CONTRIBUTIONS TO THE KNOWLEDGE

OF THE FLORA

OF THE EASTERN MEDITERRANEAN

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OF THE EASTERN MEDITERRANEAN

TAXONOMIC SECTION

ADDITIONS TO THE SUMMER FLORA OF THE AEGEAN.

INTRODUCTION.

In 1943 Dr. K.H. Rechinger published his Flora Aegaea, the first comprehensive work to be devoted to the plants of the Aegean islands. Dr. Rechinger has followed up his Flora by the following taxonomic and phytogeographical contributions:

Neue Beiträge zur Flora von Kreta in Denkschr. Akad. Wiss. Wien, 105, 2 Halbb. 1 Abt. (1943).

Der Polymorphismus in der ägäischen Flora. Öst. Bot. Zeitschr. 94, 152-234 (1947).

Florae Aegaeae Supplementum. Phyton, 1, 194-228 (1949).

Grundzüge der Pflanzenverbreitung in der Aegäis. Vegetatio, 2, 55-119, 239-308, 365-386 (1950).

Phytogeographia Aegaea. Denkschr. Akad. Wiss. Wien, 105, 2 Halbb. 2 Abt. (1949).

In the summer of 1950 I made a short journey in the Aegean (primarily for the purpose of collecting seeds), followed by an excursion into Western Anatolia (cf. Davis in Notes Roy. Bot. Gard. Edin. 21 (2): 1952). The three main places visited in the Aegean (as circumscribed by Rechinger) were Karpathos, West Crete and Mykali (in Turkey, opposite the island of Samos). Though none of these areas was unexplored, some new taxa were discovered. The extreme rarity of many of the endemics makes it certain that the Aegean, and other parts of the Eastern Mediterranean (especially Turkey), will continue to be a source of taxonomic discoveries for many /

many years to come.

ITINERARY.

KARPATHOS. The island was reached by steamer from Piraeus on July 20, 1950. I landed at Pigadhia, and proceeded the same day by bus to Voladha.

July 21 : Voladha to Lastos by mule, with ascent of Kalilimni on foot, entailing a climb along the western precipice. July 22 : Lastos to Spoa by mule, via Marmakoui and Holethria on the western flank of Kalilimni, through a Pinetum Brutiae. July 23 : Spoa to Olymbos by mule. July 24 : Olymbos to Vurgunda (on the coast N.W. of Olymbos), on foot by way of Avlona, and return to Olymbos. July 25 : Olymbos to Diaphani (on coast E. of Olymbos), and then by caique to the island of Saria; return by caique to Pigadhia. July 26 : Pigadhia to Menetes by bus, with ascent of Mt. Prof. Elias above the village; on to Phiniki by bus. July 27 : around Phiniki. July 28 : by caique to Kasos. July 29-31 : from Kasos to Piraeus by caique, sheltering at the islet of Makra en route.

Karpathos was botanised by Pichler (1883), Forsyth-Major (1886) and K.H. Rechinger (1935). Although I tended to follow in Forsyth-Major's footsteps, two new species were found, doubtless due to their late-flowering habit. The southern end of Karpathos and the great sea cliffs west of Spoa need further exploration. The beautiful endemic Campanula erucifolia Feer has only been collected by Pichler.

Dr. Rechinger records 12 taxa as endemic to Karpathos. To these must be added Carthamus Rechingeri P.H.Davis, C. leucocaulos Sibth. et Smith var. subarachnoideus P.H. Davis, Micromeria carpatha /

carpatha Rech. fil., Scabiosa cretica L. subsp. carpatha P.H.Davis, Salsola carpatha P.H.Davis, and Teucrium Montbretii Benth. var. crenatum P.H.Davis, bringing the total of endemics to 18.

CRETE. Canea was reached by steamer from Piraeus on August 1, 1950. August 2 : Canea to Meskla by car, and on to Theriso by mule. August 3 : Theriso to the shepherd huts of Katsiveli (near Pachnes) by mule. August 4 : ascent of Svourichti (E. of Katsiveli) on foot, and return to Katsiveli. August 5 : Katsiveli — Theriso — Meskla — Canea.

The White Mountains (Levka Ori) have been visited by many botanists, including Tournefort (1700), Raulin (1845), Sibthorp, Sieber (1817), Heldreich (1846), Gandoger (1916-17), Lempberg (1936), Baldacci (1893, 1899) and K.H. Rechinger (1942).

Two hundred and nine taxa (excluding Odontites cretica Boiss.) are recorded by Dr. Rechinger as endemic to Crete — the highest for any Mediterranean island. To these must be added Carlina Barnebiana Burtt et Davis, Crocus oreocreticus B.L. Burtt and Nepeta sphaciotica P.H.Davis, bringing the total to 212.

MYKALI. On this mountain (Samsun Dağ) I was accompanied by Mr. V.H.Heywood. We reached Söke by train from Izmir on August 19, 1950. Thence we took a car on August 20 to the ruins of Priene at the east foot of Samsun Dağ; we climbed the limestone mountain on foot, returning the same night to Söke. The slopes are dominated by Pinus Brutia, replaced by P. nigra subsp. Pallasiana above 900 m. on western exposures.

Mykali was visited by Forsyth-Major in June 1886. No route is given, but I suspect that he made for the highest peak, which lies towards the west end of the ridge and which we were unable /

unable to reach from Priene. Bormüller appears to have taken much the same route as ourselves in 1906.

Only two endemics are recorded for Mykali: Campanula mycalaea Barbey et Forsyth-Major and Verbascum maeandri Bornm. We found neither of these, though we discovered a third: Helichrysum Heywoodiana P.H.Davis. It seems possible that the Mykali plant identified as Origanum Dictamnus L. by Barbey (Lydie, Lycie, Carie, 81: 1890) may turn out to be a new species. It needs re-collecting.

CLIFF VEGETATION ON KARPATHOS.

On Karpathos most of the cliffs consist of compact Cretaceous limestones ideal for chasmophytes. For convenience the cliffs can be considered under two headings — those near the sea, and those in the mountains, each characterised by several species not seen in the other. For both habitats the majority of the plants are nanophanerophytes or suffrutescent chamaephytes.

1. Cliffs in the mountains. These were examined only in the central part of the island, especially in the neighbourhood of Kalilimni, the island's highest peak. There, just below the summit, there are nearly vertical cliffs (c. 80°) facing N.W. at 1100 m. These were dominated by Erica verticillata, a facultative chasmophyte. Common associates were Helichrysum orientale var. Pichleri, Cephalaria mediterranea var. Sieberi, Pimpinella Tragium aff. var. creticae and Seseli gummiferum subsp. crithmifolium. More local were Linum arboreum and Brassica cretica var. aegaea. At the foot of these shady cliffs, growing through grazed hummocks of Erica verticillata or among moss and stones, was the rare Origanum Vetteri, /

Vetteri, only known from this place. The locality is very favourable for plant life, because of the chilly mist that so frequently shrouds the summits during the hot summer months.

On another cliff in the same area, facing W. at 1000 m. and sloping at 80°, Staehelina fruticosa was co-dominant with Erica verticillata; the former tolerates somewhat drier conditions than the Cephalaria referred to above. Rocks facing W. and sloping at 50° — very hot in the afternoon sun — were dominated by the xeromorphic Inula heterolepis.

On the E. flank of Kalilimni lies the little plain of Lastos at 700 m. The stony slopes around it were covered by the dwarf bushes of Poterium spinosum, Euphorbia acanthothamnos, Carlina conformis, Lithospermum hispidulum and Coridothymus capitatus. Nearby, the step-crevices of a rather dry S.W. cliff at 650 m. were dominated by the shrubby Chamaepeuce Alpini var. camptolepis, accompanied by bushes of Scabiosa cretica subsp. carpatha and Ephedra campylopoda; Allium Bourgaei occurred on the ledges. On an adjacent N.E. cliff, arid and nearly vertical — or even overhanging — the Scabiosa formed bushes over 2 m. across. It had no associates other than a few rosettes of Silene gigantea.

2. Cliffs near the sea. Here three localities were examined: Vurgunda (N.W. of Olymbos), Phiniki and Saria.

a) Vurgunda. The vertical sea-rocks at Vurgunda contain four chasmophytes: Salsola carpatha (endemic), Galium canum (a wide leaved form), Lactuca amorgina and Capparis rupestris.

Above, on dry nearly vertical cliffs of limestone conglomerate, facing N. at 30 m. (near the cliff called Akrotirias), Dianthus arboreus and Galium canum were dominant; they were most commonly /

commonly accompanied by Salsola carpatha, Capparis rupestris and Chamaepeuce Alpini var. camptolepis (the latter mainly in step-crevices); less common were Campanula carpatha, Ephedra campylopoda and Brassica cretica var. aegaea. On the same cliff, but chiefly on the overhangs at the mouth of dry caverns, was Teucrium Montbretii var. crenatum, accompanied by Galium canum; both these species, throughout their range, seem to favour very dry and frequently over-hanging rocks. On sloping rock in the same locality Limonium Frederici was locally not uncommon.

At 60 m. Senecio gnaphalodes (confined to Karpathos and E. Crete) occurred rarely on vertical N. cliffs dominated by Dianthus arboreus. Higher up, near Avlona, this shrubby Senecio was abundant, colonising the dry walls of terraces, as it does further south at Menetes.

b) Phiniki. Here a line of limestone cliffs, facing W., descends to within 20 m. of the sea. The vertical rock was dominated by Staehelina fruticosa and Capparis rupestris. Common associates were Linum arboreum, Dianthus arboreus and Teucrium Montbretii var. helitropifolium — the latter chiefly on dry overhangs. Rare on the vertical rock were Alyssum creticum and Scabiosa cretica subsp. carpatha. In this maritime locality both the Staehelina and Dianthus had unusually fleshy leaves. It was here that Dr. Rechinger discovered the remarkable cavernicolous Arabis longistyla Rech. fil., an endemic which I did not find.

c) Saria. Here I visited the N.E. cliffs at the place called Spatharea; the cliff is of hard crystalline limestone, and at 50 m. slopes at an angle of 75°. The rock-face was dominated by two facultative chasmophytes: Erica verticillata and Lithospermum hispidulum. Growing with them, but decidedly rare, were Staehelina fruticosa, /

fruticosa, Teucrium Montbretii var. crenatum and Asperula Tournefortii var. Majori — the latter only known from this locality.

TAXONOMY.

The following annotation includes all the plants I collected in the Aegean during the summer of 1950. Material from other Mediterranean areas has been cited where pertinent. Taxa marked in the margin with an asterisk are new for the Aegean area as circumscribed by Rechinger.

GYMNOSPERMAE.

CUPRESSACEAE.

Juniperus excelsa M.B., Fl. Taur. 2, 425 (1808).

Karpathos: above Spoa, 500 m., W.slope, 23 Jul. 1950, Davis 18081.

On Karpathos this species makes a much greener tree than it does in Southern Anatolia, thus resembling J. foetidissima Willd.

J. macrocarpa Sibth. et Smith, Prodr. 2, 263 (1808).

Karpathos: Phiniki, rocky coast.

New for Karpathos.

PINACEAE.

Pinus Brutia Ten., Fl. Nap. 1, p. lxxii (1811-15).

Karpathos: W. side of Kalilimni, 800 m., forest dominant, 21 Jul. 1950, Davis 18060. Mykali: Samsun Dağ, 300-900 m., S. side, 20 Aug. 1950, Davis 18370 & Heywood.

Both this species and P. halepensis have been recorded for Karpathos, but it seems very probable that the latter species has been confused with P. Brutia, both there on Mykali. Only P. halepensis /

pensis has previously been recorded from Mykali.

Pinus nigra Arn. subsp. Pallasiana (Lamb.) Holmboe., Veg. Cyprus, 28 (1914).

Mykali: Samsun Dağ above Priene, N. side, 900-1000 m., 20 Aug. 1950, Davis 18371 & Heywood.

The species is new for Mykali.

EPHEDRACEAE.

Ephedra camylopoda C.A. Mey., Vers. Monogr. Eph. 73 (1846).

Karpathos: Lastos, 700 m., rocks, 22 Jul. 1950, Davis 18069.

ANGIOSPERMAE.

PAEONIACEAE.

Paeonia Clusii F.C. Stern in Bot. Mag. t. 9594 (1940).

Karpathos: Lastos, 700 m., N.W. slopes among rocks, 22 Jul. 1950, Davis 18062 (fruct.).

CRUCIFERAE.

Alyssum creticum L. Sp. Pl. 651 (1753).

Karpathos: Phiniki, on W. cliff, 27 Jul. 1950, Davis 18091.

Seed was collected of this remarkable woody chasmophyte, and young plants are being raised at Kew.

A. fragillimum (Bald.) Rech. fil., Neue Beitr. Fl. Kreta, 77 (1943).

W. Crete: Svourichti, 2200-2300 m., scree, 4 Aug. 1950, Davis 18127a.

* A. lepidulum Nyarady in Bull. Grad. Bot. Cluj. 7, 96 (1928) subsp. lepidulum. — Syn. subsp. genuinum Nyar. f. pauloasperum Nyar. l.c., 9, 28 (1929) — passim.

Mykali: Samsun Dağ above Priene, local on rocky S. slope, 700 - 900 m., Aug. 20, 1950, Davis 18362 & Heywood.

Our /

Our gathering of this Anatolian species closely matches material from Sipylos.

A. sphacioticum Boiss. et Heldr. in Boiss., Diagn. Ser. 1 (8) 35 (1849).

W. Crete: Svourichti, 2200 - 2300 m., in scree with A. fragillimum, 4 Aug. 1950, Davis 18127b.

Arabis alpina L. subsp. caucasica (Willd.) Briq., Prodr. Fl. Corse, 2, 48 (1913).

W. Crete: Svourichti, 2200 m., shady rocks, 4 Aug. 1950, Davis 18118.

Brassica cretica Lam. var. aegaea Heldr. et Hal. apud Hal. in Öst. Bot. Zeit. 45, 216 (1895).

Karpathos: Vurgunda, on cliff near the place called Akrotirias, 24 Jul. 1950, Davis 18046.

CAPPARIDACEAE.

Capparis rupestris Sibth. et Smith, Prodr. 1, 355 (1806).

Karpathos: Vurgunda, on dry N.W. cliff near the place called Akrotirias, 24 Jul. 1950, Davis 18042.

FRANKENIACEAE.

Frankenia hirsuta L. var. hispida (DC.) Boiss., Fl.Or. 1, 780 (1867).

Karpathos: Phiniki, sea shore, 27 Jul., 1950, Davis 18095.

The species has not been recorded for Karpathos. On the islet of Makra near Kasos I collected a form of this species near to var. hispida but with ascending glabrous flowering-stems. The forms of this species, and its relationship with the more westerly F. laevis L., need thorough revision.

CARYOPHYLLACEAE.

Arenaria cretica Sprengel, Syst. Veg. 2, 396 (1825).

W. /

W. Crete: Svourichti, 2200 m., N. rocks and scree, 4 Aug. 1950, Davis 18123.

The gathering comprises the typical form and var. *stygia* Boiss., as well as intermediates between them. A similar range is shown by some other Cretan gatherings in the Kew Herbarium.

Dianthus actinopetalus Fenzl, Pugill. Pl. Nov. Syr. 11 (1842) var. *actinopetalus*.

Mykali: Samsun Dağ above Priene, 200 m., S. cliffs, fl. pink, 20 Aug. 1950, Davis 18342 & Heywood.

D. arboreus L., Sp. Pl. 413 (1753).

Karpathos: between Marmakoui and Holethria (W. side of Kalilimni), 700 m., in vertical calcareous rocks facing west, bushes up to 0.75 m. across, leaves dark green, very free-flowering, 23 June 1950, Davis 18083 (*forma caulibus abbreviatis, foliis brevibus viridi~~s~~bus, calycis squamis paucis*); Phiniki, 10 m., W. cliff, 27 Jul. 1950, Davis 18089 (*forma maritima foliis valde carnosis*); Vurgunda, in dry N.W. cliff near the place called Akrotirias, 24 Jul. 1950, Davis 18041.

This beautiful Aegean species is not always easy to distinguish from the rarer *D. fruticosus* L. Botanists have held that *D. fruticosus* differs from *D. arboreus* in its longer calyx, more numerous calyx-scales, broader leaves that are flat and obtuse (instead of subter~~a~~ete and acute) and shorter flowering stems. To evaluate these alleged differences, I have analysed the available herbarium material for variation in the characters summarised in Tables 1 and 2. It will be noted that I have not recognised the two species as occurring on the same islands. This conclusion seems to be justified by the distribution of leaf-shape, which I must consider the /

the most reliable distinguishing character discernible in herbarium material.

In Table 1 the figures not in brackets indicate the mean for each island, and those in normal parenthesis the range of variation. The figure in square brackets represents the number of different gatherings examined for each island. In Tables 2 and 3 the length and breadth of the leaves, and the length/breadth ratio, are given for every gathering of both species. When calculating the mean values for each species, I took the mean of the average variation for each island. It can be seen from these tables that the distinguishing characters I have referred to (so far as they are analysed here) are diagnostic only when we consider the mean for each species. When individuals are considered, there is a wide range of overlap in all characters except leaf shape. In D. arboreus (as I interpret it here) the length/breadth ratio of the leaf is always above 6 (except in one short-leaved individual from Amorgos and another from Karpathos), and below it in D. fruticosus. When width is considered alone, there is overlap only in the two Cephalonian specimens (and then only where leaves of the flowering stem are concerned), which I have, for reasons to be referred to later, placed under D. arboreus. In the Aegean, the leaves of D. fruticosus are always more than 3 mm. broad, and from 1 - 2.5 (3.0) mm. in D. arboreus. A Scatter Diagram (Fig. 1) is given in which leaf-length in each species is plotted against width. It will be seen that correlation is poor between these two variables in D. arboreus, but that a positive correlation is well marked in D. fruticosus.

D. arboreus was originally described from Crete, and D. fruticosus (by reference to Tournefort's Voyage, 1, 70) from Serephos. A glance at the Tables will show that, so far as length/ breadth /

TABLE 1: Dianthus fruticosus and D. arboreus: mean values and ranges of characters for each island.

D. fruticosus L.	Length of calyx (mm.)	Number of scales on 1 side of calyx	Length of scaled part of calyx (mm.)	Length of calyx teeth (mm.)	Length/breadth ratio of leaf on flowering-stem.	Length/breadth ratio of leaf on sterile shoot.	Length of flowering stem (cm.) (to top of calyx)
Serephos [4]	23.5 (22-24)	6.75 (6-7)	10.0 (9-11)	7.7 (7-9)	4.8 (4.0-5.2)	4.7 (3.7-5.7)	13.75 (11-17)
Pholegandros [1]	23.0	5.0	9.0	6.0	5.2	?	12.0
Sikinos [1]	24.0	9.0	10.0	7.0	5.4	5.5	9.0
Mean for Species	23.5 mm.	6.9	9.7 mm.	6.9 mm.	5.1	5.1	11.6 cm.
D. arboreus L.							
Karpathos [4]	22.7 (20-25)	5.2 (4-6)	9.0 (7-11)	6.5 (6-7)	10.0 (5-12)	10.4 (6.8-15.0)	7.9 (6.5-11.0)
Amorgos [4]	23.0 (22-25)	5.5 (5-6)	9.2 (8-10)	7.0	10.1 (4-20)	14.5 (9.6-22)	9.2 (7-12)
Kalymnos [1]	22.0	6.0	9.0	8.0	10.8	11.1	15.0
Crete [11]	20.4 (15-25)	7.4 (5-9)	8.0 (6-12)	5.2 (4-7)	16.3 (10.8-21.0)	18.9 (7.7-31.0)	16.8 (9-34)
Cephalonia [2] (wild & cult.)	25.0	6.5 (6-7)	10.5 (9-12)	10.0	9.3 (8.5-10.2)	17.2 (7.5-27)	23.0 (16-30)
Mean of Species	22.6 mm.	6.1	9.1 mm.	7.3 mm.	11.3	14.4	14.4 cm.

TABLE 2: Length, breadth and length/breadth ratio of leaves in gatherings of D. arboreus L.

D. arboreus L.	Median leaf of flowering stem			Leaf of sterile shoot		
	Length (mm.)	Breadth (mm.)	Ratio	Length (mm.)	Breadth (mm.)	Ratio
Karpathos [4]						
Fors.-Maj. 24	12	1	12	15	1.0	15.0
Davis 18083	11	1	11	11	1.0	11.0
Davis 18041	12	1	12	18	2.0	9.0
Davis 18089	10	2	5	17	2.5	6.8
mean for island	11.2	1.2	10.0	15.2	1.6	10.4
Amorgos [4]						
Davis 954	19	2.0	9.5	?	?	?
Rech. 2357	12	1.7	6.8	24	2.5	9.6
Heldr. (1881)	8	2.0	4.0	18.0	1.5	12.0
Orph.	20	1.0	20.0	22.0	1.0	22.0
mean for island	14.7	1.7	10.1	21.3	1.7	14.5
Kalymnos [1]						
Fors.-Maj. 664	27	2.5	10.8	25	2.2	11.0
Crete [11]						
Rech. 14040	26	2.0	13.0	32	2.0	16.0
Rech. 14136	22	1.5	14.6	21	1.2	16.8
Lempberg 562	22	1.5	14.6	25	2.0	12.5
Bald. 1	21	1.0	21.0	31	1.0	31.0
Heldr. (1846)	27	2.5	10.8	23	3.0	7.7
Sieber (Maleka)	18	1.2	14.4	24	1.2	19.9
Heldr. (1870)	18	1.0	18.0	22	1.2	17.6
Baker (1926)	20	1.0	20.0	?	?	?
Davis 289	20	1.0	20.0	24	1.0	24.0
Davis & Barneby (Almyros)	30	2.0	15.0	25	1.2	20.0
Davis & Barneby (Candia-Neapolis)	18	1.0	18.0	18	1.0	18.0
mean for island	22.0	1.4	16.3	24.5	1.5	16.7

TABLE 2 (contd.) Length, breadth and length/breadth ratio of leaves in gatherings of D. arboreus L.

D. arboreus L.	Median leaf of flowering stem			Leaf of sterile shoot		
	Length (mm.)	Breadth (mm.)	Ratio	Length (mm.)	Breadth (mm.)	Ratio
Cephalonia [2]						
Davis 1128 (wild)	34	4	8.5	19	2.5	7.5
Cult.Hort.Kew	36	3.5	10.2	27	1.0	27.0
mean for island	35	3.7	9.3	23	1.7	17.2
Mean for species	22.0	2.1	11.3	21.8	1.7	14.4

TABLE 3: Length, breadth and length/breadth ratio of leaves in gatherings of D. fruticosus L.

