	+	+	+	2	+ +	unchanged
Physoptychia	+	+	+	+	+	+	+	+	+	+ +	+	+	+	2–6	+	unchanged
Lobularia	+	+	+	+	+	+	+	+	+	+	+	+	+	1	+	unchanged
Bornmuellera	+	+	+	+	+	+	+	+	+	+	+	+	+	2	+	expanded to contain six species
Berteroa	+	+	+	+	+	+	+	+ +	+ + +	+	+	+	+	2–6	+	unchanged
Sect. Aurinia Alyssum saxatile	+	+	+	+	+	+→	+	+	+	+	+	+	+	2	+	Aurinia
Sect. Aurinia Alyssum leucadeum	+	+	←+	←+	+	+	+	+	+	+	+	+	+	4	+	Aurinia
Ptilotrichum halimifolium	+	+	+	+	+	+	+	+	+	+	+	+	+→	2	+	Aurinia
Sect. Aurinia Alyssum corymbosum	+	+	+	+	+	←+	+	+	+	+	+	+	+	2	+	Aurinia
Sect. Aurinia Alyssum petraeum	+	+	+	+	+	+	+	+	+	+	+	+	+	2	+	Aurinia
Lepidotrichum uechtritzianum	+	+	+	+	+	+	+	+	+	+	+	+	+	2	+	Aurinia
Ptilotrichum rupestre	+	+	+	+	+	+→	+	+	+	+	+	+	+	2	+	Aurinia
Alyssum Sect. Meniocus	+ + +	+ +	+	+	+	+	+ +	+ +	+	+	+	+	+	2–6 (–8)	+ +	unchanged
Alyssum Sect. Psilonema	+ + +	+	+	+→	+	+	←+	+	+	+	+	+	+	2	+ +	unchanged
Alyssum Sect. Alyssum	+ + +	←+	+	+ +	+ +	+	+	+	+ + +	+	+	+	+→	2	+ +	unchanged
Ptilotrichum canescens	+	+	+	+ +	+	+	+	+	+	+	+	+	+	2	+	Alyssum Sect. Alyssum
Ptilotrichum elongatum	+	+	+	+ +	+	+	+	+	+	+	+	+	+	2	+	Alyssum Sect. Alyssum
Ptilotrichum purpureum	+	+	+	+ +	+	+	+	+	+	+	+	+	+	2	+	Alyssum Sect. Alyssum
Gamosepalum	+ +	←+	+	+ +	+	+	+→	+	+	+	+	+	+→	2	+ +	Alyssum Sect. Gamosepalum
Ptilotrichum lapeyrousianum	+	+	+	+	+	+	+	+	+	+	+	+	+	2	+	Alyssum Sect. Tetradenia
Ptilotrichum cochleatum	+	+	+	+	+	+	+	+	+	+	+	+	+	2	+	Alyssum Sect. Tetradenia
Ptilotrichum spinosum	+	+ +	+	+	+	+	+	+	+	+	+	+	+	2	+	Alyssum Sect. Tetradenia
Sect. Odontarrhena Alyssum Subsect. Odontarrhena	+ +	+	+	+ +	←+	+	←+	+	←+	+	+	+	+	1	+ +	new subsection
Sect. Odontarrhena Alyssum Subsect. Compressa	+ +	+	+	+	+	+	+	+	←+	+	←+	+	+ +	1	+	new subsection
Sect. Odontarrhena Alyssum Subsect. Samarifera	+ +	+	+	+	+	+ +	+	+	+	+	+	+	+	1	+	new subsection
Clypeola	+	+ +	+	+	+	+	+	+	+	+	+	+	+ +	1	+	unchanged

ABSTRACT OF THESIS

Name of Candidate Theodore Robert Dudley

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Degree Ph.D. Date 22nd March, 1963.

Title of Thesis Taxonomic Studies in the Cruciferae of the Near East

The genus Alyssum L. is one of the largest groups of Cruciferous plants in the Near East. This thesis is principally a taxonomic survey of the species in Turkey and the closely allied ones in Europe and the rest of the Orient. The genus is divided into several convenient and natural groups which can serve as the basis of further study. The sections recognized are Meniocus, Psilonema, Alyssum, Gamosepalum, Tetradenia and Odontarrhena. Two of these sections, Gamosepalum and Odontarrhena, have been further subdivided into smaller and natural subsections and/or series.