D. fruticosus L.	Median leaf of flowering stem			Leaf of sterile shoot		
	Length (mm.)	Breadth (mm.)	Ratio	Length (mm.)	Breadth (mm.)	Ratio
Serephos [4]						
Davis 870	20.0	4	5.0	16	3.5	4.6
Orph. 919	20	4	5.0	15	4.0	3.7
Sibthorp	26	5	5.2	20	3.5	5.7
Tournefort	24	6	4.0	23	5.0	4.6
mean for island	22.5	4.7	4.8	18.2	4.0	4.7
Pholegandros [1]						
Davis 214	31	6	5.2	?	?	?
Sikinos [1]						
Davis 899	19	3.5	5.4	18	3.2	5.5
Mean for species	24.2	4.4	5.1	18.1	3.6	5.1

breadth ratio is concerned, the populations of Crete and Serephos stand at opposite extremes of variation. When only the types are considered, D. arboreus and D. fruticosus therefore appear more distinct than they really are, since it is on Karpathos and Amorgos that individuals of D. arboreus occur with abnormally low leaf-ratios on the flowering shoots. These have leaves that are too short, narrow and fat to be included in D. fruticosus.

It may be argued that the differences in leaf shape (which are not absolute) scarcely justify separation of these two chasmophytes as distinct species. That may be so. The shape of the leaf apex and the thickness of the leaf (not treated in the Tables) certainly show an overlap, though they are fairly closely correlated with length/breadth ratio. The thickness of the leaf is readily modified by environment. On Karpathos I collected a form of D. arboreus on sea cliffs at Phiniki (Davis 18089) with very fleshy leaves having a length/breadth ratio (flowering shoot) falling within the range of D. fruticosus; but seedlings raised from this plant at Kew are giving plants almost typical for cultivated D. arboreus, which usually has somewhat wider and flatter leaves than it does in the wild (thereby approaching D. fruticosus).

In addition to the leaf differences, there is the alleged difference in scent, D. arboreus being described as fragrant, and D. fruticosus as scentless. I have not been able to verify this, as the true D. fruticosus is very rare in cultivation, being apparently less hardy than its ally. It is possible that there is also a difference in the markings on the trunk. In branches of D. fruticosus which I collected on Pholegandros, the old leaf scars completely encircle the trunk, whereas they appear to be interrupted and less pronounced in D. arboreus. However, this may /

may not be a constant feature. It may be that, when these plants are better known, they may have to be treated as subspecies of one species. In the meantime, having some respect for Linnaean species and relict chasmophytes, and remembering that other differences may exist that are not brought out by this analysis, I prefer to recognise these plants as specifically distinct.

It must be stressed that D. arboreus is a very variable plant, even on one island. This is particularly true of Karpathos, where the species extends from sea level to 700 m. Special mention must be made of the unusual form from Cephalonia (the only station for D. arboreus outside the Aegean). This was first collected by Heldreich, and identified as D. fruticosus. I have collected this plant in Heldreich's Cephalonian locality (Assos), where it occurs on the walls of the castle. However, it is common on the neighbouring sea cliffs with Senecio bicolor (Willd.) Tod. (which also grows in the Cyclades), and there seems no reason to consider it introduced. The Cephalonian plant certainly approaches D. fruticosus so far as the width of the leaves on the flowering stem is concerned, but on other characters (including length/breadth ratio) it seems better placed under D. arboreus. It has remarkably long calyx-teeth (10 mm.). Seed collected at Assos produced plants at Kew which retained the long teeth, but in leaf-shape approached typical D. arboreus more closely than did the wild gathering - a fact which supports the inclusion of the Cephalonian plant in D. arboreus rather than D. fruticosus.

The range of the two species is shown on the map (Fig. 2). If the unverified records of D. arboreus are correct, then D. fruticosus is surrounded by a broken ring of D. arboreus. As forms of D. arboreus have not infrequently been referred to D. fruticosus, I have mapped only verified records of the latter.

Rechinger /

Rechinger (Fl. Aeg., 156) records the South Italian D. rupicola* Biv. from Crete on Giuseppi's evidence. I believe this record to be erroneous, and also that Sibthorp's Cretan record of D. fruticosus may well be a mistake. D. rhodius Rech. fil., described in bud from Rhodes, needs to be better known, though certainly in its leaf shape (which resembles that of D. rupicola) it appears to be well distinguished from its two Aegean allies, D. arboreus and D. fruticosus.

Minuartia verna (L.) Hiern. subsp. attica (Boiss. et Spruner) Hayek var. cretica Hayek in Öst. Bot. Zeitschr. 71, 101 (1922).

Paronychia macrosepala Boiss., Diagn. Ser. 1 (3) 11 (1843).

Karpathos: Phiniki, 5 m., rocky coast, 27 Jul. 1950, Davis 18064.

Silene gigantea L., Sp. Pl. 418 (1753).

Karpathos: Lastos, 700 m., N.W. cliff, 22 Jul. 1950, Davis 18064.

HYPERICACEAE

Hypericum Cuisinii Barbey in Bull. Soc. Vaud. Sci. Nat. 21, 94 (1885).

Karpathos: Phiniki, 10 m., cliff, 27 Jul. 1950, Davis 18086; Olymbos, on schist rocks (Obs.).

H. empetrifolium /

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* In the Kew Herbarium there are three gatherings of Dianthus rupicola from Majorca, all collected from the sea cliffs of Cabo de Formentor (Bartolome Rotger, 5 Nov. 1935; E.W.Kennedy, 11 May 1936 and 14 July 1936). This Balearic locality constitutes an important new record. The species has, however, been recorded from Algeria.

<u>H. empetrifolium</u> Willd. Sp. Pl. <u>3</u>, 1452 (1803) var. <u>empetrifolium</u>.

<u>Karpathos</u>: Holethria, W. of Kalilimni, in open <u>Pinetum Brutiae</u>, 22 Jul. 1950, Davis 18061. <u>Mykali</u>: Samsun Dağ above Priene, in <u>Pinetum Brutiae</u>, Aug. 1950, Davis 18354 & Heywood.

A new record for Mykali.

<u>H. Kelleri</u> Bald. in Malpighia <u>9</u>, 67 (1895).

<u>W. Crete</u>: between Theriso and Katsiveli, at hollow called Kolokytha, abundant in flat earthy depressions, 1700 m., 3 Aug. 1950, Davis 18164.

<u>H. trichocaulon</u> Boiss. et Heldr. grew in the same locality, but the two species (both endemic to Crete) were ecologically isolated: <u>H. Kelleri</u> growing in flat earthy depressions of transported <u>terra rossa</u>, and <u>H. trichocaulon</u> on the rocky hillsides above. I was unable to find any hybrids.

<u>H. triquetrifolium</u> Turra, Fars. 12 (1765). — Syn. <u>H. crispum</u> L., Mantissa, 106 (1767).

<u>Karpathos</u>: Avlona, 300 m., fallow fields, 24 Jul. 1950, Davis 18024.

LINACEAE.

<u>Linum arboreum</u> L., Sp. Pl. 279 (1753).

<u>Karpathos</u>: Kalilimni, N.W. side, 1000 - 1200 m., N. cliffs, 21 Jul. 1950, Davis 18006.

ZYGOPHYLLACEAE.

<u>Zygophyllum album</u> L., Decas Prima Pl. Rar. Hort. Upsal. t. 6, (1762).

<u>Kasos</u>: islet of Makra near Kasos, sandy shore, leaves glaucous, 29 Jul. 1950, Davis 18109.

In the Aegean this predominantly Saharo-Sindian psammophyte has only been recorded from two small islands off the south coast of Crete.

RUTACEAE. /

RUTACEAE.

Ruta chalepensis L. var. bracteosa (DC.) Boiss., Fl. Or. 1, 922 (1867).

Karpathos: Avlona, 24 Jul. 1950, Davis 18031.

RHAMNACEAE.

Rhamnus oleoides L., Sp. Pl. ed. 2, 279 (1762).

Taxonomists have tried very hard to retain R. graeca Boiss. et Heldr. as specifically distinct from R. oleoides L. — a species in Sect. Cervispina originally described from Spain. The more material that accumulates in herbaria the more difficult it becomes to assign specific rank to R. graeca, since the complex is obviously very critical in the Eastern Mediterranean.

The glabrity of the disc in R. oleoides, and its pubescence in R. graeca (discernible even in fruit if carefully examined under a low-power microscope) is a fairly constant distinction, though forms of R. oleoides with a hairy disc do occur, even in Spain. Halácsy (Consp. Fl. Graeca 1, 320: 1901) recognised five varieties of R. oleoides in Greece (including the islands), but some of these scarcely seem to merit taxonomic rank; furthermore, by the characters of the disc and leaf-shape, some of them should have been placed under R. graeca rather than R. oleoides.

The taxonomists' task is made more difficult by the seasonal variation in leaf texture and indumentum, and by the environment's effect on the habit of the bush. Only cultivation under uniform conditions could show how much of the variation is genotypic.

Having examined the disc on all material in the Kew Herbarium, I find myself able to recognise four subspecies of R. oleoides (incl. R. graeca) in the Eastern Mediterranean. These have a partly overlapping distribution (map., Fig. 3) and intermediate specimens are /

are not rare; nevertheless, the differential characters seem sufficiently well correlated to justify this taxonomic treatment. The material I have examined does not seem to necessitate the inclusion of R. oleoides within the West Mediterranean R. lycioides L., which was the course adopted by Jahandiez and Maire (Cat. Pl. Maroc, 2, 476: 1932). However, if this transference should prove necessary, the four subspecies recognised here could be transferred to R. lycioides. In providing a Key and differential descriptions (with citations of specimens examined), I have described each subspecies in its more typical form.

Key to the East Mediterranean subspecies of R. oleoides L.

Disc typically glabrous:

Bush erect; lamina entire, glabrous, coreaceous, 10-25 mm. long, narrowly elliptical (or elliptical), drying yellowish green.. oleoides

Bush prostrate; lamina crenulata, sparsely puberulent, firm, 5-10 mm. long, elliptical-obovate, drying a slightly yellowish green.................................. tauricola

Disc typically puberulent:

Lamina obovate, generally entire, puberulent or glabrous, 6-18 mm. long, drying light greyish green .... graeca

Lamina narrowly obovate-elliptical, crenulate or entire, glabrous, 6-10 mm. long, drying slightly yellowish green.. microphylla

Subsp. oleoides

Frutex erecto-divaricatus, ramis griseo-brunneis, spinis 2-6 cm. longis 1-1.5 mm. latis juventute puberulis vel glabris. Folia coreacea; lamina anguste elliptica vel interdum elliptica, integerrima, 1.0 - 2.5 cm. longa, 4-10 mm. lata, inferne attenuata, glaberrima, /

glaberrima, in sicco luteolo-viridia, subtus nervatura fusca reticulata. Discus glaber.

Crete: Chalepa, Sieber. Amorgos, Orphanides.

Of the specimens cited, only the Cretan example is typical of this subspecies. The Amorgos plant has a puberulent disc, but is otherwise typical of oleoides. I have seen specimens of this subspecies from Spain (where it is widespread), Portugal, Sardinia, Gibraltar and Malta.

Subsp. tauricola P.H.Davis, subsp. nov.

Frutex prostratus, divaricato-intricatus, ramis griseis, spinis 1.0 - 4.5 cm. longis 1.25 mm. latis juventute puberulis. Folia firma; lamina elliptico-obovata, 5-10 mm. longa, 2-3.5 mm. lata, utrimque leviter 1-5-crenulata, brevissime pubescens (deinde glabrescens), in sicco viridis, subtus nervatura indistincta notata. Discus glaber.

S.W. Turkey: Prov. Antalya, distr. Kemer (Lycia), ~~at~~ on Tahtali Dağ, 2100 m., on limestone rock, rare, 10 Jul. 1948, Davis 15074; distr. Gebiz (Pisidia), on Bozburun Dağ between Boğaz Azzi Yaylâ and Tozlu Çukur Yaylâ, 1700 m., 24 Jul. 1949, Davis 15578; prov. Isparta, on Dedegöl Dağ above Oruz Gaz Yaylâ, 2000 m., rock, 2 Aug. 1949, Davis 15963 (holotypus in Herb. Kew).

The above gatherings are fairly uniform and seem to represent a distinctive ecogeographical race in the high mountains of S.W. Anatolia. A specimen from Karakuyu near Dinar at only 400 m. (Davis 15000) could probably be included in this taxon, but has thicker very glabrous leaves.

Subsp. graeca (Boiss. et Reuter) P.H.Davis, comb. et stat. nov. — Syn. R. graeca Boiss. et Reuter in Boiss., Diagn. Ser. 2 (5) 74 (1856); R. oleoides L. var. obovata Hal., Consp. Fl. Gr. 1, 320 (1901).

Frutex /

Frutex erecto-divaricatus vel prostratus, congestus, ramis griseis, spinis 1-6 cm. longis 1-2 mm. latis juventute puberulis. Folia firma; lamina obovata, 6-18 mm. longa, 4-8 (10) mm. lata, integra, utrimque puberula, in sicco pallide griseo-viridis, subtus nervatura indistincta notata. Discus puberulus.

Greece: Lycabettus et Hymettus (Heldr. 79, syntypus in Herb. Kew!) ad radices Mt. Pentelici pr. Geraka, 1 Mar. 1887, Heldr.; Nauplia, in Mt. Palamidi, 28 Mar. 1885, Hausskn.; Tolon (Argolis), Atchley 1087; Greece, Guccorini 1836; Pylos (Navarino) — Herb. Stuart Mill, leg. 1862; Megara, 10 Jun. 1896, St. Lager; supra Leucadia (S. Maura), Orphanides. Cyclades: Naxos, Rech. fil. 2235. Dodecanese: Rhodes, in Mt. Prof. Elias pr. Salakos, Rech. fil. 7245. Crete: ins. Dhia, distr. Megalokastro, Baldacci 302.

Of these specimens, the following are not typical: Orphanides' specimen from Kalamata is very erect; Baldacci 28 has leaves with 1-6 crenulations; Baldacci 302 approaches subsp. microphylla. I have not seen the type of R. graeca var. argolica Hal. (Nauplia, leg. Orphanides), but it seems most likely that it should be included in subsp. graeca.

Subsp. microphylla (Hal.) P.H.Davis, stat. nov. — Syn. R. oleoides var. microphylla Hal., Consp. Fl. Gr. 1, 320 (1901); R. oleoides L. var. sphaciotica Hal., ibid.

Frutex erecto-divarictus, quam in subsp. oleoide magis nanus et densius ramosus, ramis griseo-brunneis, spinis 1-4.5 cm. longis 0.75 - 1.0 mm. latis juventute puberulis vel glabris. Folia firma vix coreacea; lamina anguste obovato-elliptica, 7-10 (17) mm. longa, 2.5 - 3.5 (4.5) mm. lata, integra vel utrimque minute glanduloso-crenulata, glabra, subtus nervatura reticulata quam in subsp. oleoide minus prominente notata. Discus puberulus.

Crete: /

Crete: Mt. Juktas, Atchley 1114: Kissamos, Reverchon 228; (syntypus in Herb. Kew.); Akrotiri, Baldacci 7 (syntypus in Herb. Kew.); Crete, Trevor-Battye; Levka Ori in sax. calc. jugi Xyloscala, Rech. fil. 13747; Samaria distr. Sphakia, Baldacci 218 (syntypus R. oleoidis L. var. sphacioticae Hal. in Herb. Mus. Brit. - forma lamina 10-17 mm. longa). Karpathos: Pigadhia - Aperi, 29 Apr. 1883, Pichler (Herb. Edin.); Kalilimni, 1100 m., rocks, Davis 18000; Kurup, Pichler 157.

Both crenulate and entire-leaved forms occur in the type gathering (Baldacci 7). Of the Karpathos specimens, Davis 1800 and Pichler 157 appear to have glabrous discs.

The following references will be found helpful in identifying the species of Sect. Cervispina found in the Near East:

Bornmüller in Fedde Repert. 29 (1) 33-38 (1931)

Diapoulis, Ta Rhamnaceae (Athens - undated)

Feinbrun in Pal J. Bot. (Jer. Ser.) 3, 167-9 (1946)

Schneider, Illustriertes Handbuch der Laubholzkunde, 2, 269-291 (1909)

Schwarz, O. in Fedde Repert. 54 (1) 26-34 (1944)

* Rhamnus Pichleri Schneider et Bornm. ex Bornm. in Fedde Repert. 29, 36 (1931), in adnot. - Syn. R. eriocarpa O. Schwarz in Fedde Repert. 54 (1) 26 (1944).

Mykali: Samsun Dağ above Priene, 800 m., shady cliff, branches loosely appressed to cliff, 20 Aug. 1950, Davis 18369 & Heywood.

This distinctive chasmophyte, distinguished from all its allies by its velvety fruits, has only been previously recorded from the Lycian Taurus, where I have collected it in several localities. It seems to me that Bornmüller's description of R. Pichleri, very brief /

brief though it is, is sufficiently definite to validate the name, so that the later name R. eriocarpa Schwarz (accompanied by a full description which does not include the type of R. Pichleri) must be rejected. An isotype of R. Pichleri is in the Kew Herbarium.

R. prunifolia Sibth. et Smith, Prodr. 1, 157 (1806).

W. Crete: Svourichti, 2200 m., rocks, 4 Aug. 1950, Davis 18141.

ANACARDIACEAE.

Pistacia Lentiscus L., Sp. Pl. 1026 (1753).

Saria: at the place called Spatharea, dominant on screes at alt. 50 m., 25 Jul. 1950, Davis 18071.

LEGUMINOSAE.

Anthyllis aegaea Turrill in Kew Bull. 1939, 189 (1939).

Amorgos: above Langadha, 700 m., N. cliffs E. of the place called Stavros between Langadha and Krikilos, very local and inaccessible, saxatile 1 m. shrub, 8 Oct. 1939, Davis 962 (fruct.).

The species has previously only been recorded from the Cycladean island of Pholegandros.

Astragalus angustifolius Lam., Encyc. 1, 321 (1783) var. angustifolius.

W. Crete: Katsiveli in Levka Ori, 1800 m., fl. whitish, mountainsides, 3 Aug. 1950, Davis 18151.

Cicer incisum (Willd.) K. Maly in Aschers. et Graeb., Syn. Fl. Mitt. 6 (2) 900 (1909).

W. Crete: Svourichti, 2200-2300 m., screes, fl. purple, 4 Aug. 1950, Davis 18119.

Ononis Natrix L., Sp. Pl. 717 (1753) subsp. Natrix.

Mykali: Samsun Dağ, 400 m., above Priene, rocky slopes, fl. yellow with reddish brown lines on vexillum, 20 Aug. 1950, Davis /

Davis 18350 & Heywood.

ROSACEAE.

Potentilla speciosa Willd., Sp. Pl. ed. 2, 1110 (1800).

W. Crete: Svourichti above Katsiveli, 2100 m., on N. cliffs near spring, dominant on vertical rock, 4 Aug. 1950, Davis 18114.

The gathering shows every transition between the typical form and var. minor Lihm. which appears to be no more than a depauperate modification.

Rubus ulmifolius Schott subsp. anatolicus Focke in Aschers. & Graeb. Syn. Fl. Mitt. 6 (1) 503 (1904).

Karpathos: between Olymbos and Diaphani, by spring, bush 2 m. tall, fl. deep pink, 25 Jul. 1950, Davis 18059.

ONAGRACEAE.

Epilobium parviflorum Schreb. Spicil. Fl. Lips. Consp. n. 314 (1771) var. parviflorum.

Mykali: Samsun Dağ, 400 m., above Priene, 20 Aug. 1950, Davis 18351 & Heywood.

UMBELLIFERAE.

Daucus Carota L. subsp. maxima (Desf.) Thell., Fl. Adv. Montp. 405 (1912).

Karpathos: Voladha, 400 m., edge of fields, 20 Jul. 1950, Davis 18016; Avlona, edge of terraces, 24 Jul. 1950, Davis 18029.

Not previously recorded from Karpathos.

Foeniculum Piperitum DC., Prodr. 4, 142 (1830).

Karpathos: Voladha, 400 m., roadside, perennial, foetid, fl. yellow, 19 Jul. 1950, Davis 18021.

Peucedanum /

Peucedanum alpinum (Sieber ex Schultes) Burtt et Davis in Kew Bull. 1949 227 (1949).

W. Crete: Svourichti, 2200 m., -2300 m., perennial, screes, petals maroon, 4 Aug. 1950, Davis 18126.

Pimpinella Tragium Vill. var. depressa (DC.) Boiss., Fl. Or. 2, 871 (1872).

W. Crete: Katsiveli in Levka Ori, 1850 m., at edge of protected potato patch, 4 Aug. 1950, Davis 18160; Svourichti, 2200 m., screes, 4 Aug. 1950, Davis 18124.

aff. var. depressam (DC.) Boiss.

Karpathos: Kalilimni, N.W. side, 1100 m., shady cliffs, saxatile, stems erect, 21 Jul. 1950, Davis 18007.

The large Karpathos gathering is close to the Cretan var. depressa, but differs from it in having stems which, though very variable in height, are invariably erect. It grows in rock crevices at lower altitudes than the Cretan plant which is an alpine of earthy hollows and scree. In Crete the species always has procumbent stems, even when growing in places (cf. No. 18160) protected from grazing. The forms of this polymorphic species require revision.

Seseli gummiferum Pallas ex J.E. Smith, Exot. Bot. Tab. 2, 121 (1804).

When studying Seseli crithmifolium (DC.) Boiss. to decide whether this plant was specifically distinct from its allies, it was found that this taxon, as it is accepted by Hayek and K.H. Rechinger, contains two different elements, one of which evidently requires a new name.

Having examined De Candolle's type of S. gummiferum Pallas ex Smith var. crithmifolium DC., collected by Tournefort on the islet of Nikouria near Amorgos (as reference to Tournefort's Voyage 1, 88, makes clear), it was found that this plant had glabrous rosette-leaves with linear laciniae. When Boissier raised the variety /

variety to specific rank, he described a different plant – a Seseli collected on Pholegandros by Orphanides (Herb. Boiss.!), having densely velutinous rosettes with much broader divisions than in De Candolle's plant. It seems very doubtful if Boissier had Tournefort's specimen before him when he described S. crithmifolium; he probably saw it earlier and erroneously considered it to have come from Pholegandros, where Tournefort does not mention having seen a Seseli. However, Boissier cites S. gummiferum var. crithmifolium as a synonym of his S. crithmifolium, so that the former must be taken as the type of the later binomial, even though Tournefort's plant is not covered by Boissier's description. The Seseli from Pholegandros, provided by Boissier with a description, therefore lacks a valid name. I have called it S. gummiferum subsp. aegaeum.

Examination of the two Aegean Seselis, and of the South Anatolian S. corymbosum (all of which I have seen in the field), shows that they are very closely related to one another and to the Crimean S. gummiferum. Now that more material is available, several of the characters given by Boissier to distinguish the species in this group do not hold. Consequently I am treating them here as geographical races (subspecies) of S. gummiferum. Their allopatric distribution is shown on the map (Fig. 4).

It is curious that subsp. crithmifolium, occupying an area between that of subsp. aegaeum and subsp. corymbosum, should be the only race of S. gummiferum s. lato with glabrous rosette leaves; in the field this was noted to be a constant character. In leaf form, however, subsp. crithmifolium is like subsp. corymbosum, although the latter grows at higher altitudes and is geographically more isolated from subsp. crithmifolium than the latter is from subsp. aegaeum. The two races that are geographically the most distant from one another /

another are morphologically the closest: subsp. gummiferum and subsp. corymbosum.

The three subspecies of S. gummiferum that I have collected all grow in vertical limestone rocks, and appear to be monocarpic or sometimes perennial. They may take several years to flower, the caudex hanging out of the cliff, crowned by the fine glaucous rosette, like a palm. On Amorgos the caudex of subsp. crithmifolium can be as much as two feet long. In cultivation at Kew this subspecies took eleven years to flower; however, the plants had evidently been pot-bound and bloomed when they were planted out on the rock garden. Subsp. crithmifolium seems to be more variable (even on Karpathos) than subsp. corymbosum or subsp. aegaeum. The thickness of the leaves in this species can be considerably modified by the environment, but appears to be greatest in subsp. aegaeum. The latter and subsp. crithmifolium are the only two races in cultivation.

Apart from subsp. crithmifolium, the only plant which has previously been subordinated to S. gummiferum is the Bulgarian S. gummiferum var. resiniferum Vel. There is an isotype of this plant in the Kew Herbarium, and I am sure that it is no more than a form of S. rigidum W.K., a species widespread and variable in Bulgaria.

Key /

Key to the subspecies of S. gummiferum Pallas ex Smith.

1. Rosette leaves velutinous:
   2. Divisions of basal leaves linear, 1-3.5 mm. broad, acute, very shortly velutinous:
      3. Central umbel usually 18-30-rayed; peduncles of umbellules at least 10 times as broad as their indumentum (Crimea)....................gummiferum
      3. Central umbel usually 35-80-rayed; peduncles of umbellules 4-7 times as broad as their indumentum (S. Anatolia)..........................corymbosum
   2. Divisions of basal leaves oblong or even obovate-oblong, 3-6 mm. broad, sub-obtuse, densely velutinous. Central umbel 20-50-rayed (Pholegandros, Crete)..aegaeum
1. Rosette leaves glabrous, linear or oblong-linear, acute (Karpathos, Saria, Amorgos, Nikouria).........crithmifolium

These four subspecies are differentially described below, together with citations of the specimens examined. I am particularly indebted to the Keepers of the Paris and Geneva Herbaria for the loan of material, without which this species could not have been revised.

Subsp. gummiferum.

Laciniae foliorum basalium lineares acutae firmae, 2-18 mm. longae, 1-3 mm. latae, glaucae, brevissime velutinae. Umbella centralis 18-30-radiata (-50 in cult.), pedunculo 1.5 - 4.0 (11.0 in cult.) cm. longo breviter velutino. Pili pedunculorum umbellularum vix latitudinis pedunculi aequantes. Fructus 3.5 - 4.0 mm. longus, 1.5 mm. latus, oblongus, valleculis quam costis 1-2-plo latioribus.

Crimea:- /

Crimea:- Tauria merid., Steven; Tauria, Karadag, on rocks, 1926, V. Vasiliev; E. Tauria, W. Besser; Tauria, Sokon bis Sudak, 1896, Callier 103; Cult. Jardin des Plantes, Couches, 4 Sept. 1819. Typus: Cult. in Oxford Bot. Garden & Hort. Lady Hume (n.v.)*

Subsp. corymbosum (Boiss. et Heldr.) P.H.Davis, comb. et stat. nov. — Syn. S. corymbosum Boiss. et Heldr. in Boiss. Diagn. Ser. 1 (10) 29 (1849).

Laciniae foliorum basalium lineares acutae firmae, 2-31 mm. longae, 1.5 - 3.5 mm. latae, glaucae, brevissime velutinae. Umbella centralis (22) 35-80-radiata, pedunculo 2-8 cm. longo breviter velutino. Pili pedunculorum umbellularum $\frac{1}{4}$ - $\frac{1}{7}$ latitudinis pedunculi aequantes. Fructus (immaturus) 2.5 mm. longus, 1.0 mm. latus, valleculis quam costis 2-4-plo latioribus.

S. Anatolia:- Prov. Isparta, in fissuris rupium Mt. Anemas, 1845, Heldreich (isotypus in Herb. Kew.); W. side of Sarp Dağ, 1700 m., in crevices of vertical rocks, perennial?, 29 Jul. 1949, Davis 15787. Caramania, Heldreich in Herb. Hooker. Prov. Antalya, distr. Gebiz (Pisidia): Bozburun Dağ, 1400 m., between Pinargazu and Boğaz Azzi, on cliff dominated by Staehelina Lobelii, 23 Jul. 1949, Davis 15511; obs.distr. Alanya near Ak Dağ S. of Geyik Dag, 1947. Prov. Niğde, distr. Ulukişla (Cilicia): between Alihoca and Bulgar Maaden, on limestone cliff, 3 Sept. 1949, Davis 16419. /

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* The only specimen in J.E. Smith's herbarium (where one would expect the type to be) bears the legend "Mr. Lambert's garden, Boyton, Aug. 1806". I have considered this specimen to be typical of the species.

16419. Prov. Mersin, distr. Karaisah (Cilicia): Gulek Boğaz, cliffs, monocarpic or perennial, 31 Jul. 1949, Davis 16468. In Monte Tauro, Kotschy 228.

* Subsp. aegaeum P.H.Davis, subsp. nov. — Syn. S. crithmifolium (DC.) Boiss., Fl. Or. 2, 962 (1872) quoad descr. tantum.

Laciniae foliorum basalium oblongae vel etiam obovato-oblongae, 3-15 mm. longae, 3-6 mm. latae, crassae, valde glaucae, dense velutinae. Umbella centralis 20-50 radiata, pedunculo 2-4.5 cm. longo velutino. Pili pedunculorum umbellularum $\frac{1}{4}$ latitudinis pedunculi aequantes. Fructus 3.5 - 4 mm. longus, 1.25 mm. latus, oblongus, valleculis quam costis 2-4-plo latioribus.

Aegean:- Pholegandros, on cliffs below the town, 30 Sept. 1939, Davis 928; ibid., in scopulis maritimis, Jun. 1864, Orphanides (Herb. Boiss.). Crete: in fissuris rupium calc. abruptarum pr. Mangasa (prov. Hierapetra), rarius, 18 Sept. 1938, Barneby 1897 & Davis — holotypus in Herb. Kew.; cult. in Hort. Edin., 1952.

Subsp. crithmifolium (DC.) P.H.Davis, stat. nov. — Syn. S. gummiferum Pallas ex Smith var. crithmifolium DC., Prodr. 4, 145 (1830); S. crithmifolium (DC.) Boiss., Fl. Or. 2, 962 (1872), quoad syn. haud descr.

Laciniae foliorum basalium lineares vel oblongo-lineares, ± crassae, glaucae, 2-40 (-45 in cult.) mm. longae, 1-3.5 mm. latae, acutae, glaberrimae. Umbella centralis (17) 23 - 45 (50) -radiata, pedunculo 2.5-10 (16 in cult.) cm. longo dense velutino-pubescente. Pili pedunculorum umbellularum $\frac{1}{4}$ - $\frac{1}{3}$ latitudinis pedunculi aequantes. Fructus 3 mm. longus, 1 mm. latus, valleculis quam costis 2-3-plo latioribus.

Aegean:- Insulae maris Aegei Insula Nikouria pr. Amorgos , Tournefort /

Tournefort (holotypus in Herb. Paris); Nikouria, obs. Davis, 1939. Amorgos, at Langadha, 200 m., N. cliffs, monocarpic with caudex up to 2 ft. long, Davis 940 — cult. in Hort. Kew. 3 Sept. 1951; supra coenobium Panagia, 8 Aug. 1881, Heldreich; Amorgos, July 1897, Chr. Leonis. Karpathos, 25 May, 1886, Forsyth-Major 94; Karpathos at Holethria on W. side of Kalilimni, 1100 m., N. cliff, 21 Jul. 1950, Davis 18082. Saria (pr. Karpathos), ad rupes calc. vert. faucis Endi pr. Palatta, 18 Jul. 1886, Forsyth-Major 541.

CAPRIFOLIACEAE.

Lonicera etrusca Santi var. Roeseri Heldr. in Boiss., Diagn. Ser. 2 (2) 107 (1856).

Karpathos: Avlona, walls of terraces, 24 Jul. 1950, Davis 18030; Prof. Elias near Menetes, cliffs, 26 Jul. 1950, Davis 18100.

The variety has not hitherto been recorded from Karpathos.

RUBIACEAE.

Det. Dr. D. Ehrendorfer (Vienna).

Asperula idaea Hal., Consp. Fl. Gr. 1, 737 (1901).

W. Crete: Katsiveli in Levka Ori, 1850 m., at edge of protected potato patch, 4 Aug. 1950, Davis 18157; Svourichti above Katsiveli, 2200 m., growing through Astragalus angustifolius, fl. pink, 4 Aug. 1950, Davis 18133.

Asperula Tournefortii Sieber var. Majori (Barbey) Rech. fil., Neue Beitr. Fl. Kreta, 132 (1943).

Saria: place called Spatharea, E. cliffs sloping from 80° - 90°, 25 Jul. 1950, Davis 18072 — locus classicus.

Galium /

Galium canum Req. in DC., Prodr. 4, 602 (1830-).

Karpathos: Vurgunda, on dry sea rocks, vertical or overhanging, fl. dark purplish brown, 24 Jul. 1950, Davis 18028; Vurgunda, on cliffs near the place called Akrotirias, 24 Jul. 1950, Davis 18048.

Galium fruticosum Willd., Sp. Pl. 1, 585 (1798).

W. Crete: Meskla, 500 m., shady rocks, 5 Aug. 1950, Davis 18152.

Galium incurvum Sibth. et Smith, Prodr. 1, 92 (1806).

Karpathos: Kalilimni, N.W. side, 1100 m., 21 Jul. 1950, Davis 18009.

Galium samothracicum Rech. fil. in Fedde Repert. Beih. 100, 134 (1938).

W. Crete: Katsiveli in Levka Ori, fl. pale yellow, perennial, procumbent -- ascending, 4 Aug. 1950, Davis 18162.

Rubia Olivieri Rich. in Mem. Soc. Hist. Nat. Paris, 5, 132 (1834) var. Olivieri.

Karpathos: Vurgunda, near the place called Akrotirias, 24 Jul. 1950, Davis 18051.

Valantia aprica (Sibth. et Smith) Boiss. et Heldr. in Boiss., Diagn. Ser. 1 (10) 72 (1849) var. aprica.

W. Crete: Svourichti above Katsiveli, 2200 m., N. screes, 4 Aug. 1950, Davis 18117.

DIPSACACEAE.

Cephalaria mediterranea (Viv.) Szabo var. Sieberi (Szabo) in Math. Termsz. Kozl. 38, 149-155 (1940).

Karpathos: Kalilimni, N.W. side, 1100 m., N. cliffs, fl. cream, 21 Jul. 1950, Davis 18008.

In Szabo's monograph of Cephalaria (l.c. supra), which

I /

I have not seen, this plant is treated as a variety of the rare Corsican-Sardinian C. mediterranea (Viv.) Szabo. Szabo recognises three geographically isolated varieties of this species, which, in the material at Kew, differ chiefly in the shape of the bracts. In this character, var. mediterranea (var. latifolia (Moris) Szabo, passim), as it is represented by the one Corsican specimen at Kew, is intermediate between the Aegean var. Sieberi and the Majorcan var. balearica (Coss.) Szabo. Var. Sieberi was originally described from Crete, whence it has not been collected again. Sieber's Cretan specimen has narrower less dentate leaves than gatherings of this taxon from Karpathos and Ikaria, which, in their broadly elliptical leaves, resemble the Majorcan variety. Indeed, the Karpathos plant (of which a large gathering was made) differs from var. balearica only in its bracts, the median and inner ones being oblong and acute (as in the Cretan type), instead of spathulate and more or less obtuse as in the Balearic race.

Scabiosa cretica L., Sp. Pl. 100 (1753).

An intensive study of the available herbarium material of S. cretica L. and S. variifolia Boiss. has led me to consider these taxa conspecific, and to recognise four subspecies within S. cretica L.

Linnaeus's description of S. cretica in the Species Plantarum is transcribed almost verbatim from his Hortus Cliffortianus which he cites immediately after his description. It therefore seems that the specimen in Clifford's herbarium must be taken as the lectotype.

In the Species Plantarum Linnaeus described this taxon as coming /

coming from Crete and adjacent islands. However, both Linnaeus's description ('foliis lanceolatis sub-integerrimis') and the Clifford specimen are clearly referable to the form of this species which grows on Sicily. Material from Sicily has narrower leaves than the Cretan race and sometimes has 1-3 small teeth on the upper part of the blade — a feature present in the type specimen but not seen in Balearic or Cretan material. In short, there is no justification for associating the type of S. cretica with Crete. It is doubtful if the species was known to Linnaeus except as a cultivated plant; apart from the specimen in the Clifford herbarium, there are three other early sheets of S. cretica at the British Museum, all originating from the Chelsea Physic Garden between 1745 and 1773 and referable to the Sicilian form.

The Sicilian origin of S. cretica presents us with nomenclatural difficulties when we come to name both Sicilian and Cretan subspecies. It would not only be illogical, but would lead to confusion, to refer to the Sicilian taxon (which also occurs in the Balearics) as subsp. cretica — the name which should be adopted in accordance with the ruling taken at Stockholm (1950). Consequently I have named this plant subsp. occidentalis P.H.Davis. This treatment, though it may conflict with the present letter of the law, certainly conforms to it in spirit, since nomenclatural rules are intended to avoid confusion, not to add to it. The Cretan race I have named subsp. minoana P.H. Davis, the Karpathos race (hitherto included in S. variifolia) subsp. carpatha P.H. Davis, and the Rhodian one subsp. variifolia (Boiss.) P.H. Davis.

Boissier described the leaves of S. variifolia as being glabrous, whereas those of S. cretica (s. stricto) are sericeous. However, as Rechinger (Fl. Aeg., 594) has pointed out, this refers only /

only to the mature leaf, because the leaves of S. variifolia are covered with hairs when young; in fact, what appears as a juvenile character in S. variifolia is retained in the adult leaf of S. cretica.

S. cretica (incl. S. variifolia) is confined to the vertical limestone cliffs of a few Mediterranean islands and headlands — indeed, its distribution (shown on the map in fig. 6) is similar to that of Dianthus arboreus and its allies referred to earlier in this paper. Its woody saxatile habit and disjunct distribution suggest that the Scabious is a Tertiary relict; it probably became differentiated into distinct subspecies as a result of geographical isolation initiated in Pleistocene times. The distribution of the variation found in S. cretica (s. lato) appears to have a clinal basis. This is shown in fig. 5, where eight suitable variable characters are plotted against longitude. These variables are as follows:

1. Length/breadth ratio of longest rosette-leaf.
2. Length of longest tooth on rosette leaves.
3. Number of teeth present on rosette leaves.
4. Number of nerves per largest rosette-leaf.
5. Length/breadth ratio of involucral phyllaries.
6. Length/breadth ratio of median lobe of ray flowers.
7. Number of nerves on epicalyx (counted at margin).
8. Indumentum present or absent on mature leaves.

The variables were assessed for each gathering, and the mean (except for indumentum) calculated for each of the following five areas: Balearics; Sicily/Calabria; Crete; Karpathos; Rhodes. It may be seen from the figure that Crete acts as a focal point for the majority /

majority of these character gradients. One of two explanations may account for this:

a) The species originated in the Cretan area and thence spread W.N.W. and E.N.E. before the land connections were broken.

b) The direction of the clines indicates no more than that external factors have, through selection, superimposed this pattern on an ancestral population that once extended from what are now the Balearic islands to Rhodes.

The latter seems the more probable explanation, but in either case geographical isolation would have interrupted and to some extent obscured the original clines. With the exception of the Balearic populations, there would seem to be a strong tendency for leaf-lobing to increase towards the North. This trend continues to the very rare S. cretica L. var. heterophylla Pasq. on Capri (the type, which is presumably in the Naples herbarium, has not been examined) and to S. hymettia Boiss. et Spruner in Attica. The latter species, though a smaller plant, is very closely related to S. cretica (s. lato), and probably shares a close common ancestry with it.

It must be pointed out that the herbarium material used for this attempted analysis was very inadequate, especially from Rhodes. The numbers in parenthesis indicate the suitable gatherings available from each area: Balearics (5); Sicily/Calabria (23); Crete (5); Karpathos (7); Rhodes (2). Adequate sampling, especially in the Aegean, might considerably modify the trends recorded here. Nevertheless, it is felt that the variation in the specimens available has been fairly accurately expressed. So far as the recognition of the four subspecies is concerned, no analysis is required for their identification: their leaf shapes are /

are sufficiently distinctive to make determination an easy matter.

Key to the subspecies of S. cretica L.

1. Indumentum of leaves persistent. Leaves entire or nearly so:

 2. Lamina oblanceolate, 3.5 - 5.0 times longer than broad .... occidentalis

 2. Lamina broadly elliptical-obovate 1.5 - 2.6 times longer than broad........................ minoana

1. Indumentum of leaves deciduous:

 3. Leaves all oblong-elliptical, obtuse, the inner sometimes with 1-3 short blunt lobes................................ carpatha

 3. Leaves entire at outside and centre of rosette, ± acute, the intermediate ones pinnatifid into 2-5 acute lanceolate lobes .... variifolia.

I append differential descriptions of each of the four subspecies, with citation of specimens examined:-

Subsp. occidentalis P.H. Davis, nom. nov. — Syn. S. cretica L., sensu orig., haud in Creta crescens.

Lamina foliorum basalium sericea, oblanceolata, acuta, latitudine plerumque 3.5 - 5.0-plo longiora, integra (vel in Sicilia - ut in typo - saepe superne minute et sparce 1-3-serrulata), 5-7-nervosa. Folia caulina plerumque absentia, vel si adsint oblanceolata. Involucri phylla latitudine 3-4-plo longiora. Epicalyx 24-35-nervosa.

Majorca: Bourgeau 1757, Sennen 1086, Biana 690. Minorca: Porta & Rigo, Knoche B. 204. Sicily: 1916, H.C. Baker; Mt. Pellegrino, Laconi 309; Palermo, Ross 30, Dörfler, Prior, Todaro 1089, /

1089, Ross 2546; Taormina, Bornmüller 398, Rigo 4049; Davis 44, Laciata 5/83, Beguinot 2755; pr. Isnello, Strobly; Belmonte (Herb. Hook.); Castelbouno, Strobly; Castelfano pr. Bagheria, Pavillon. Calabria: Pallaro, Huter 93; Calabria, L. Thomas. Holotypus in Herb. Cliff. (cult.).

* Subsp. minoana P.H. Davis, subsp. nov.

Lamina foliorum basalium sericea late elliptico-obovata, subobtusa, latitudine 1.5-2.6-plo longiora, integerrima, 7-nervosa. Folia caulina absentia vel si adsint obovato-elliptica. Involucri phylla latitudine 2.4-3.1-plo longiora. Epicalyx 27-33-nervosa.

Crete: in rupestr. reg. sup. et mediae Mt. Aphendi Sarakeno, distr. Pedhiada, 18 Jun. 1899, Baldacci 125 (1899: Iter Creticum Alterum - holotypus in Herb. Mus. Brit.); Kastamonitza, 1938, Davis & Barneby, Baldacci 126 bis; Nida (Psiloriti), Baldacci 126 ter.; Lassiti (Dikte), Sieber.

* Subsp. carpatha P.H. Davis, subsp. nov.

Lamina foliorum basalium juventute subsericea, deinde glabra, obovato-elliptica, obtusa, plerumque integra vel interdum folia interiora 1-2-lobata (lobis 1-14 mm. longis obtusis), latitudine 2-3.2-plo longiora, 5-7 nervosa. Folia caulina absentia, vel si adsint anguste obovato-elliptica integra. Involucri phylla latitudine 2.2-3.5-plo longiora. Epicalyx 27-38-nervosa.

Karpathos, 1886, Forsyth-Major 236 (holotypus in Herb. Kew.); Lastos, Pichler 342, K.H. Rech. 8179 & 8291, Davis 18063 (700 m., dominant on dry N.W. cliff, fl. lilac-pink). Saria, Forsyth-Major 198.

In leaf-form the Karpathos plant resembles the Cretan subspecies rather than the one from Rhodes, and, were it not for its /

its leaves being glabrous at maturity, would probably have been referred by earlier authors to S. cretica rather than S. variifolia. It is beautifully figured in Stefani, Forsyth-Major and Barbey's Karpathos (Tab. VI: 1895 - sub. S. variifolia).

Subsp. variifolia (Boiss.) P.H. Davis, comb. et stat. nov. — Syn. S. variifolia Boiss., Fl. Or. 3, 137 (1875).

Lamina foliorum basalium juventute sericea, deinde glabra, subacuta, latitudine 2.2-2.7-plo longiora, 3-7-nervosa, extima et integra ± acuta, intermedia in lobos 2-5 lanceolatos acutos 10-24 mm. longos pinnatifida. Folia caulina subpinnatifida. Involucri phylla latitudine 2.7-plo longiora. Epicalyx 30-32-nervosa.