It was necessary, subsidiary to the taxonomy of Alyssum, to examine carefully the generic limits within the Tribus Alysseae. An enumeration of the genera and a discussion of the differences between the tribal organization of Schulz (1936) and that of the present author is included. On the basis of its type species, the genus Ptilotrichum Meyer is regarded as a synonym of Alyssum Sect. Alyssum. The components of Ptilotrichum have accordingly been distributed among other genera in the tribe. For example, Bornmuellera Hausskn. has been expanded to include species previously referred to Ptilotrichum. Ptilotrichum reverchonii Degen & Herv. and its allies have been placed in a new genus, Hormathophylla Cullen and Dudley. It has been deduced that Aurinia Desv., long treated as a section of Alyssum, is better regarded as a distinct genus possessing numerous discontinuities allowing generic distinction from Alyssum; its systematics are treated in a separate sectio (Section IX). Lepidotrichum Velen. & Bornm., which was previously a monotypic genus, has been referred to Aurinia. Nyárády's Triplopetalum and Haussknecht's Gamosepalum are both included in Alyssum, the former in Sect. Odontarrhena Subsect. Samarifera, the latter forming a natural section closely allied to Sect. Alyssum. Alyssoides Miller (gen. cons.) has been expanded to contain several species which have previously considered as species of Alyssum. Leptoplax Schulz has no close relationship with any genus in Tribus Alysseae and has been transferred to Tribus Lunarieae where its closest affinity is with Peltaria Jacq. Tables of data and a pictorialized representation of generic affinities accompany the Section on the Re-Organization of the Alysseae (Section II), and support the conclusions contained therein.

The monographic works on Alyssum of previous botanists (Boissier, Fenzl, Baumgartner and Nyárády) are discussed and criticised. The material and methods employed for the accumulation of the data presented in this thesis are explained. An account of geographical distribution and endemism of Alyssum is given in Section V; this section primarily refers to the 87 species found in Turkey, of which 49 are strictly confined to that area. The closest affinities to the Turkish taxa are analysed section by section, and the conclusion is reached that Anatolia is the present centre of diversity and speciation for the genus.

The taxonomic characters and their variability, used in this study to determine affinities and taxonomic limits, are discussed. Illustrations of types of hairs, petals, filaments, fruits, pedicels and styles accompany the discussion of taxonomic characters, as well as a floral diagram and views of a typical Alyssum flower.

In the section on Biology, what is known about the pollination and breeding mechanisms as well as the chromosome numbers in Alyssum are detailed and discussed. Fruit and seed dispersal is fully reviewed, as well as some first-hand observations on the production of seed mucilage.

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P.T.O.

Use other side if necessary.

The Synopsis of Alyssum (Section X) lists all the currently recognized specie of Alyssum (161 in number), and their respective placement in the presently recognized infra-generic groups of Alyssum. Of the total number of species in Alyssum, 128 - including 47 with entirely extra-Turkish distribution (but closely related to the 87 occurring in Turkey) - are keyed out in Section XII, and are included in the Section on Systematic (Section XIII). All of the species occurring in this systematic section are accompanied by useful references, complete synonymy, specimen citations, and discussions, when applicable, of some important features relating to distribution, synonymy and relationships. From among the 87 species of Alyssum found in Turkey, 10 are new to science and have been described fully in Latin, and all but one have been illustrated and provided with photographs of their holotypes (see Appendix). Of the 16 subspecies recognized in the species of Alyssu in this study, 11 occur in Turkey and 4 are endemic to that area; of these 16 subspecies, 4 are new combinations. Also of the 27 varieties, 22 occur in Turkey, but only 8 are endemics; of these 27 varieties 7 are new combinations and 2 are new to science. Approximately 50 binomials (including about 30 species recognized by Nyárády) have been reduced to synonymy in this study, and approximately 10 long-ignored binomials have been re-instated within the genus.

All of the species (and their infra-specific taxa) occurring in Turkey are furnished with distribution maps, with the exception of only a few very widespread European and Asiatic species. Additional photographs, primarily of habitats, have been included in the Appendix for species of Aurinia and Alyssum when of particular interest and value to this study.