Rhodes: Rochers du Mt. Santo Elio pres Salakos, 4 Jun. 1870, Bourgeau 79 (isotypus in Herb. Kew.); ibid., K.H. Rech. 7234. Scabiosa sphaciotica. Roem. et Schult., Syst. Veg. 3, 86 (1818) var. sphaciotica.

W. Crete: Svourichti, 2300 m., summit screes on gentle S. slopes, fl. pale lilac - whitish, 4 Aug. 1950, Davis 18128.

COMPOSITAE

Achillea cretica L., Sp. Pl. 899 (1753).

Karpathos: Vurgunda, on cliffs near the place called Akrotirias, 24 Jul. 1950, Davis 18047.

Carlina conformis (Barbey et Major) Davis, comb. nov. — Syn. Atractylis conformis Barbey et Major in Stef., Fors. - Maj., Barb., Karpathos, 115 (1895).

Karpathos: Voladha, 400 m., rocky sea shore, round spiny bush, radii yellow, 19 July 1950, Davis 18012; Vurgunda, rocky shore, radii yellow, 24 July, 1950, Davis 18023.

The genera Carlina L. and Atractylis L. are rather imperfectly /

imperfectly distinguished from one another. Nevertheless, on the sum of its characters, the very distinct Dodecanese endemic, hitherto known as Atractylis conformis, must be assigned to Carlina. Furthermore, it has a closer affinity with the Anatolian Carlina pallescens Wetts. (which I know only from the original figure) and C. oligocephala Boiss. et Kotschy, than with any known species of Atractylis. The characters which generally serve to distinguish these two genera may be tabulated as follows:

Carlina	Atractylis
Outer phyllaries grading into the median phyllaries.	Outer phyllaries rather sharply distinguished from the median phyllaries.
Inner phyllaries (radii) overtopping the flowers and radiating when dry.	Inner phyllaries (radii) not or only a little longer than the flowers, erect.
Ligules absent.	Ligules present or absent.
Pappus in one row, the plumose setae joined 3 or 4 together in their lower part, thus appearing branched.	Pappus in 1-3 rows, the plumose setae joined into a ring at the base, thus appearing simple.

Certain species in each genus show single characters usually diagnostic of the other, so that the ensemble of characters must be considered when assigning a species to its genus. The difference in the radii has often been given most weight. The Karpathos plant shows all the characters typical of Carlina, except for that of the phyllaries.

C. conformis is abundant on Karpathos, ranging from sea level /

level — where it forms spiny domes 1 m. across — up to nearly 1200 m. on Kalilimni.

Carlina corymbosa L. subsp. curetum (Heldr.) Rech. fil., Fl. Aeg. 644 (1943).

Karpathos: between Olymbos and Diaphani, 25 July 1950, Davis 18057 (forma).

Carthamus dentatus (Forsk.) Vahl, Symb. 1, 69 (1790) var. dentatus — Syn. C. ruber Link, Linn. 9, 580 (1835); C. Sartorii Heldr., Florula Aeginensis in Bull. Herb. Boiss. 6, 305 (1898).

Mykali: Samsun Dağ above Priene, 200 m., 20 Aug. 1950, Davis 18368.

New for Mykali.

Examination of copious material in the Kew Herbarium makes it impossible to separate C. ruber Link from C. dentatus (Forsk.) Vahl. The structure of the pappus, often cited as the crucial difference, is not correlated with the other diagnostics claimed by Halácsy (Consp. Fl. Gr. 2, 170: 1902) to distinguish the two taxa. C. dentatus was originally described from Malta (as a lapsus calami ?) and C. ruber from the Peloponnesus. When Link described the latter species, he differentiated it from C. lanatus L., C. creticus L. and C. leucocaulos Sibth. et Smith, but made no reference to C. dentatus. C. Sartorii Heldr. (cited by Halácsy and Hayek as a synonym of C. ruber) must be considered synonymous with C. dentatus.

I am uncertain of the taxonomic position of the rare C. dentatus var. ambiguus (Heldr.) Hayek, restored to specific rank by K.H. Rechinger in his Neue Beitr. Fl. Kreta, 153 (1943). There is as syntype of this plant at Kew, and also Rechinger 14377 (Crete: Lassithi); both these gatherings resemble forms of C. dentatus in their involucre, but have a pappus whose innermost series of pales is /

is short, thereby resembling C. Boissieri Hal.

In C. dentatus (excl. C. ambiguus) the median series of pappus pales stands apart from the multiple outer series, and is at least as long as the latter; but this median series generally hides an innermost ring of very short pales that is absent (judging from the description) in the type of C. ruber. Specimens with this apparently reduced pappus structure have been seen from Lycia, Cyprus and S. Greece. However, specimens occur which are intermediate in the form of their pappus between C. ruber and typical C. dentatus, nor can these differences be correlated with other characters that have been claimed to separate the two taxa. C. ruber must be 'sunk'.

Carthamus leucocaulos Sibth. et Sm., Prodr. 2, 160 (1813) var. subarachnoideus Davis, var. nov.

A typo foliis et involucri phyllis exterioribus sparsim arachnoideis (deinde glabrescentibus) divergit.

Karpathos: Lastos, 700 m., edge of fields, 20 July 1950, Davis 18019; in lapidosis inter Menetes et Pigadhia, 14 Jun. 1935, Rech. fil. 8137.

Whereas C. leucocaulos on Crete (locus classicus) is always entirely glabrous (except for sessile glands), the two gatherings from Karpathos have slightly cobwebbed leaves and phyllaries. I have therefore described it as a new geographical variety, the smallness of the morphological difference scarcely warranting its description as a subspecies. In its indumentum the Karpathos plant resembles C. gracillimus Rech. fil. from Rhodes, which, however, differs specifically from C. leucocaulos in other characters. Thanks to Dr. K.H. Rechinger, I have been able to examine the /

the type of the latter.

* Carthamus Rechingeri P.H. Davis, sp. nov.

Affinis C. Boissieri Hal. et C. tenui (Boiss. et Bl.) Bornm. sed foliis caulinis longius lobatis minus amplexicaulibus, corymbo densiore magis divaricato-ramoso, capitulis minoribus, involucri phyllis externis quam floribus 2-3-plo longioribus basi vix ampliatis, pappo paleis intermediis omnibus obtusissimis retuso- vel fimbriato-truncatis recedit.

Radix tenuis, fusiformis. Caulis 30-50 cm. altus, 5 mm. latus, robustus, eburneus, inferne simplex glabrescens leviter striato-sulcatus, superne in paniculam corymbosam 25-35 cm. latam divaricato-ramosus, ramulis terminalibus subarachnoideis. Folia basalia emarcida; caulina profunde pinnatifida, sessilia sed vix amplexicaulia, ambitu oblonga, coreacea, elevatim nervosa, minute glandulifera glabrescentia virescentia tamen subnitida, 4-7 cm. longa, rachide lineare 4-6 mm. lata integra vel spinulosa, lobis lateralibus remotis utrimque 4-7 anguste lanceolato-linearibus ad 1-1.5 cm. longis angulo recto patentibus in spinam flavescentem sensim attenuatis integris vel prope basin paululum spinulosis lobo terminale 1-3-plo brevioribus; caulina superiora breviora lobis paucioribus. Capitula (phyllis exterioribus exclusis) ovata, 1.5-2.0 cm. longa, numerosa, pedunculis 0.5-2 cm. longis. Involucri phylla exteriora profunde pinnatifida patenti-recurva, dense et minute glandulifera, subarachnoidea, inferne paululum dilatata, 3-4 cm. longa, subtus longitudinaliter elevatim trinervata, lobo terminali lobis lateralibus remotis utrimque 2-3 (4) angustissimis spinosis ad 5-8 mm. longis 2-3-plo longiore, rachide integro /

integro vel sparse spinuloso; phylla interiora oblongo-lanceolata, subintegra, acutissima vel etiam acumininata exterioribus 2-3-plo breviora. Receptaculum longe fimbrilliferum. Flores lilacini. Corolla 16 mm. longa; tubus tenuissimus 11 mm. longus; limbus cylindricus fere 5 mm. longus in lacinias aequales lineares 3 mm. longas nervis binis lateralibus praeditas divisus. Antherae 3 mm. longae. Achenia turbinato-subtetragona, nitida, griseo-eburnea (deinde saepe excavato-punctata flavescentia) 3 mm. longa. Pappus paleaceus, pallide fuscus, 4-5 mm. longus; paleae extimae brevissime retusae ad intermedias lineares minutissime nigro-maculatas margine apice obtusissimas retusas vel fimbriato-truncatas acheniam 1½-plo longiores regulariter auctae; paleae intimae 1.5 mm. longae, conniventes, pallidae, apice fimbriato-truncatae. Floret Jul.

Karpathos: between Olymbos and Diaphani, in phrygana, fl. lilac, 25 Jul. 1950, Davis 18055 (holotypus in Herb. Kew.; isotypus in Herb. Edin.); in saxosis calcareis ad Phiniki, 18 Jun. 1935, Rech. fil. 8305 (sub C. Boissieri Hal. in Rech. fil., Fl. Aeg. 670: 1943).

The new species, apparently endemic to Karpathos, is named after Dr. K.H. Rechinger who first collected it. It is closely allied to C. Boissieri Hal. and C. tenuis (Boiss. et Bl.) Bornm., but differs from both of these in the following diagnostics: stem leaves less amplexicaule and with longer lobes, more markedly branched general inflorescence (here the difference from C. Boissieri is particularly well marked), smaller heads with longer outer phyllaries that are scarcely dilated at the base, and pappus with the intermediate pales very obtuse, being shortly lacerated at the apex or retuse. In addition, the outer involucral phyllaries of C. Rechingeri /

Rechingeri have longer lobes than in C. tenuis. Rechinger's specimen (which is without fruit) differs from the type in having leaves that have more numerous and shorter lobes, the main rachis being somewhat denticulate. The specific description covers both gatherings.

Material in the Kew Herbarium seems to justify according specific status to C. syriacus (Boiss.) Dinsm., C. tenuis (Boiss. et Bl.) Bornm., C. alexandrinus (Boiss.) Bornm., and C. Boissieri Hal., instead of treating them as varieties of C. glaucus M.B. — a species of which I have only seen material from the Caucasus and adjacent Iberia. Facies is very important in distinguishing these critical species, particularly the form of the general inflorescence.

Centaurea idaea Boiss. et Heldr. in Boiss., Diagn. Ser. 1 (10) 119 (1849).

W. Crete: Svourichti above Katsiveli, 2200 m., fl. yellow, 4 Aug. 1950, Davis 18135.

Centaurea raphanina Sibth. et Smith, Prodr. 2,205 (1813).

W. Crete: Svourichti above Katsiveli, 2300 m., Davis 18139.

Chamaepeuce Alpini Jaub. et Spach var. camptolepis Boiss., Fl. Or. 3, 554 (1875).

Karpathos: Lastos, 700 m., dry S.E. cliff, 22 July 1950, Davis 18036.

Cichorium pumilum Jacq., Obs. Bot. (4) 3 (1771).

Karpathos: Avlona, fallow field, fl. blue, 24 July 1950, Davis 18036.

C. spinosum L., Sp. Pl. 813 (1753).

Karpathos: Vurgunda, shore, 7 July 1950, Davis 18034.

Cirsium /

Cirsium creticum (Lam.) Urv., Enum. 107 (1822).

Mykali: Samsun Dağ above Priene, 400 m., by spring, fl. purple, 20 Aug. 1950, Davis 18367.

New for Mykali.

C. morinifolium Boiss. et Heldr. in Boiss., Pl. Or. 3, 530 (1875).

W. Crete: Katsiveli, 1800 m., in hollows, stems 1 m., fl. dirty white, 3 Aug. 1950, Davis 18150.

Crepis Sibthorpiana Boiss. et Heldr. in Boiss. Diagn. Ser. 1 (11) 56 (1849).

W. Crete: Svourichti above Katsiveli, 2200 m., rocky slopes, perennial, 4 Aug. 1950, Davis 18140.

Echinops viscosus DC., Prodr. 6, 525 (1837) subsp. viscosus. – Syn. E. viscosus DC. subsp. creticus (Boiss.) Rech. fil. et subsp. glandulosus (Weiss.) Rech. fil. et subsp. eu-viscosus Rech. fil., Fl. Aeg. 641 (1943).

Karpathos: between Olymbos and Diaphani, 25 July 1950, Davis 18056 (a dwarfed form).

E. viscosus was originally described by De Candolle from Sicily and from the Aegean islands of Cos, Tenedos and Samos. K.H. Rechinger (Fl. Aeg. 641) has taken the Sicilian plant as the lectotype. I have not seen Gussone's Sicilian specimen, but at Kew there are specimens from Milazzo in Sicily which appears to be the locus classicus. Of this Sicilian material the inner phyllaries are united in Borzi's gathering (as described for the species by De Candolle) but free in Todaro's specimen. However, the latter is in flower, whereas Borzi's specimen is only in bud. There is no doubt that the phyllaries generally are free in this polymorphic species. Although union or freedom of the innermost phyllaries is made the basis of Sect. Ritrodes Bunge emend. Boiss. and Sect. Ritro Endl., /

Endl., the distinction is an artificial one, for it seems that the species constituting Sect. Ritrodes (with phyllaries united) have arisen from different stocks in Sect. Ritro (with phyllaries free). The phyllaries may be free or united in a single species, as is not uncommonly the case in E. Ritro L., especially in Turkey where forms of this species with united phyllaries are frequent.

I am unable to follow K.H. Rechinger's subspecific classification of E. viscosus in the Aegean. Rechinger considers E. viscosus L. subsp. creticus (Boiss.) Rech. fil. to be very close (and possibly not distinct from) subsp. bithynicus, but an isotype of subsp. creticus, collected by Heldreich near Kissamos in Crete, is in the Kew Herbarium and is almost identical with the Sicilian plant (subsp. viscosus). Nor do I consider that subsp. glandulosus (Weiss.) Rech. fil. should be separated from the latter. Indeed, in the Aegean I can only recognise subsp. viscosus and subsp. bithynicus (Boiss.) Rech. fil.; the latter includes those Aegean gatherings cited by Rechinger under subsp. creticus.

In Cyprus there appears to be only one Echinops; it has often been erroneously referred to E. spinosissimus Turra (E. spinosus L.). Although it approaches that Egyptian species in leaf-shape, the habit of the Cyprus plant is essentially that of E. viscosus. It is either a new subspecies of the latter or a closely related new species. In the Lebanon and Palestine E. viscosus is exceptionally variable, suggesting that hybridisation has occurred in that area. Some forms are difficult to separate from E. horridus Desf.

The genus wants careful collecting, with notes on flower colour and habit (especially the number of flowering stems), being characters /

characters which are lost in the dried specimen. The basal leaves should not be forgotten. Nothing is known of the reproductive system of the genus, but signs of hybridisation should be looked for in the field.

Helichrysum Heywoodianum PH.Davis, sp. nov. (Sect. Staechadina DC. * * imbricata Boiss.).

Affinis H. armenio DC. praesertim var. glandulifero (Schultz Bip.) Bornm., sed habitu vix suffruticoso, basi valde compacto e caudicibus crassis nigris composito, turionibus sessilibus, foliis basalibus manifeste trinerviis basi latius ampliatis purpureis, phyllis involucri ad basin dorso semper manifeste tomentosis supra obtusissimis vix inflatis inter alia removitur.

Planta basi caespitosa e caudicibus brevibus crassis lignosis nigris dense composita. Radix tortuosa, crassa, cortice fibroso. Caules floriferi virgati, 20-40 cm. alti, 1-1.5 mm. lati, araneosi sed glandulis sessilibus praediti, ex toto dense foliati. Turiones steriles in caudicibus sessiles. Folia basalia linearia sed prope apicem latiora, inferne distincte trinervia, subacuta, 4-7 cm. longa, 3-5 lata, virescentia, glandulis sessilibus aureis dense praedita, sparse araneosa (pilis deinde deciduis), basi in vaginam late ovatam purpuream persistentem ampliata, bulbum formantia. Folia caulina valde numerosa, erecta, internodiis longiora, linearia, acuta, sessilia, 1-3 cm. longa, 1-3 mm. lata, infima trinervia, cetera uninervia, glandulis sessilibus praedita, subaraneosa. Corymbus terminalis, e capitulis 10-20 - dense compositus, pedunculis 5-10 (15) mm. longis simplicibus vel divisis dense araneosis foliis bracteiformibus lineari-subulatis 2-3 mm. longis praeditis. Involucrum turbinato-conicum, 6-7 mm. longum, in sicco 8-9 mm. latum, pallide /

pallide stramineum vel nonnumquam citrinum; phylla circ. 50, ab infimis brevissimis ad intima 3-4-plo longiora regulariter imbricata; phylla basalia dimidio inferiore viride oblongo-tomentoso, dimidio superiore membranaceo glabro sublongiore; phylla mediana parte inferiore oblonga pallide viridia, extra tomentosula in partem alteram membranaceam ± aequilongam glabram stramineam obovatam obtusissimam subplanam saepe breviter atque irregulariter fimbriata; phylla intima simillima, sed pars membranacea inferiore 2-3-plo brevior. Flores aurei. Corolla anguste tubulosa, 4.5 mm. longa, in lobos 0.25 mm. longos triangulari-ovatos regulariter fissa. Antherae 2 mm. longae. Ovarium 1 mm. longum. Achenia 1-1.25 mm. longa, oblonga, teretia, truncata, brunnea, glabra sed sub lente papillis obovoideis unicellularibus scabridula. Pappus albus, 4 mm. longus, persistens, e pilis simplicibus (sub lente brevissime barbulatis) compositus. Floret Aug.

Mykali: Samsun Dağ above Priene, 800-900 m., on sloping limestone rocks with Inula heterolepis Boiss., or among rocks in Pinetum Brutiae; base very woody, stems erect, leaves green and viscid, involucral phyllaries pale straw yellow, flowers yellow, 20 Aug. 1950, Davis 18359 & Heywood (holotypus in Herb. Kew., isotypus in Herb. Edin.).

This very distinct new species, the third endemic known for Mykali, appears to be most closely related to H. armenium DC. from Armenia, Kurdistan and Persia. As H. Heywoodianum belongs to the Mediterranean element (Pinus Brutia being the dominant tree on Mykali), its relationship to this distant Irano-Turanian species is remarkable.

In addition to the differentiae cited, the new species gemerally differs from H. armenium DC. in having involucral phyllaries that are thinner and have slightly lacerated margins; the basal /

basal leaves are also longer and more slender, and the capitulum is more broadly conical. In habit H. Heywoodiana resembles H. Aucheri Boiss. from Eastern Turkey, but differs from the latter primarily in its more slender stems, more sparse partly glandular indumentum, linear acute green leaves, purple leaf-bases, fewer-headed corymbs, smaller turbinate-conical capitula, and thinner straw-coloured involucral phyllaries. Somewhat less closely related to the new species (which I have named after my friend and fellow-collector Mr. V.H. Heywood) is H. arenarium (L.) DC., a Eurasian species of sand-dunes and sandy soils. The latter is not found in the Mediterranean region. Its extension into Europe, from the dry regions of Western Asia, has probably been made possible by its arenicolous habit.

Helichrysum italicum (Roth) Don var. microphyllum (Willd.) Boiss. Fl. Or. 3,234 (1875).

W. Crete: Above Theriso, 1400 m., 3 Aug. 1950, Davis 18149.

H. orientalis (L) DC., Prodr. 6, 183 (1837) var. orientalis.

Karpathos: Vurgunda, near cliff called Akrotirias, 24 July 1950, Davis 18039.

The typical form is new for Karpathos.

var. Pichleri (Barbey) Hayek, Prodr. Balc. 2, 598 (1931).

Karpathos: Kalilimni, 1100 m., N. cliff, 27 July 1950, Davis 18007.

Hypochaeris tenuiflora (Boiss.) Boiss., Fl. Or. 3, 785 (1875).

W. Crete: Svourichti above Katsiveli, 2300 m., summit screes, perennial, ligules yellow, 4 Aug. 1950, Davis 18125.

Inula heterolepis Boiss., Diagn. Ser. 2 (3) 12 (1856).

Karpathos: Kalilimni, 1000 m., sunny rocks, 27 July, 1950, Davis /

Davis 18040. Mykali: Samsun Dağ at and above Priene, 100-900 m., on sloping rocks and on walls of temples, 20 Aug. 1950, Davis 18343 & Heywood.

Lactuca alpestris (Gand.) Rech. fil., Neue Beitr. Fl. Kreta, 160 (1943).

W. Crete: Svourichti above Katsiveli, 2100 m., ligules 5, lemon yellow, 4 Aug. 1950, Davis 18121.

Lactuca amorgina Boiss., et Orph. apud Hal. in Verh. Zool.-Bot. Ges. Wien, 49, 188 (1899).

Karpathos: Vurgunda, in vertical sea rocks, 24 July 1950, Davis 18027 (alabastro).

New for the Dodecanese. This species has previously been recorded from the Cyclades, Crete and Hydra; on Rhodes it is replaced by the very closely related L. eburnea Rech. fil.

Onopordon bracteatum Boiss. et Heldr. in Boiss. Diagn. Ser. 1 (10) 91 (1849).

Karpathos: Lastos, 700 m., rocky level places, biennial ?, fl. purple, 20 July 1950, Davis 18018. – I have not seen the type.

Otanthus maritimus (L.) Hoffmgg. et Link, Fl. Port. 2, 364 (1809). – Syn. Diotis maritima (L.) Smith, Engl. Fl. 3, 403 (1825).

Kasos: islet of Makra, on sandy shore, 29 July 1950, Davis 18105.

A new record for Kasos.

Pulicaria uliginosa Stev. in DC., Prodr. 5, 478 (1836).

Mykali: Samsun Dağ above Priene, 400 m., at springs, 20 Aug. 1950, Davis 18348 & Heywood.

New for Mykali.

Senecio gnaphalodes Sieber, Reise Kreta 1, 352 (1823).

Karpathos: Avlona, among rocks and on loose walls of terraces and rubble (collected to show range of leaf-variation), 24 /

24 July 1950, Davis 18032; Prof. Elias above Menetes, screes and walls, 26 July 1950, Davis 18102.

The variant with shortly lobed leaves (var. apricus Dörfler) is not worth nomenclatural recognition. Every degree of lobing is found in natural populations, both on Crete and Karpathos, though the entire-leaved form (the type of the species) predominates on both islands. There may be as many as nine lobes on each side of the leaf (as represented in Davis 18032) but such extreme forms are rare.

Senecio fruticulosus Sibth. et Smith, Prodr. 2, 178 (1813).

W. Crete: Svourichti above Katsiveli, 2200-2300 m., 4 Aug. 1950, Davis 18137.

Staehelina fruticosa (L.) L., Syst. Nat. ed. 12, 2, 538 (1767).

Karpathos: Kalilimni, 1000 m., N. cliff, 21 July 1950, Davis 18012; Phiniki, 10 m., vertical west cliff, bushes 1 m. across, 27 July 1950, Davis 18090 (forma foliis carnosulis prope mare crescens).

CAMPANULACEAE

Symphyandra cretica DC., Monogr. Camp. 366 (1830).

W. Crete: Meskla, in a ravine leading towards Theriso ¼ hour on foot from Meskla, rare on shady rocks, fl. lilac-blue, Aug 2, 1950, Davis 18142.

This beautiful species, endemic to West Crete, has not previously been recorded from the north side of the White Mountains.

Hayek (Prodr. Balc. 2, 549) treated S. cretica as consisting of three allopatric subspecies: eucretica Hayek, sporadum (Hal.) Hayek and samothracicum (Deg.) Hayek, from Crete, Jura and Samothrace respectively. However, the morphological differences between these three Aegean taxa seem sufficiently well marked to justify their /

their being given specific rank. Of the three, the Cretan plant is the most distinct, differing from the other two (in addition to the characters given by Hayek) in having the lower part of the petiole ciliate instead of glabrous.

It is curious that the Korean S. asiatica Nakai is more nearly related to S. cretica than to any other species of Symphyandra. It seems probable, however, that the genus has, like Asyneuma Gris. & Schenk, evolved from more than one section of Campanula L.

ERICACEAE

Arbutus Unedo L., Sp. Pl. 395 (1753).

Karpathos: above Spoa, facing W., 500 m., in Pinetum Brutiae, 23 July, Davis 18079.

Erica verticillata Forsk., Fl. Aegypt. Arab. 210 (1775).

Karpathos: between Marmakoui and Holethria, on W. side of Kalilimni, 700 m., slopes in open Pinetum Brutiae, 22 July 1950, Davis 18084.

PLUMBAGINACEAE

Limonium Frederici (Barbey) Rech. Fil., Fl. Aeg. 427 (1943).

Saria: place called Spatharea, on calcareous sea rocks, 25 July 1950, Davis 18073 (forma depauperata). Karpathos: Vurgunda, near cliff called Akrotirias, 30 m., sloping cliffs, leaves glaucous, fl. lilac, 24 July 1950, Davis 18049.

Limonium hyssopifolium (Girard) Rech. fil., Fl. Aeg. 427 (1943).

Karpathos: Phiniki, on sea rocks, damp sand and shingle, 27 July 1950, Davis 18092. Kasos: islet of Makra, fl. lavender, 29 July 1950, Davis 18106.

This species is new for Kasos. In the Kew Herbarium there is a specimen of L. hyssopifolium from my Karpathos locality (Rech. /

(Rech. fil. 8298), cited in Flora Aegaea as L. Sieberi O. Kuntze. L. hyssopifolium seems ill-defined from L. graeca Poiret; my Karpathos gathering shows a wide range of tubercle-development, varying from weakly developed to very prominent.

Pichler 565, cited as L. Sieberi in Flora Aegaea, matches the type of L. pigadensis Rech. Fil. from the same locality.

BORAGINACEAE

Anchusa caespitosa Lam., Encycl. 1, 498 (1783).

W. Crete: Katsiveli, 1850 m., 4 Aug. 1950, Davis 18159.

It is very difficult to collect seeds of this species as they are carried off (by ants ?) just before ripening.

Echium diffusum Sibth. et Smith var. Halacsyi (Holmboe) Hayek, Prodr. Balc. 2, 94 (1928).

Karpathos: Prof. Elias near Menetes, 26 July 1950, Davis 18099.

CONVOLVULACEAE

Cuscuta Epithymum L. var. micrantha Boiss., Fl. Or. 4, 116 (1875).

Karpathos: between Voladha and Lastos, 600 m., on Ononis spinosa, 20 July 1950, Davis 18015. W. Crete: Svourichti above Katsiveli, 2100 m., on Verbascum spinosum, 4 Aug. 1950, Davis 18132.

The species has not previously been recorded for Karpathos.

SCROPHULARIACEAE

Digitalis ferruginea L., Sp. Pl. 368 (1753).

Mykali: Samsun Dağ above Priene, 900-1000 m., Aug. 1950, Davis 18364 & Heywood.

In the Aegean only recorded hitherto from Euboea.

Linaria /

Linaria microcalyx Boiss., Diagn. Ser. 1 (4) 72 (1844).

Karpathos: Vurgunda, gravel beach, leaves fleshy and pilose, 24 July 1950, Davis 18044.

Odontites Linkii Heldr. et Sart. in Boiss., Diagn. Ser. 2 (3) 177 (1856). – Syn. Euphrasia frutescens Sieber, Avis, 4 (1821), nomen; E. fruticosa Sieber, Avis, 5 (1821), nomen; Odontites cretica Boiss., Fl. Or. 4, 477 (1879); O. frutescens Sieber ex Hal., Consp. Fl. Gr. 2, 438 (1902).

Karpathos: Prof. Elias near Olymbos, N. limestone cliff, leaves bright green, 23 July 1950, Davis 18069; Vurgunda, near cliff called Akrotirias, 24 July 1950, Davis 18038. Euboea: Gorge of R. Kersus, 100 m., Sept. 1932, S.C. Atchley 1519.

New for Karpathos and Euboea.

Now that more material is available of O. Linkii Heldr. et Sart. (hitherto only recorded from the Greek mainland), I find myself unable to separate it from the endemic Cretan O. cretica Boiss. (Omalo, leg. Sieber !) which is the only member of the genus recorded by K.H. Rechinger from the Aegean. All the characters used by Boissier to distinguish these two plants break down. Although my Karpathos specimens only bear the previous year's capsules, I think they can safely be equated with O. Linkii. Specimens of the latter from the locus classicus (Parnassus, where R. Barneby and I collected it at Delphi in 1938) have anthers varying from glabrous to lanate.

Scutellaria hirta Sibth. et Smith, Prodr. 1, 425 (1806).

W. Crete: Svourichti above Katsiveli, 4 Aug. 1950, fl. pale yellow, Davis 18129.

Verbascum macrurum Ten., Fl. Nap. Prodr. App. 5, p. 9 (1826).

W. Crete: above Theriso, open hillsides, biennial, fl. large, 3 Aug. 1950, Davis 18156.– Det. Dr. A. Huber-Morath.

Verbascum /

Verbascum spinosum L., Cent. Pl. 2, 10 (1756).

W. Crete: above Theriso, 1600 m., 3 Aug. 1950, Davis 18145. – Det. Dr. A. Huber-Morath.

LABIATAE

Ballota pseuodictamnus (L.) Benth., Lab. Gen. et Sp. 594 (1834).

W. Crete: above Theriso, 700 m., 3 Aug. 1950, Davis 18144.

Calamintha cretica (L.) Benth., in DC., Prodr. 12, 227 (1848).

W. Crete: Meskla, limestone rocks in gorge, 5 Aug. 1950, Davis 18153.

Calamintha incana (Sibth. et Smith) Boiss. ex Benth. in DC., Prodr. 12, 226 (1848) var. incana.

Karpathos: Olymbos, through Poterium spinosum, on schist, 25 July 1950, Davis 18054; Spoa, 23 July 1950, Davis 18080. Mykali: Samsun Dağ above Priene, 400 m., 20 Aug. 1950, Davis 18346.

The species is new for Karpathos and Mykali.

Calamintha Nepeta (L.) Savi var. Spruneri (Boiss.) Hayek, Prodr. Balc. 2, 326 (1929).

W. Crete: Meskla, in ditches, erect, fl. lilac, 5 Aug. 1950, Davis 18155.

Coridothymus capitatus (L.) Reichenbach fil. in Öst. Bot. Wochenbl. 7, 161 (1857) var. capitatus.

Karpathos: Avlona, 24 July 1950, Davis 18035.

Melissa officinalis L., Sp. Pl. 592 (1753).

W. Crete: Meskla, in ditches, 5 Aug. 1950, Davis 18154.

The form is the one generally recognised as var. villosa Benth. It is much commoner in the Eastern Mediterranean than in the West, but is linked to the typical form by numerous intermediates.

Mentha longifolia (L.) Huds. Fl. Angl. ed 1, 221 (1762), sensu lato (excl. /

(excl. M. microphylla C. Koch).

Mykali: Samsun Dağ above Priene, by spring with M. rotundifolium, 20 Aug. 1950, Davis 18366.

New for Mykali.

Mentha rotundifolia (L.) Huds., Fl. Angl. ed. 1, 221 (1762).

Mykali: Samsun Dağ above Priene, 400 m., fl. white, 20 Aug. 1950, Davis 18347.

The species has hitherto been recorded from the Aegean only from Poros, Rhodes, Crete and Cos.

Micromeria Juliana (L.) Benth., Lab. Gen. et Sp., 373 (1834).

Mykali: Samsun Dağ above Priene, 900 m., 20 Aug. 1950, Davis 18363 and Heywood (grazed); ibid., 400 m., No. 18356.

Nepeta sphaciotica Davis, sp. nov. (Sect. Eunepeta Boiss. Subsect. Stenostegiae Boiss.).

Valde affinis N. parnassicae Heldr. et Sart. et N. pilinuci P.H. Davis; a priore foliis latioribus grossius crenatis, spicis abbreviatis recedit; ab altera verticillastris superioribus coarctatis, nuculis ad apicem haud pilosis inter alia recedit.

Planta perennis, basi lignosa tortuosa. Caules erecti, 12-18 cm. alti, 1-1.5 mm. lati, glandulis sessilibus et pilis eglandulosis breviter viscidulo-tomentosi. Folia petiolata; lamina oblongo-ovata, obtusa, basi abrupte truncata vel etiam subcordata, rugulosa, 12-15 mm. longa, 8-10 mm. lata, utrinque regulariter 8-10-crenata, virescens, petiolum 2-10-plo longior, glandulis sessilibus et pilis eglandulosis brevissime tomentosula. Verticillastra 4-9-nata, 6-12-flora, infima saepe distantia breviter pedunculata, cetera subsessilia in spicam densam 2.5-5.0 cm. longam et 1.2-1.4 cm. latam (corollis exclusis) condensata. Bracteae anguste oblongo-lanceolatae, tomentosulae, acutissimae, trinerviae, anguste /

anguste membranaceo-marginatae, tubum calycis aequantes. Calyx 7 mm. longus, tubulosus, manifeste nervosus, tomentosus, glandulis sessilibus praeditus, fauce subobliquus, ad 1/3 vel paulo ultra in dentes lanceolatos acuminatos membranaceo-marginatos ciliatos subaequaliter fissus. Corolla 12 mm. longa, alba, tubo exserto; labium superius 2 mm. longum retusum; labium inferius trilobatum, lobo mediano 3 mm. longo profunde dentato immaculato, lobis lateralibus late rotundatis 1.5 mm. longis 2 mm. latis. Nuculae late oblongae, 2-2.25 mm. longae, 1.25 mm. latae, obtusissimae, glabrae, granulato-papillosae.

W. Crete: Levka Ori on Mt. Svourichti (above the shepherd encampment 'Katsiveli' near Pachnes), on N. side of summit, 2300 m., rare, fl. white immaculate, 8 Aug. 1950, Davis 18116 (holotypus in Herb. Kew.; isotypus in Herb. Edin.).

With the exception of the very different N. melissifolia Lam., no species of Nepeta in Subsect. Stenostegiae has previously been found in Crete. N. sphaciotica P.H. Davis is a very rare plant: only about six clumps were found, among limestone rocks just below the summit of Svourichti. A shepherd told me that he had not seen the plant on any of the surrounding peaks. In its viscid glandular indumentum it resembles N. parnassica Heldr. et Sart. (endemic to Mt. Parnassus) and N. pilinux P.H. Davis from the Isaurian and Pisidian Taurus of Southern Anatolia. Apart from its dwarf stature (which may be a modification, as similar forms occur in N. pilinux in exposed habitats), it differs from N. parnassica in its abbreviated spike, and in the form of its apparently greener leaves: the lamina is broader and has fewer, more coarse crenations. From N. pilinux (now known from six Anatolian gatherings), which it resembles in leaf, it differs in its conferted spike and glabrous /

glabrous nutlets; in addition, it usually differs from N. pilinux in its larger flowers, longer bracts and more exserted calyx-tube. The length of the calyx-teeth, relative to the calyx-tube, is much more variable in this group of species than the descriptions of Boissier and Hayek suggest. Although N. sphaciotica might be treated as a subspecies of either of its two allies, it seems preferable to give it specific rank; it would be difficult to assign it to one species rather than the other, and to reduce N. pilinux and N. sphaciotica to subspecies of N. parnassica would be to throw out of balance the circumscription of allied species of Nepeta now generally recognised in the Balkans. In this genus facies, though difficult to define, is particularly important in the delimitation of species. There can be few genera in the Eastern Mediterranean more in need of revision than Nepeta.

To N. camphorata Boiss. et Heldr. and N. Heldreichii Hal., geographically the nearest allies of N. sphaciotica, the new species appear to be less closely related.

Origanum heracleoticum L., Sp. Pl. 589 (1753) var. heracleoticum.

Mykali: Samsun Dağ above Priene, 400-500 m., 20 Aug. 1950, Davis 18349.

The species is new for Mykali.

var. trichocalycinum (Hausskn.) Hal., Consp. Fl. Gr. 2, 555 (1902).

W. Crete: Theriso, fl. white, 3 Aug. 1950, Davis 18143.

Origanum Maru (L.) Hayek, Prodr. Balc. 2, 336 (1929).

W. Crete: above Theriso, 400 m., fl. purplish pink, 5 Aug. 1950, Davis 18165.

Origanum x minoanum Davis, nom. nov. – Syn. Majorana leptoclados Rech. fil., Neue Beitr. Fl. Kreta, 125 (1943), non Origanum leptocladum Boiss., Fl. Or. 4, 548 (1879).

W. /

W. Crete: above Theriso, 1500 m., only one plant seen, growing with O. heracleoticum, fl. lilac pink, 3 Aug. 1950, Davis 18149.

I am still of the opinion that this plant is a hybrid between O. heracleoticum and O. Maru, which were growing nearby.

Origanum Onites L., Sp. Pl. 590 (1753).

Karpathos: near Holethria (E. of Kalilimni), grazed, 22 July 1950, Davis 18085.

Origanum sipyleum L., Sp. Pl. 589 (1753).

Mykali: Samsun Dağ above Priene, rocky slopes in open Pinetum Brutiae, Aug. 1950, Davis 18360 & Heywood.

Origanum Vetteri Briq. et Barb. in Stef., Fors.-Maj., Barb., Karpathos, 124 (1895).

Karpathos: Kalilimni, N.W. side, 1100-1200 m., among rocks at foot of cliff, growing with mosses, decumbent, fl. pink, 21 July 1950, Davis 18005.

The stamens were observed in the field to stick straight out of the corolla instead of ascending under the upper lip. O. Vetteri therefore breaks down the main distinguishing character between Origanum L. s. str. and Amaracus Gled. stressed by Briquet (in Engl. & Prantl, Pflanzenf. 4 (3a) 304-309: 1897), and helps to justify the inclusion of Amaracus Gled. and Majorana Moench in Origanum L.

In cultivation I have found spontaneous hybrids between O. Dictamnus L. and O. Tournefortii Sibth. - the first cross known between species in Sect. Amaracus, which in nature are never able to hybridise owing to their allopatric distribution. The generic limits of Origanum were discussed by the writer in Kew. Bull. 1949, 404.

Phlomis floccosa D. Don in Bot. Reg. 15, t. 1300 (1829).

Karpathos: /

Karpathos: Voladha, 400 m., 20 July 1950, Davis 18013.

Phlomis Pichleri Vierh. in Öst. Bot. Zeitschr. 65, 232 (1915).

Karpathos: Voladha, 600 m., 20 July 1950, Davis 18014; Diaphani, near sea level, edge of dry stream bed, 25 July 1950, Davis 18074; Kalilimni above Lastos, 800 m., 21 July 1950, Davis 18001.

On Karpathos this endemic species ascends to higher altitudes than P. floccosa D. Don, which is a common plant of the Mariut (Egypt).

Satureia Biroi Javorka in Mag. Bot. Lap. 21, 25 (1922).

Karpathos: above Spoa, facing West, in open Pinetum Brutiae, 23 July 1950, Davis 18077.

Satureia spinosa L., Sp. Pl. ed. 2, 795 (1763).

W. Crete: Svourichti above Katsiveli, 2200 m., 4 Aug. 1950, Davis 18136; above Theriso, 1500 m., fl. white or very pale lilac, 3 Aug. 1950, Davis 18146.

Sideritis sipylea Boiss., Diagn. Ser. 1 (5) 32 (1844).

Mykali: Samsun Dağ above Priene, 800-1000 m., among rocks in open Pinetum Brutiae, fl. dirty lemon yellow with 2 thin brown lines on upper lip, 20 Aug. 1950, Davis 18361 & Heywood.

Sideritis syriaca L., Sp. Pl. 574 (1753).

W. Crete: Katsiveli, stems usually simple, but branched forms not uncommon, 3 Aug. 1950, Davis 18147.

Stachys mucronata Sieber ex Sprengel, Syst. Veg. 2, 733 (1825).

Karpathos: Kalilimni, 1000 m., fl. white, 21 July 1950, Davis 18004.

Stachys spinosa L., Sp. Pl. 581 (1753).

Karpathos: Prof. Elias above Menetes, rocky slopes, 26 July 1950, Davis 18097.

Teucrium alpestre Sibth. et Smith, Prodr. 1, 395 (1806) var. alpestre.

W. /

W. Crete: between Katsiveli and Theriso, above the place called Kapsika, 1700 m., fl. creamy yellow, 5 Aug. 1950, Davis 18163.

var. maius Boiss., Fl. Or. 4, 819 (1879).

Karpathos: Prof. Elias above Menetes, fl. creamy, 26 July 1950, 18098; Olymbos, schistose hillsides, 25 July 1950, Davis 18052.

In E. Crete this variety is linked to the typical White Mountain form of the species (var. alpestre) by intermediate forms.

Teucrium brevifolium Schreb., Pl. Vert. Unilab. 27 (1774).

Karpathos: Phiniki, rocky slopes near the sea, 27 July 1950, Davis 18094.

Teucrium divaricatum Sieber ex Boiss., Fl. Or. 4, 816 (1879) subsp. villosum (Cel.) Rech. Fil., Fl. Aeg. 497 (1943).

Karpathos: Olymbos, fl. purple, 25 July 1950, Davis 18053; Prof. Elias above Menetes, 26 July 1950, Davis 18101.

Teucrium Montbretii Benth. subsp. heliotropifolium (Barbey) Davis, comb. et stat. nov. — Syn. T. heliotropifolium Barbey in Bull. Soc. Vaud. Sc. Nat. 21, 97 (1875).

var. heliotropifolium.

Karpathos: Phiniki, 10-30 m., vertical and overhanging W. cliff, 27 July 1950, Davis 18087. Syntypi: Prof. Elias pr. Elympo [Olymbos], Pichler 497, vix florentem detexit; dein ad rupes Kilimni [Kalilimni] tantum cum foliis iterum invenit.

var. crenatum Davis, var. nov.

Folia utrinque manifeste 3-5-crenata (haud integra), crenis obtusis.

Karpathos: Vurgunda, on cliff near the place called Akrotirias, vertical and overhanging cliffs facing N. and in caverns, 50 m., fl. whitish but for pale purplish posterior dorsal lobes, nervature of leaves very pronounced, 24 July, 1950, Davis 18050 (holotypus /

(<u>holotypus in Herb. Kew.</u>) <u>Saria</u>, 18 Jul. 1886, Barbey 486.

The new variety, on account of its crenate leaves, links typical <u>T. heliotropifolium</u> (with entire leaves) to <u>T. Montbretii</u> subsp. <u>pamphylicum</u> Davis, and, if the latter is to be retained within <u>T. Montbretii</u> (cf. Davis in Kew. Bull. 1951, 116), makes it unnatural not to include <u>T. heliotropifolium</u> in the same species. Taking this view, <u>T. Montbretii</u> subsp. <u>heliotropifolium</u> var. <u>crenatum</u> differs from subsp. <u>pamphylicum</u> in its fewer leaf-crenations, more prominent venation, generally more rounded leaf-base (instead of abruptly truncate or subcordate), and generally shorter indumentum. On Karpathos var. <u>crenatum</u> is known only from the north end of the island and adjacent Saria. The crenation was a constant feature in the population I collected. An occasional leaf-crenation occurs in var. <u>heliotropifolium</u>, noticeably at Phiniki in the S.W. part of Karpathos.

<u>Teucrium Polium</u> L. var. <u>dumulosum</u> Rech. fil. emend., Fl. Aeg. 500 (1943).

<u>Dodecanese</u>: islet of Makra near Kasos, 29 July 1950, Davis 18110.

The species is new for Kasos.

<u>Teucrium scordioides</u> Schreb., Pl. Vert. Unilab. 37 (1774).

<u>Mykali</u>: Samsun Dağ above Priene, 400 m., 20 Aug. 1950, Davis 18345.

New for Mykali.

CHENOPODIACEAE

<u>Arthrocnemon glaucum</u> (Del.) Ung.-Sternb. in Atti Congr. Bot. Firenze, 1874, 283 (1876).

<u>Karpathos</u>: Vurgunda, sea rocks, 5 m., 24 July 1950, Davis 18022.

New /

New for Karpathos.

Salsola aegaea Rech. fil., Beitr. Fl. Kreta, 67 (1943).

Kasos: islet of Makra, 29 Jul. 1950, Davis 18104.

New for Kasos.

Salsola carpatha Davis, sp. nov. (Sect. Pseudonoea Ulbrich).

Affinis S. canescenti (Moq.) Boiss., sed foliis latioribus oblongo-linearibus, floribus minus remotis sed magis patentibus bracteolas aequantibus, bracteis brevioribus haud caudatis, bracteolis diversis recedit.

Suffrutex 30-40 cm. altus, e rupibus calcareis maritimis dependens, basi stricte divaricato-ramosus. Rami alterni, arcuati, graciles, vetusti, grisei cortice longitudinaliter fisso, floriferi sordide eburnei 1 mm. lati, pilis brevibus eglandulosis subappressis (deinde deciduis) canescentes. Folia alterna, oblongo-linearia, 5-13 mm. longa, 1.5-3.0 mm. lata, sessilia, acuta, subplana vel obsolete triquetra, canescentia, internodiis sub-breviora. Spica interrupta 3-10 cm. longa, e floribus 5-10 mm. (infimis ad 15 mm.) distantibus composita. Bracteae anguste oblongo-ellipticae, acutae, 4-8 mm. longae, canescentes, infra medium contractae sed ubique in marginem membranaceam ciliatam sensim dilatatae. Bracteolae bracteis similes, sed aliquantum breviores. Flores 12-20, singuli in axillis bractearum sessiles, late divaricati, bracteis breviores vel nunc aequantes, bracteolis aequilongi. Perigonii phylla 5, libera, ovato-lanceolata, subacuta, 3.5-4 mm. longa, extus appresse canescentia, 2 externa, 3 interna, ad ¼ supra basin alis immaturis praedita. Filamenta 3.5 mm. longa, linearia. Antherae 3 mm. longae, in appendices 1.5 mm. longos acute sagitatae. Ovarium late ovoideum, 1 mm. longum. Stylus 2 mm. longus, ad medium bifidus. Embryo horizontalis. Fructus ignotus. Floret Jul.

Karpathos: /

<u>Karpathos</u>: Vurgunda (N.W. of Olymbos) at 5-20 m. alt., on calcareous sea rocks with <u>Galium canum</u>, 24 July 1950, P.H. Davis 18025 (<u>holotypus in Herb. Kew.</u>; <u>isotypus in Herb. Edin.</u>).

As with <u>Helichrysum Heywoodianum</u> P.H. Davis described in this paper, <u>Salsola carpatha</u> P.H. Davis is most closely related, not to any Aegean species, but to one further East and of a very different habitat and climate: <u>S. canescens</u> (Moq.) Boiss., a plant of high arid mountains in Kurdistan, N.W. and S.W. Persia and (according to Boissier) the Lebanon.

<u>S. carpatha</u> differs from <u>S. canescens</u> in its shorter bracts and bracteoles that are ciliate and differently shaped, the bracteole being more gradually enlarged by its membranous margin; it is further distinguished by its broader leaves, and less remote and more spreading flowers. Hitherto only <u>S. Kali</u> L. and <u>S. aegaea</u> Rech. fil. have been recorded from Karpathos, neither of which is nearly related to the new species.

It may be pointed out that Ulbrich, in his treatment of the genus <u>Salsola</u> L. in Engler & Prantl, Pflanzenf. ed. 2, <u>16c</u>, 566 (1934), describes the species of Sect. <u>Pseudonoea</u> Ulbrich (to which <u>S. carpatha</u> belongs) as having <u>opposite</u> leaves; it is obvious that <u>alternate</u> was meant.

<u>Suaeda fruticosa</u> (L.) Forsk, Fl. Aegypt. Arab. 70 (1775).

<u>Kasos</u>: islet of Makra, 29 July 1950, Davis 18111.

In the Aegean the species has only been recorded from Crete. My specimens are in leaf, so that the determination is tentative.

POLYGONACEAE

<u>Polygonum aviculare</u> L., Sp. Pl. 362 (1753) subsp. <u>aviculare</u>.

<u>W. Crete</u>: Katsiveli, 1850 m., weed in potato patch, 4 Aug. 1950, Davis 18161.

Polygonum /

<u>Polygonum maritimum</u> L., Sp. Pl. 361 (1753).

<u>Karpathos</u>: Phiniki, sea level, 27 July 1950, Davis 18096.

LAURACEAE

<u>Laurus nobilis</u> L., Sp. Pl. 369 (1753).

<u>Mykali</u>: Samsun Dağ above Priene, 400 m., 20 Aug. 1950, Davis & Heywood.

Not previously recorded from Mykali.

THYMELIACEAE

<u>Thymelea hirsuta</u> (L.) Endl., Gen. Pl. Suppl. IV(2) 65 (1847).

<u>Kasos</u>: islet of Makra, 29 July 1950, Davis 18108.

New for Kasos.

EUPHORBIACEAE

<u>Euphorbia Paralias</u> L., Sp. Pl. 458 (1753).

<u>Karpathos</u>: Vurgunda, gravel beach, 24 July 1950, Davis 18045.

New for the island.

<u>Euphorbia Peplis</u> L., Sp. Pl. 455 (1753).

<u>Karpathos</u>: Vurgunda, gravel beach, 24 July 1950, Davis 18043.

New for Karpathos.

SANTALACEAE

<u>Osyris alba</u> L., Sp. Pl. 1022 (1753).

<u>Mykali</u>: Samsun Dağ at Priene, 100 m., 20 Aug. 1950, Davis 18344 & Heywood.

ORCHIDACEAE

<u>Himantoglossum hircinum</u> (L.) Spreng. subsp. <u>calcaratum</u> (Beck) Soo in Fedde, /

flourishes in dry scrub and woodland.

The number of veins on the leaf and the position of the tendrils are not good vegetative characters for distinguishing S. excelsa L. from S. aspera L. subsp. mauritanica (Desf.) Asch. et Gr. S. excelsa differs vegetatively from the latter in having leaves of thinner texture that are truncate or only slightly cordate at the base.

AMARYLLIDACEAE

Allium Bourgaei Rech. Fil. in Ann. Nat. Mus. Wien, 47, 150 (1936).

Karpathos: Lastos, 700 m., N.W. cliff, in cracks and on ledges, 22 July 1950, Davis 18066.

Allium margaritaceum Sibth. et Smith, Prodr. 1, 224 (1806) var. margaritaceum.

Karpathos: Kalilimni above Lastos, 1000 m., growing through Poterium spinosum, fl. whitish with a green spot on the petals, 21 July 1950, Davis 18002.

K.H. Rechinger records only var. guttatum Stev. from Karpathos.

Allium paniculatum L., Sp. Pl. ed. 2, 428 (1762).

Karpathos: Lastos, 700 m., fallow fields, 20 July 1950, Davis 18017.

New for the island.

JUNCACEAE

Juncus articulatus L., Sp. Pl. 327 (1753).

Mykali: Samsun Dağ above Priene, springs, 400 m., Davis 18357.

A new record for Mykali.

CYPERACEAE /

CYPERACEAE

Pycreus globosus (All.) Reichenb., Fl. Germ., Exc. 1,14010 (1830).

Mykali: Samsun Dağ above Priene, 400 m., springs, 20 Aug. 1950, Davis 18358.

ILLUSTRATIONS

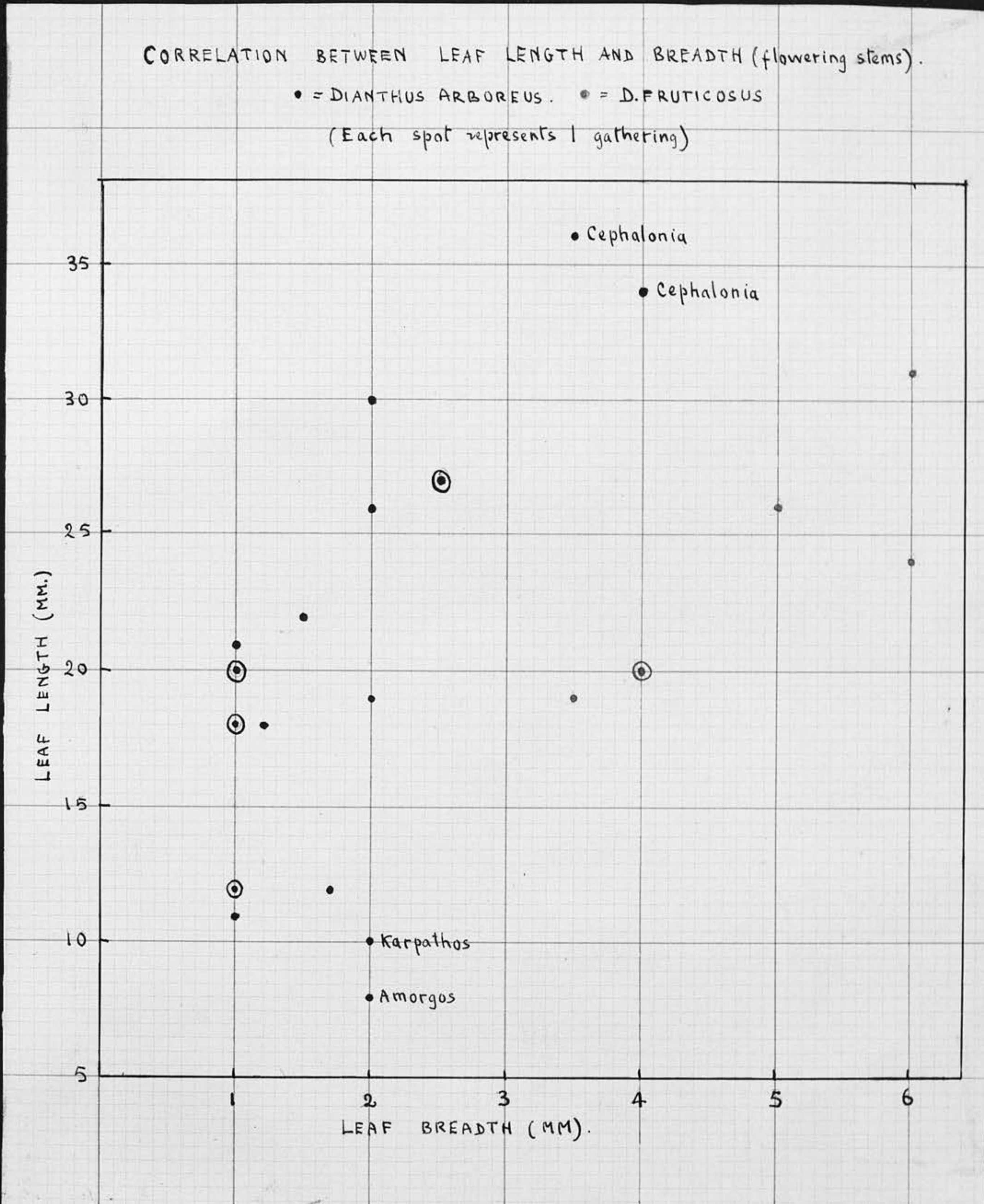

CORRELATION BETWEEN LEAF LENGTH AND BREADTH (flowering stems).
• = DIANTHUS ARBOREUS. • = D. FRUTICOSUS
(Each spot represents 1 gathering)
Cephalonia
Cephalonia
Karpathos
Amorgos
35
30
25
20
15
10
5
LEAF LENGTH (MM.)
1
2
3
4
5
6
LEAF BREADTH (MM).

Fig. 1.

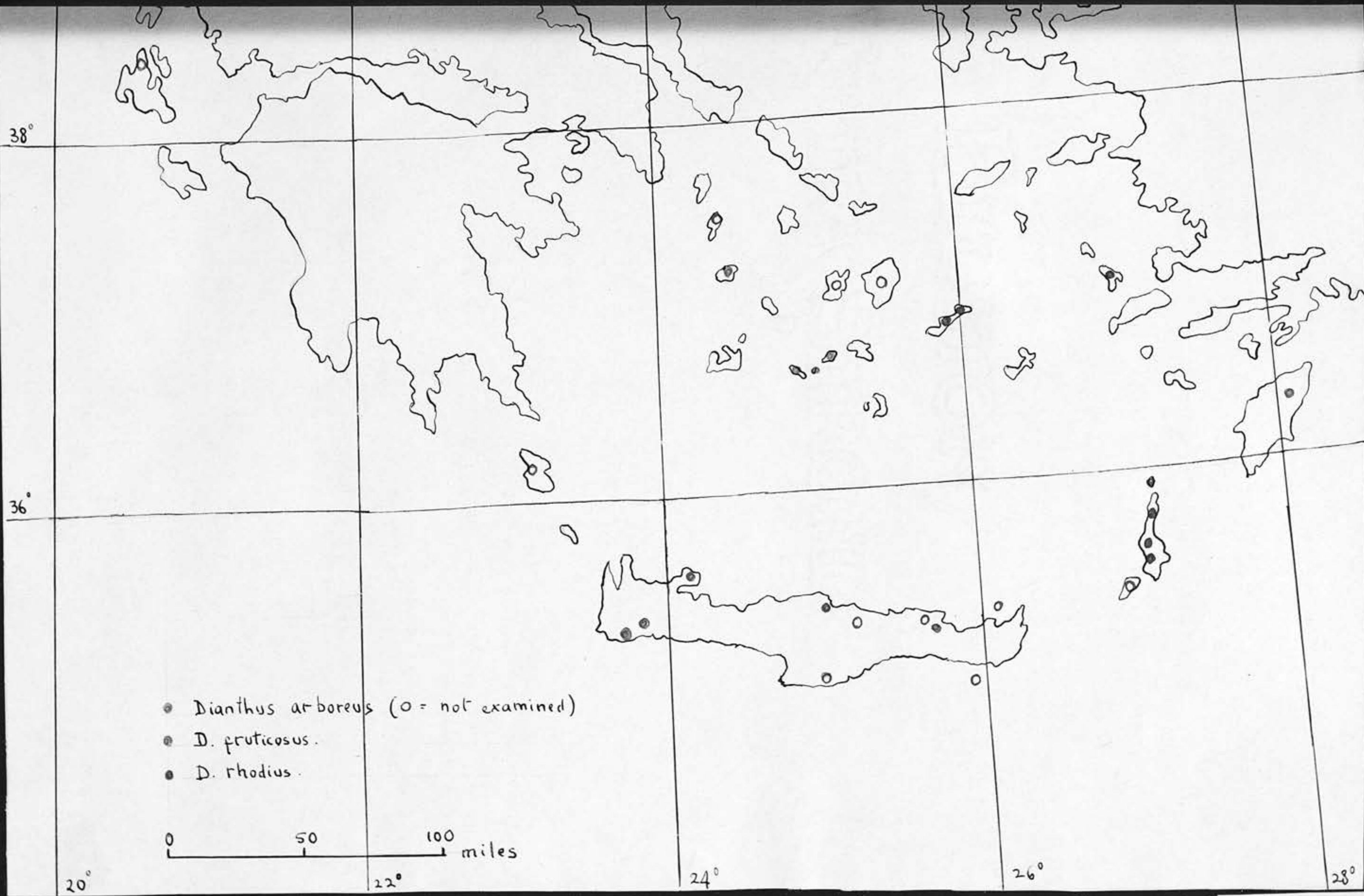

38°
36°
Dianthus arboreus (O = not examined)
D. fruticosus.
D. rhodius.
0
50
100
miles
20°
22°
24°
26°
28°

Fig. 2.

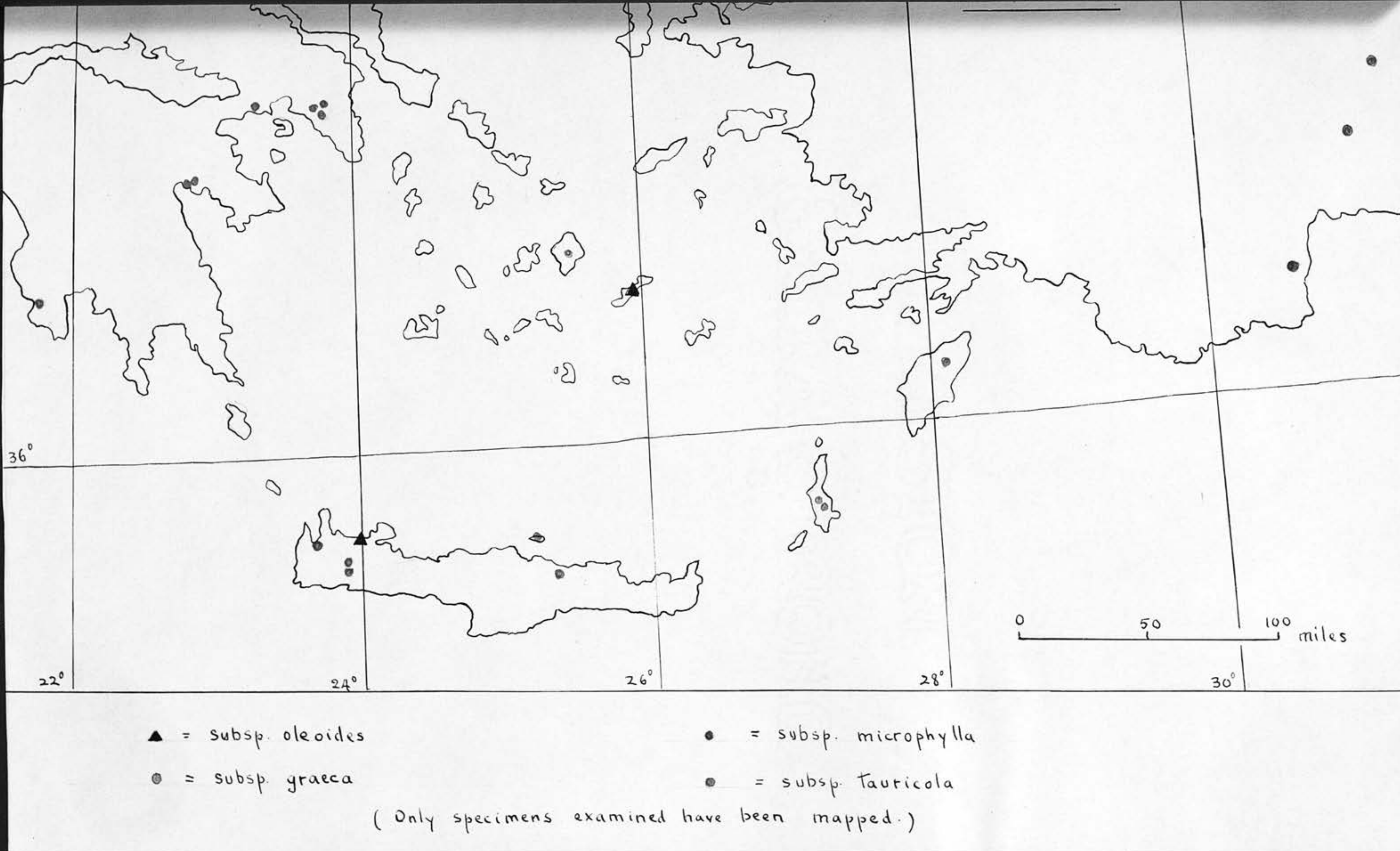
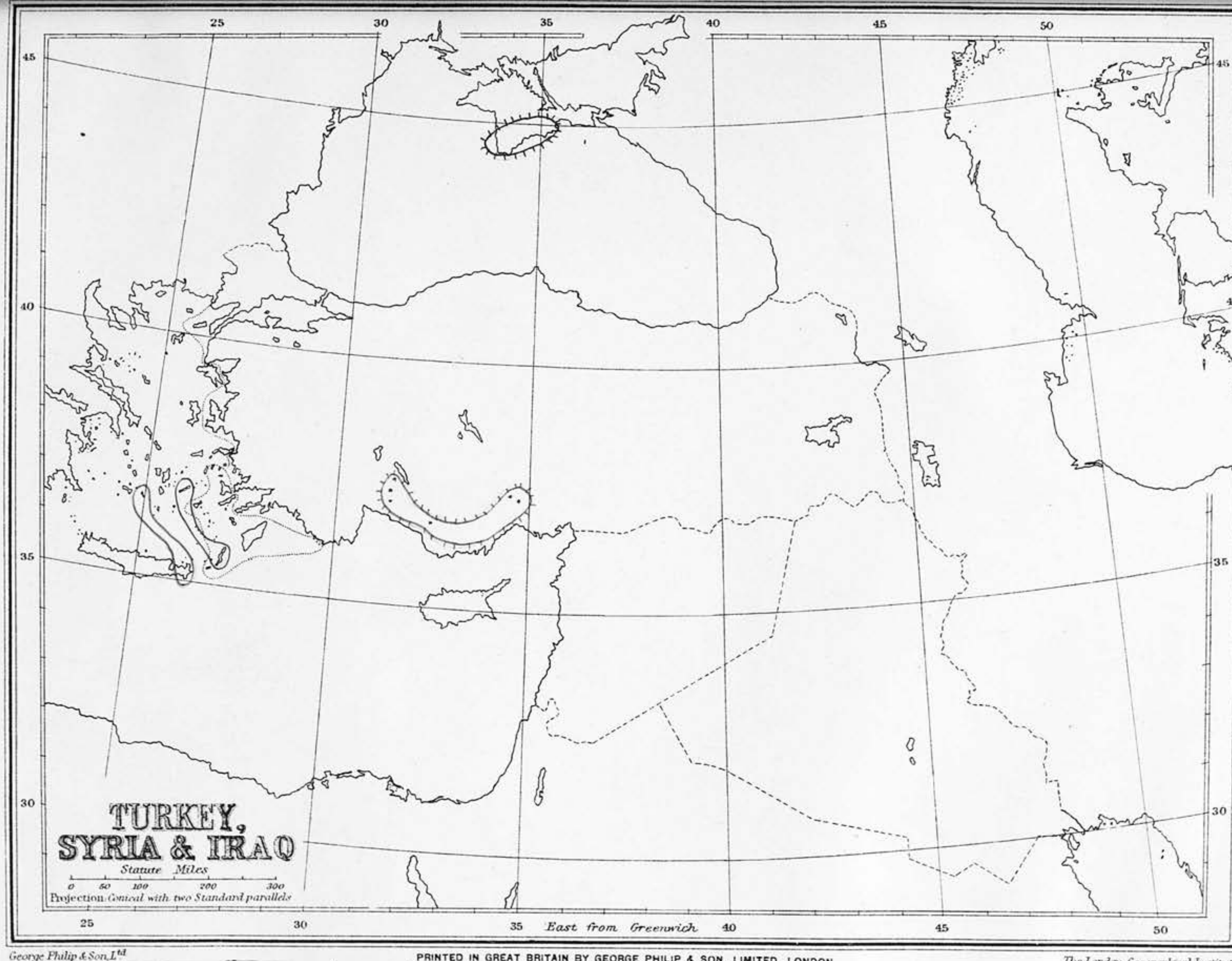

36°
22°
24°
26°
28°
30°
0
50
100
miles
▲ = subsp. oleoides
● = subsp. graeca
● = subsp. microphylla
● = subsp. Tauricola
(Only specimens examined have been mapped.)

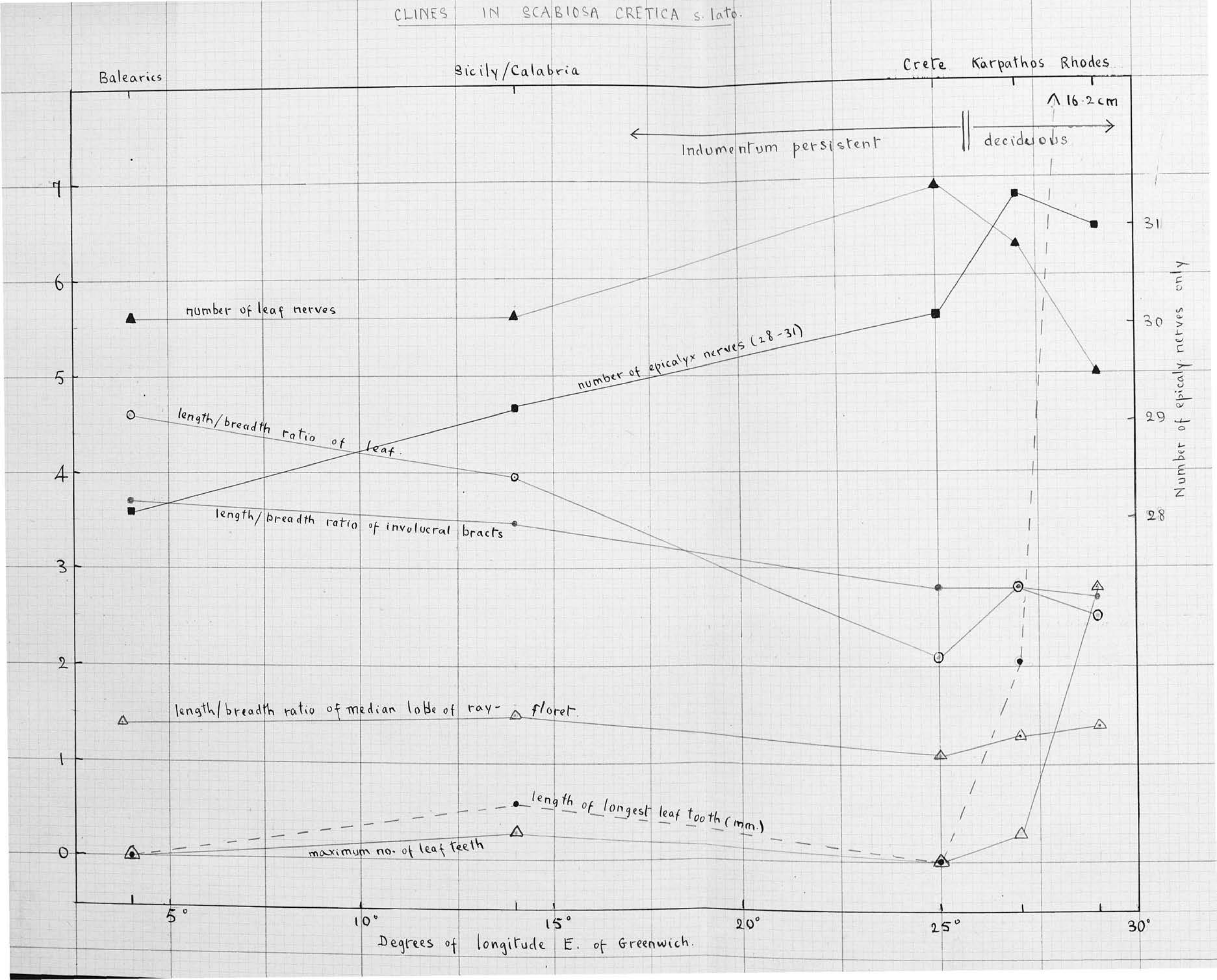
Fig. 3.



subsp. crithmifolium. ssp. aegaeum. ssp. corymbosum.

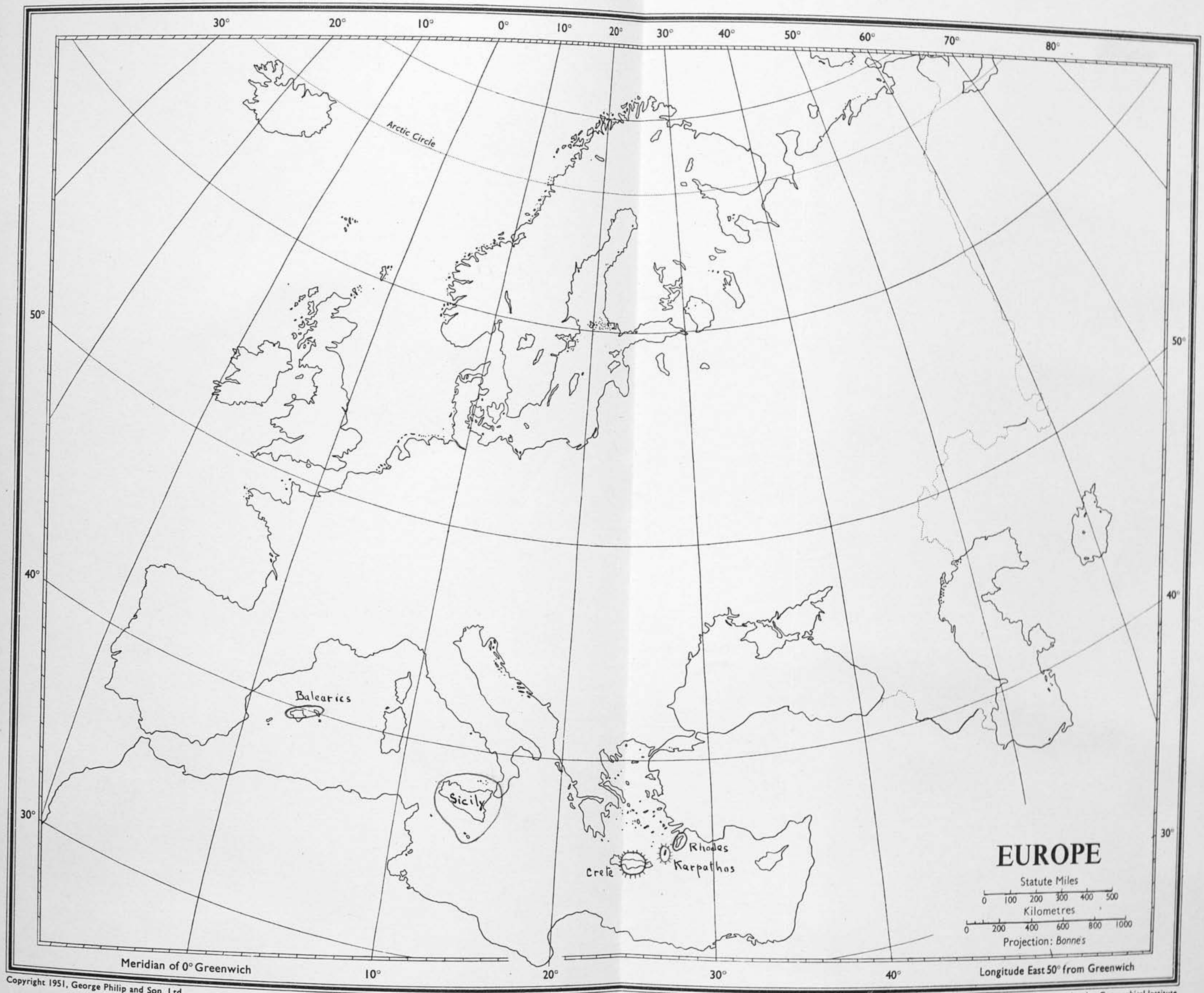
ssp. gummiferum.

Fig. 4.



CLINES IN SCABIOSA CRETICA s. lato.
Balearics
Sicily/Calabria
Crete
Karpathos
Rhodes
16·2 cm
Indumentum persistent
deciduous
number of leaf nerves
number of epicalyx nerves (28-31)
length/breadth ratio of leaf.
length/breadth ratio of involucral bracts
length/breadth ratio of median lobe of ray-floret
length of longest leaf tooth (mm.)
maximum no. of leaf teeth
Number of epicalyx nerves only
0
1
2
3
4
5
6
7
28
29
30
31
5°
10°
15°
20°
25°
30°
Degrees of longitude E. of Greenwich.

DISTRIBUTION OF SCABIOSA CRETICA s. lato.



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The London Geographical Institute. DEA

Subsp. occidentalis. Ssp. minoana. Ssp. carpatha. Ssp. variifolia.

VARIATION IN ALNUS SUBCORDATA C.A. MEYER.

CONTENTS.

I. INTRODUCTION.

As pointed out by Richens (1945, p. 28), little is known about infraspecific variation in the genus <u>Alnus</u> L. Through biometrical analysis of normal herbarium material, I have tried to portray some of the variation found throughout the range of the Alders generally distinguished as <u>A. subcordata</u> C.A. Meyer and <u>A. orientalis</u> Decaisne, the former from the South Caspian, the latter from the East-Mediterranean Levant.

Most of the Turkish material I collected in 1947 and 1949. It was Professor Otto Schwarz's suggestion (<u>in litt</u>.) that the Alder from S.W. Turkey might represent a new species intermediate between <u>A. subcordata</u> and <u>A.orientalis</u>, that lead me to collect Alders in the Taurus and to undertake this study. As will be apparent later, I have been unable to accept Professor Schwarz's opinion on the status of the Turkish Alder.

It should be at once stated that the specimens used were not specially collected for a biometrical study, and suffer from all the disadvantages usually associated with general herbarium material: sampling anything but random, fructifications often lacking, specimens representing different types of shoot, etc. With the specimens collected by other botanists, it has often been difficult to decide how many individuals are represented in a gathering, though the wide range in indumentum and dentation has often been helpful in this respect; further, localities are often inadequately cited, and ecological data extremely meagre. Despite these inadequacies, it is hoped that this study expresses moderately accurately the variation found in the material available.

II. DISTRIBUTION /

in the Pisidian Taurus (Bozburun Dağ), where the Alder is common.

Examination has shown that in gross morphology A. orientalis is little better distinguished from A. subcordata than the geographical races of A. orientalis are from one another. For the purpose of analysis, I have divided the range of the two species into four areas (cf. Map 1): Caspian (13), Turkey (20), Cyprus (14), Lebanon (8). The figures in brackets refer to the maximum number of trees examined from each area. The order in which these areas are arranged is that in which the majority of the characters analysed were found to trend. As will be shown later, there is reason to believe that this order reflects the history of the Alders under review. With the limited material available (55 trees), it has not generally been practicable to subdivide these areas into smaller units. The four groups here delimited may not be fully inbreeding communities, since the~~ir distribution~~ trees largely follow~~s~~ the course of streams, but at least it seems very likely that they are now isolated from one another. In Lycia (between Caria and Pamphylia in Turkey) I found no Alnus, but Spratt and Forbes (1847, 2, p. 141) records an Alder from the S. Lycian coast which is probably A. orientalis, so that in S. Turkey the range of the species may be considered fairly continuous.

III. CYTOLOGY.

In recent years the genus has been the subject of considerable cyto-genetical research. The results, however, have not infrequently been invalidated by misidentification. Gram and co-workers /

co-workers (1941) have shown that A. subcordata (var. subcordata) is an auto-tetraploid (2n = 56), and that triploid counts are probably due to examining garden hybrids between this plant and the diploid race of A. glutinosa (L.) Gaertn. or A. incana (L.) Willd. Authentic material of A. orientalis has unfortunately not been examined (a triploid count almost certainly refers to a garden hybrid), but Gram et al. believe it will prove to be, like all species of Alnus, diploid or tetraploid. In this connection it should be noted that the closely related A. cordata (Lois.) Desf. (from S. Italy and Corsica) is diploid (2n = 28).

Pollen of triploid Alni shows a very high percentage of abortive grains, but that of diploids and tetraploids is normal. Staining with aceto-carmine, I examined pollen of A. subcordata from Persia and of A. orientalis from Cyprus and Turkey, and found it to be completely normal.

Alnus species are known to be remarkably interfertile, but as no other Alder occurs within the territory of A. orientalis there seems no reason to suspect that we are dealing with hybrid swarms. The undoubted occurrence, however, of diploid and tetraploid races of A. glutinosa suggests that similar races may eventually be detected in other species, and hybrids between them may occur. A. glutinosa grows within the area of A. subcordata; one specimen (Sintenis No. 2123b, from Bender Ges near Asterabad) is suspected, on morphological grounds, of being a hybrid between these two species, and has therefore been excluded when calculating the variation means for A. subcordata.

IV. CURRENT CLASSIFICATION.

There have been two monographer's of the genus Alnus: Winkler /

Winkler (1904) and Callier (1906, 1912). Before proceeding with this study, it seems desirable to enumerate the infraspecific categories that have been recognised in A. subcordata and A. orientalis. These taxa are cited merely for reference. As will be apparent later, this classification is not upheld by the present author.

Alnus subcordata C.A. Meyer, Verz. Pfl. Cauc. 43 (1831).

a. var subcordata (var. typica Callier in Fedde, Repert. 10, 228: 1911, passim). Typus : Lenkoran, Meyer!

b. var. villosa (Regel) Winkler in Engler, Pflanzenr. Betulaceae, 113 (1904). Syntypi : Lenkoran, Meyer! Hohenacker!

c. var. cerasifolia Bornm. in Bull. Herb. Boiss. Ser. 2, 8, 560 (1908). Typus : N. Persia - Kudum near Rescht, Bornm. 8243!

Alnus orientalis Decaisne in Ann. Sc. Nat. Ser. 2, 4, 348 (1835).

a. var orientalis (var. longifolia Winkler in Engler, Pflanzenr. Betulaceae, 113: 1904, passim).

α. forma orientalis (forma typica Winkler in Engler, Pflanzenr. Betulaceae, 113: 1904 - passim). Typus : Lebanon - Beirut, Bové 496!

β. forma tomentosa Winkler in Engler, Pflanzenr. Betulaceae, 113 (1904). Syntypi : Cilicia - Cydnus, Bulgar Dagh, Kotschy 347; Giosna, 1000 m., 1895, Siehe 310!

b. var. Weissii Winkler in Engler, Pflanzenr. Betulaceae, 113 (1904).

γ. forma Weissii (forma Winkleri Callier in Fedde, Repert. 10, 227: 1911, passim). Typus : Cyprus, Kotschy 679! [Episcopi, etc.].

forma /

δ. forma puberula Callier in Fedde, Repert. 10, 228 (1911).
Typus : Cyprus, Kotschy 679, pp. ? .

c. var. ovalifolia Winkler in Engler, Pflanzenr. Betulaceae, 114 (1904). Typus : Cyprus, Kotschy 618! [Episcopi, etc.]

V. VARIATION.

The material has been examined for variation in the different characters annotated below.

1. Leaf-shape.

To define mean leaf-shapes I have used rectangular co-ordinates, following the tedious optical method (entailing the use of a photographic enlarger) described by Melville (1937, p. 673) for his critical studies of Elms. The width of the leaf is thereby expressed as a percentage of its length at intervals of 10% along the midrib.

As it has often been necessary to utilise rather fragmentary herbarium material, I have not been able to compare strictly comparable leaves as would have been possible with more abundant or specially collected specimens. However, proximal and distal leaves were avoided. In Alders different kinds of crown shoots are less clearly defined than in Elms; I have only been able to distinguish (purely arbitrarily) between short shoots, longer short-shoots, and long shoots, the increase in length being correlated with elongation of the internodes. Of these three kinds, only the first two have been extensively used in this study, as they are those most frequently represented in herbaria; both are lateral shoots and pass imperceptibly into one another — a feature in which Alders again differ /

differ from Elms. The long shoots are probably of varied origin: they may be normal vigorous shoots ending the principal crown branches, or they may be Lammas or even proleptic shoots.

A. <u>Regional Variation</u>.

To obtain the mean leaf-shape for each of the four areas, the average leaf-shape (ignoring dentation) was calculated for the same kind of shoot on each tree (using 1 - 15 leaves, according to available material, though usually 1 - 5); the mean of means was then obtained for each area, leaf outlines for short and longer short-shoots being treated independently. Single leaves were never used unless they were considered typical of the shoot.

The leaves being somewhat asymmetrical, the long and short sides of leaves were measured and compared separately; when there was no difference in the length of the two flanges of the lamina, the broader side was treated as the 'longer', because it was found that the long side is normally the broader. However, the asymmetry is so slight that it is doubtful if the result justifies the labour of taking a double series of measurements.

Mean leaf-shapes for the four areas (for short and longer short-shoots) are shown in Fig. 1; the mean length of the lamina is given below the leaf outline, and the range of length in parenthesis. Here, as in all other types of variation dealt with, the Caspian area is represented by two means: one for var. <u>subcordata</u> (incl. var. <u>villosa</u>) and one for var. <u>cerasifolia</u>. These varieties seem well distinguished from one another, and to average them would be to produce a mean that may not occur in nature.

Considering the leaves of the <u>short shoots</u> depicted in Fig. 1, /

Fig. 1, it will be seen that in both var. subcordata and var. cerasifolia, the blade is broadest about 45% from the base of the lamina (often a little lower in the latter variety); in var. cerasifolia there is a marked inflexion towards the tip.* The ovate outlines from Lebanon and Turkey are similar to one another, except that in the Lebanon the leaf is broadest at 40% from the base (the lowest in the series) instead of at 40 - 45% as in Turkey, and the apex is more acute. The Cyprus outline differs from that of Turkey and Lebanon in being elliptical — i.e. its broadest part is at 50%; its apex is less acute — a character clearly brought out by the Tables (see below). None of the outlines from the three Mediterranean areas show any noticeable inflexion towards the tip, though it is sometimes present in individual leaves.

The same mean outlines are shown superimposed in Fig. 2.

The three Mediterranean ones are so near to one another that, in view of the limited Lebanon material, it is doubtful how much weight should be given to the differences. It will be seen, however, that the most striking difference between the Mediterranean outlines lies in the apical angle and in the point at which the leaf is broadest.

A similar range of variation can be seen in the mean leaf outlines from the longer short-shoots (Fig. 1), though here less abundant /

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* To portray the inflexion accurately, it would be necessary to measure the width of the blade at 95% along the midrib. Similarly, the base of the leaf could be more accurately drawn if a reading could be taken at 5% along the midrib.

abundant material has resulted in a less satisfactory picture. The leaves are longer, but it should be noted that the outlines are also relatively broader than those of the short shoots, and, in addition to the more pronounced cordation in the Caspian outline (only var. subcordata is represented) there is a slight tendency towards these characters even in the Mediterranean series. This is associated with more pronounced asymmetry. Indeed, occasional Mediterranean trees are found which show, even on their shorter shoots, well-marked cordation – see the mean outline for a Cilician specimen (longer short-shoot) in Fig. 3.

The tendency towards cordation is usually most pronounced in leaves of long shoots (when these are available), as can be seen from Fig. 3, where a ~~the~~ Turkish ~~and Lebanon~~ individual ~~s~~ is ~~are~~ shown. Indeed, such outlines closely resemble those of longer short-shoots in the Caspian area of var. subcordata. Cordation is probably, as in Elms, a juvenile character.

The figures used to construct the mean leaf-shapes for short shoots are given in the accompanying two Tables of co-ordinates. The figures in brackets indicate the number of trees on which each mean is based. To express cordation, Column A gives the point of union of leaf margin and petiole. In Column A and O the co-ordinate of length is (by convention) written as the numerator, and the co-ordinator of breadth as the denominator. The Tables also give the mean leaf lengths.

The graph in Fig. 4 shows that there is generally a negative correlation between leaf width and length where the mean for each area (short shoots) is concerned; that is, the two clines /

TABLE 1. CO-ORDINATES OF LEAVES OF SHORT-SHOOTS.

Long side												
Co-ordinates of Length:	A	0.	10.	20.	30	40.	50.	60.	70.	80.	90.	Length of Lamina in cm.
CASPIAN:												
var. <u>subcordata</u> (6):	3.9/0	0/8.8	22.9	28.8	31.7	33.2	33.6	32.0	28.4	22.7	13.6	6.6
var. <u>cerasifolia</u> (3):	0.3/0	0/1.2	15.7	20.6	24.5	26.0	25.4	23.4	19.9	15.3	7.2	6.6
TURKEY (17):	0.2/0	0/0.8	17.9	24.8	28.0	29.3	29.1	27.8	24.2	19.0	11.1	5.7
CYPRUS (14):	0/0	0/0.2	16.6	23.4	27.3	29.2	29.6	28.1	25.3	20.6	13.1	5.0
LEBANON (7):	0.2/0	0/1.2	17.9	24.5	27.2	28.1	27.4	25.0	21.4	16.3	9.6	7.4
Short side												
CASPIAN:												
var. <u>subcordata</u>:	3.6/0	0.3/7.5	21.8	27.7	30.2	31.7	31.8	30.2	27.0	21.4	13.3	
var. <u>cerasifolia</u>:	0.7/0	0.7/0	14.9	21	23.8	25.1	25.1	23.3	19.9	14.9	7.6	
TURKEY:	1.0/0	0.9/0	15.3	23.4	26.7	28.6	28.3	28.6	23.4	18.3	11.4	
CYPRUS:	0/0	0/0.2	16.6	23.4	27.3	29.2	29.6	28.1	25.3	20.6	13.1	
LEBANON:	0.2/0	0/1.2	17.9	24.5	27.2	27.4	27.4	25.0	21.4	16.3	9.6	

TABLE 2. CO-ORDINATES OF LEAVES OF LONGER SHORT-SHOOTS.

Long side Co-ordinates of Length:	A	0.	10.	20.	30.	40.	50.	60.	70.	80.	90.	Length of Lamina in cm.
CASPIAN:												
var. subcordata (8):	4.1/0	0/7.8	22.8	28.2	31.3	32.4	31.7	29.7	26.0	18.4	10.5	9.2
TURKEY (17):	0.3/0	0/1.1	19.9	25.8	29.3	30.6	30.2	28.3	24.7	19.0	11.4	7.8
CYPRUS (4):	1.2/0	0/4.1	20.9	27.6	32.1	33.4	33.6	31.3	27.7	21.6	12.6	5.9
LEBANON (2):	0.2/0	0/2.0	17.3	24.4	27.7	28.9	27.7	25.3	21.2	15.8	8.6	8.5
Short side												
CASPIAN:												
var. subcordata:	4.2/0	2.6/7.1	20	26.4	29.8	31.3	31.3	29.7	25.7	20	11.5	
TURKEY:	0.9/0	0.8/0.4	17.9	25.0	28.3	29.8	29.5	27.4	24.1	19.3	11.7	
CYPRUS:	1.7/0	1.1/2.9	17.9	24.6	28.3	30.4	30.5	28.9	25.5	20.1	11.9	
LEBANON:	0.2/0	0/2.0	17.3	24.4	27.7	28.9	27.7	25.3	21.3	15.8	8.6	

cline trend in opposite directions, the leaves becoming relatively wider as they get shorter. An exception is found in A. subcordata var. subcordata — perhaps due to inadequate sampling. In the same figure, the range of variation in width is indicated by broken vertical lines. The scatter diagram constructed for the mean of individual trees (Fig. 5) shows, of course, a less close negative correlation. It is best shown in Cyprus and Turkish populations, but correlation is virtually absent in the other areas; again this may well be due to inadequate material from the Caspian and Lebanon. The diagrams should be compared with those showing the different relationship between leaf-length and vein-number discussed below.

B. Local Variation.

It now becomes necessary to consider the variation found within each of the four areas, and to relate it to the smaller taxonomic units that have been described.

a. Caspian.

Bornmüller has aptly named a variety of the Caspian Alder, A. subcordata var. cerasifolia Bornm.; this is distinguished from the typical form by its narrow generally acuminate leaves with rounded (or rarely slightly subcordate) base. The variety makes up 27% of the Caspian specimens, all from Persian localities, and seems a distinctive unit. Bornmüller describes it as growing with the typical form and var. villosa (Regel) Winkler, (merely an indumentum variant of the latter), but its distribution, cytology and ecology require investigation before its nature can be understood. At Lenkoran in Transcaucasia (locus classicus of A. subcordata), only var. subcordata s. str. and var. villosa (Regel) Winkler have been collected; a very large-leaved form was gathered by Sintenis (No. 1387a) /

(No. 1387a) at Bender Ges near Asterabad. Between these two localities, which lie at the extremes of A. subcordata's range, the three named varieties occur.

A series of Caspian leaf-shapes is given in Fig. 6; each outline being the average shape for the leaves of short shoots on individual trees; the outline on the left is that of var. *cerasifolia* from Ghilan; the rest are referable to var. *subcordata* (incl. var. *villosa*), of which that on the right is the large-leaved form from Bender Ges.

b. Turkey.

No endemic leaf-shape variants have been named from the Turkish area, the only endemic taxon being forma *tomentosa* Winkler which will be considered under the heading 'Indumentum'. Except in width, the Turkish trees do not show much variation in leaf-outline. The narrowest forms occur at the Eastern end of the Turkish range, but these cannot be referred to var. *Weissii* Winkler (described from Cyprus) because the leaves are ovate rather than elliptical; they differ from the Lebanon var. *orientalis* (var. *longifolia* Winkler), in being broader a little higher up the lamina - at 40 - 45% along the midrib.

There is sufficient material from Turkey to attempt a division of the region into three arbitrary subareas (Caria, Pamphylia-Pisidia, Cilicia) to show the range in leaf-width and leaf-length for short shoots. The result may be tabulated as follows:-

Area	Width (% of length)	Length	No. of trees examined
Caria	32.2%	5.3 cm.	7
Pamph.-Pisidia	24%	6.1 "	6
Cilicia	29.4%	5.6 "	4

The /

The Cilician outline is virtually the same width as that from Cyprus (29.6%), and is therefore the nearest mainland leaf-shape to the island race. The Carian outline is the nearest to the Caspian A. subcordata var. subcordata.

c. Cyprus.

Considering the small size of this area, the Cyprus trees show a surprisingly wide variation in leaf-shape. Two endemic varieties have been named: A. orientalis var. Weissii Winkler with narrowly elliptical leaves, and var. ovalifolia Winkler having leaves that are broadly elliptical and obtuse. These do not appear to be geographically separated, and they are certainly linked by a series of intermediate forms. If the endemic varieties are interpreted rather widely,* outlines corresponding to var. Weissii make up 43% of the Cyprus specimens, var. ovalifolia 36%, and intermediate forms the remaining 21%. This estimate, however, has regard only to the general outline of the leaf in the two varieties, not to serration or leaf size, both of which are very small in the type specimens. Out of 14 individuals examined, only 3 (21%) are typical var. Weissii, and 3 typical var. ovalifolia — considering size and serration as well as shape. It is possible that in Cyprus exceptionally small leaf-size is due to a relatively unfavourable environment; in the central massif, summer humidity and rainfall are probably lower than elsewhere in the range of A. orientalis.

In /

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* The width limits (mean of individual short shoots) of var. Weissii are taken here as 24-27% at 50% along the midrib (the widest point), and 9-12% at 90% up the midrib; similarly, var. ovalifolia is taken as 33-36% at 50%, and 14-20% at 90%.

In Fig. 6, mean outlines for particular Cyprus trees (short shoots) are arranged to show the range of variation, from the type of var. Weissii on the left, to the type of var. ovalifolia on the right.

d. Lebanon.

Except for slight differences in width, little leaf-variation is found in the Lebanon compared with other areas. All forms are referable to A. orientalis var. orientalis (var. longifolia Winkler).

The Lebanon Alder has the longest leaf in A. orientalis; indeed the mean leaf-length for short shoots is even longer than in A. subcordata, though it falls between the latter and the Turkish race of A. orientalis when longer short-shoots are compared.

The small range of variation probably reflects the preponderance of specimens collected at Beirut.

2. Dentation.

No attempt is made here to define leaf-dentation in exact terms; it shows considerable variation, even on a single branch. It can be said, however, that the very irregular, almost repandate toothing that is common in the Mediterranean races of A. orientalis has not been seen in A. subcordata. On the other hand, the more regular serration of the Caspian trees, both in its finer and coarser manifestations, has its counterpart in the Mediterranean. Although regular small serrations are characteristic of typical material of A. subcordata var. cerasifolia, A. orientalis var. Weissii and var. ovalifolia, they are by no means confined to those forms; though common in Turkey and Cyprus, this type of serration has not been seen /

seen in the Lebanon, where coarser often sub-repandate dentation is the rule.

3. Vein-number in Relation to Leaf-size.

As shown by the scatter diagram in Fig. 7, vein-number (counted on the long side of the leaf) generally shows a weak positive correlation with leaf-size. The geographical distribution of the two characters (mean of individuals) is shown by the use of different symbols for the separate areas. Only leaves from short shoots are included.

The lack of correlation shown between vein-number and leaf-length in the Caspian area may be due to inadequate material; on the other hand, it may be (as Dr. Melville has suggested to me) that the many-veined leaves are potentially large, but for environmental reasons have failed to develop fully.

It will be seen from the population graphs (Fig. 8 and 9) that mean vein-number and leaf-length decline from the Caspian, through Turkey to Cyprus, and rise again in the Lebanon. The Cyprus population, therefore, has a smaller mean leaf-length and vein-number than the mainland races. In the same figures the range of variation in length is shown by vertical broken lines.

It seems that both leaf-size and vein-number are partially correlated with rainfall and probably humidity. In general, the drier the conditions the smaller the leaf and the fewer the veins. This may well be a genetic character, since the Cyprus race of A. orientalis retains its small leaf under cultivation at Kew. It may be added that the small Cyprus race of Cedrus libani /

libani (subsp. brevifolia) behaves in the same way.

4. Stomatal Position.

Callier (1906) drew attention to the difference in the position of the stomata in the two species under review. He found that A. orientalis possessed stomata on both surfaces of the leaf, whereas in A. subcordata they were only present below. My study confirms this rather unexpected difference. Using the commercial preparation 'Newskin', I have taken epidermal prints of all herbarium material available. The Caspian trees are found to possess no stomata on the upper surface of the leaf, while the Mediterranean ones invariably do, though they may be very sparse. In material of A. orientalis cultivated at Kew (from Cyprus), and of cultivated material of A. subcordata var. subcordata (Jardin Vilmorin), the stomatal difference was found to hold; it can therefore be considered a genetic character.

5. Indumentum.

The indumentum of the young shoots and petioles shows considerable proportional variation in the different areas. I have recognised three degrees of increasing hair-cover (1 - 3) visually estimated by density; complete glabrity is indicated by 'O'. The percentage (correct to the nearest whole number) of each of these four kinds per area is given in the following Table, together with the /

the number of trees examined.

AREA	AMOUNT OF INDUMENTUM 0	1	2	3	NUMBER OF TREES EXAMINED
CASPIAN					
var. cerasifolia	-	25%	75%	-	4
var. subcordata	-	37%	62%	-	8
TURKEY	15%	40%	5%	40%	20
CYPRUS	64%	21%	14%	-	14
LEBANON	75%	12%	12%	-	8

The differences appear significant, particularly as indumentum plays an important part in the classification of Alders. Maximum variation is shown in the Turkish area; it is only there that the densest hair-covering (3) occurs — a form that has been recognised as var. <u>tomentosa</u> (Hartig) Winkler. The Cyprus and Lebanon races resemble each other in indumentum characters, over 60% of the trees being completely glabrous. In the Caspian, glabrous forms are absent. These indumentum forms do not appear to occupy particular districts within each area, but to be scattered throughout it. In Turkey, for example, I have collected glabrous and densely hairy trees side by side. The occurrence of the densest type of indumentum only in Turkey, where it is widespread throughout the range, suggests that local Turkish populations are not reproductively isolated from one another. In Turkey the tomentose form (3) has presumably arisen since the isolation of the Anatolian race, and has become diffused throughout it.

Within /

Within the geographical areas, indumentum variation is not correlated with variation in leaf shape.

The graph in Fig.11 shows the mean amount of indumentum for each area, using the same 4-part scale of values. The Turkish and Caspian races are very similar, and so is the Cyprus race similar to that from the Lebanon. It must be pointed out, however, that the mean for Turkey is not a very natural one because the gap between indumentum '1' and '3' is filled by only a single specimen. However, this may be due to biased sampling: I probably tended to collect the extremes of indumentum variation in any one locality.

6. <u>Fruiting Catkins</u>.

The average shape of the ripe fruiting catkins was found to vary very considerably between one area and another. Due to the reflexion of the lower scales, the open catkin is in fruit a little longer than it is when closed. Specimens, however, were too few to allow comparison only of 'cones' in the same state of development; but, as the elongation of the opening fruiting catkin is partly compensated for by the spreading of the intermediate scales, failure to separate the 'cones' by stages of development may not have greatly affected the accuracy of the means.

To show the range of variation in the 'cone'-shape for each area, the maximum and minimum length/breadth ratios (each being the mean for one tree) are tabulated below, together with the means. The number of trees examined in each area is given in the right hand columns, below the state of the 'cones' measured.

AREA	LENGTH/BREADTH RATIOS			STATE OF CONE		
	Max.	Mean	Min.	Shut	½ Open	Open
CASPIAN						
var. <u>cerasifolia</u>	1.81	1.67	1.59	0	1	2
var. <u>subcordata</u>	1.71	1.70	1.70	0	1	1
TURKEY	1.95	1.54	1.40	8	4	3
CYPRUS	1.63	1.51	1.12	3	2	4
LEBANON	1.38	1.25	1.17	4	1	1

The means are plotted graphically in Fig. 10 which brings out clearly the cline in length/breadth ratio. Vertical broken lines indicate the range of variation – a range which would certainly be increased if more material was available from the Lebanon and Caspian. The material we have, however, shows no overlap between the Lebanon 'cones' and those from Turkey and the Caspian. It therefore seems surprising that taxonomists have paid so little attention to 'cone' shape in their efforts to separate <u>A. orientalis</u> from <u>A. subcordata</u>. Although there is much variation in the length of 'cone' on an individual tree, there is very much less in the length/breadth ratio.

The colour of the ripe fruiting catkins shows geographical variation. In the Lebanon and Caspian areas the cones are black, in Turkey black or sometimes dark brown, and in Cyprus predominantly brown.

7. <u>Fruit</u>.

Winkler (1904) claimed that <u>A. orientalis</u> could be distinguished from <u>A. subcordata</u> by its fruit lacking a wing. The following /

following Table will show that this view is not tenable. As when estimating the degree of hairiness, arbitrary values have been given to indicate increasing width of wing, '0' indicating absence of wing, and '3' its maximum development.

AREA	AMOUNT OF WINGING ON FRUIT				NUMBER OF TREES EXAMINED
	0	1	2	3	
CASPIAN					
var. cerasifolia	0	100%	0	0	1
var. subcordata	0	0	0	100%	2
TURKEY	12%	44%	44%	-	16
CYPRUS	-	100%	-	-	8
LEBANON	67%	17%	17%	-	6

The width of the wing is more or less constant for each tree. It will be seen that in the Lebanon the majority are wingless. The most broadly winged type is confined to the Caspian area, but it is known (in the specimens available) only from Lenkoran in Transcaucasia, where only A. subcordata var. subcordata (incl. var. villosa) occurs. A cultivated specimen from Jardin Vilmorin, however, which matches the type of A. subcordata fairly well and has normal pollen grains, has nearly wingless seeds. The very narrowly winged Caspian seeds that I have seen belong to var. cerasifolia. More fruiting material is required from this area. The Cyprus population, in contrast with the wide variation in the form of its leaves, is very uniform in the shape of its fruits, all /

all being extremely narrow-winged. Turkey shows a predominance of winged (1 and 2) seeds.

The graph in Fig. 11 shows the trend in winging of the fruit. It more or less parallels the cline in length/breadth ratio of the fructification (Fig. 10).

VI. DISCUSSION.

1. Taxonomy.

Firstly, let us consider whether specific status should be accorded to the two Alders that are the subject of this paper. Winkler (1904) and Callier (1906) both treated A. orientalis as specifically distinct from A. subcordata. Winkler in his key separated the former by its wingless seeds; Callier distinguished it by its glabrous twigs and the possession of stomata on the upper leaf-surface.

I have confirmed the stomatal difference. With regard to the winging of the fruits, I have shown how this varies in the geographical races studied, so that Caspian and Mediterranean trees cannot be clearly separated on this character. The same applies to presence or absence of indumentum. A hairy form of A. orientalis occurs in its locus classicus (Beirut). This variant was presumably unknown to Callier. Must we assume, too, that he was ignorant of the tomentose Turkish form of the species, described by Winkler in 1904 as forma tomentosa ? At any rate, Callier omits all reference to an Alder in South Turkey (though A. orientalis is recorded from Cilicia by Boissier, 1879, 4, 1179), confining A. orientalis to Lebanon and Cyprus. In 1911, however, he divided the /

the Cyprus var. *Weissii* into forma *Weissii* (as forma *puberula*) and forma *Winkleri* (glabrous), thereby recognising the existence of a hairy form within *A. orientalis*; but he never admitted the Turkish Alder into the fold.

The existence in N. Persia of *A. subcordata* var. *cerasifolia* Bornm. makes it very difficult to separate the Caspian and Mediterranean Alders as distinct species. The rounded or truncate base to var. *cerasifolia*'s narrow leaves makes it so closely resemble forms of *A. orientalis* that one might include it in that taxon if leaf-shape was the only criterion. But in amount of indumentum, leaf-length, and shape of fruiting catkin, *A. subcordata* var. *cerasifolia* is closer to var. *subcordata* than to *A. orientalis*. Furthermore, the geographical distribution and stomatal character give one very strong reasons for associating var. *cerasifolia* with *A. subcordata*.

The occasional occurrence of subcordate leaves on longer short-shoots in Mediterranean trees (Fig.20, right), is another case of overlap between *A. subcordata* (var. *subcordata*) and *A. orientalis*. Indeed, except for the stomatal character, there is no *absolute* morphological difference between the two species. *Individuals* in the Caspian area may resemble in certain characters individuals in the Mediterranean races, and *vice versa*. Apart from the stomatal difference, it is only as *populations* that *A. orientalis* can be distinguished from *A. subcordata*. Enough specimens, however, can be assigned, on gross morphological grounds, to the Caspian or to the Mediterranean Alders to make it practicable to treat *A. orientalis* as a subspecies of *A. subcordata*. There is always the stomatal difference to fall back on in cases of doubt. This, then, is /

is the classification I adopt (see Sect. VII of this study).

Having decided to assign subspecific rank to A. orientalis, we must now consider what treatment should be accorded to the variation within these two taxa. Winkler (1904) infected the genus Alnus with a rash of infraspecific names; Callier (1911) spread the infection further. Most of these names were applied to unit characters that are found in certain individuals but which do not represent populations.

There are at least three ways in which the lesser variations could be dealt with.

a) By naming geographical races. It has been shown that the three races of A. orientalis differ from one another considerably when they are treated as groups. Yet in each area every character shows a range of overlap with that found in another area, so that there would be a considerable number of individuals that could not be assigned to a particular geographical race if their provenance was unknown. Stomatal position would be of no help. To give taxonomic names to these races would serve no useful purpose.

b) By naming the more striking individual variants, as was done by Winkler. To be logical, we should have to describe still more units, for Winkler's are quite inadequate. It would be inaccurate, for instance, to assign a Turkish tree to var. orientalis s. str. (var. longifolia), an epithet first assigned to a Lebanon Alder which may differ from Turkish trees in several characters, although the leaf-shape may be very similar. Every region would need a plethora of names to describe the variation within it. One recoils at the thought /

thought of the possible character-combinations that would, by this method, require names. Such a type of classification – fortunately becoming rare in modern taxonomy – is to be deplored.

c) By recognising no taxonomic units below subsp. subcordata and subsp. orientalis. This is the view adopted here with regard to subsp. orientalis. If it is required to distinguish between the Lebanon, Cyprus and Turkish races, they can be referred to as such without inventing Latin epithets for the purpose. In the case of subsp. subcordata, however, there are two forms which seem so distinct from one another, despite the fact that they grow in the same area, that there is every justification for recognising them as different taxa – var. subcordata and var. cerasifolia. Until their nature is understood, varietal rank seems the most suitable status to assign to them.

2. Questions of Origin.

There can be no doubt that the histories of the two subspecies of Alnus subcordata are so closely interwoven that one must have arisen from the other, or the two must have had a common ancestor. This analysis has brought out the fact that the Turkish Alder, in the majority of characters, is intermediate between the Caspian Alders on the one hand and the race from Cyprus on the other.

It seems improbable, remembering that the flora of the Lebanon and Cyprus is predominantly an extension and modification of the Mediterranean flora of Anatolia, that A. subcordata s. lato arose in either Cyprus or Lebanon. It is more likely, either that the stock penetrated westwards from the Caspian area to Anatolia (and thence to Cyprus and Lebanon), or that Anatolia is the centre (though /

(though perhaps a secondary one) whence the Alders spread both to the Caspian and to the Lebanon and Cyprus. Either possibility would be consistent with the morphologically intermediate nature of the Turkish Alder. In this regard, it is worth recalling that the mean leaf-shape and leaf-length of the Cyprus race is nearer to the Cilician population than to trees further West in Turkey. This is not surprising, since the last land-connexion between Cyprus and the mainland was probably with this region of Turkey in late Pliocene, or early Pleistocene times. The variation pattern specific for the Caspian, Turkey, Cyprus and Lebanon races must have developed as a result of geographical isolation, though it may well be superimposed on clines that were more pronounced when the range of the species was more continuous.

The cytology of subsp. orientalis may help us to solve the history of the group. If it is found to be diploid, we may infer (with reservations) that the tetraploid subsp. subcordata has been derived from it. The Italian and Corsican A. cordata (diploid), bears its cones singly instead of 2 or 3 together (as in the less reduced A. subcordata), and does not suggest an immediate ancestor for the latter species. However, it seems very probable that both species were derived from a more generalised diploid Tertiary ancestor — an opinion which palaeontological evidence would seem to support.

There is considerable fossil evidence to show that this group of Alders was widely distributed in the Northern hemisphere in Upper Tertiary times. There can be no doubt of A. subcordata's antiquity. Stefanoff and Jordanoff (1935) found abundant remains of /

of this species in the Pliocene deposits of Bulgaria. The identification is based on leaf, catkin and fruit impressions. They consider the Tertiary fossils, A. Kaefersteinii Goepp. pro parte and A. stenophylla Sap. et Mar. to be synonymous with the modern A. subcordata. As all the Bulgarian leaves are more or less cordate at the base, they would seem to belong to subsp. subcordata (var. subcordata ?) rather than to subsp. orientalis. On the other hand, the fossil Alder of this group found in the Pliocene of West Europe is, according to the same authors, virtually the modern A. cordata, which at that time probably grew under warmer conditions than the Bulgarian Alder. In the Pliocene of the South of France, A. cordata was associated with Liquidamber and Platanus — a community very reminiscent of that found in S.W. Turkey (Köyceğiz) today.

It is claimed by Stefanoff and Jordanoff that the Pliocene climate of Bulgaria was similar to that of present-day Atlantic North America and Eastern Asia, and also resembled the modern S.W. shores of the Caspian and the S.E. shores of the Black Sea. It is therefore not surprising that we find A. subcordata (associated with the relict Pterocarya fraxinifolia) surviving by the Caspian today, and showing greater morphological diversity there than anywhere else in its range. Furthermore, two species related to A. subcordata are natives of those other regions said by Stefanoff and Jordanoff to have a climate like that of Pliocene Bulgaria: A. japonica Sieb. et Zucc. (tetraploid) and A. maritima (Marsh.) Nutt., from Japan and the seaboard of Eastern North America respectively. Such a relict distribution, even in the absence of fossil evidence, would lead one to expect a wide distribution for the group in the Northern /

Northern hemisphere of Tertiary times.

At the present day, neither subsp. subcordata nor subsp. orientalis is ever found far from the sea. Away from it, humidity is presumably too low for the species' survival. Under existing conditions, any direct overland connexion between the Mediterranean and Caspian Alders, by way of the arid mountainous regions of Eastern Turkey or West Persia, would be impossible. During the Pluvials of the Pleistocene, conditions in the Near East must have been considerably wetter and cloudier than they are today. Yet even then I very much doubt if there could have been a suitable overland migration route between the Caspian and South Turkey. Little of Kurdistan lies below 5000 ft., which is considerably higher than the species can tolerate today, even in the wet climate of N. Persia. In Pluvial times the intervening area must have been even less favourable than it is at present, because of depression of the snowline.

If we exclude the possibility of a direct hinterland connexion between the two subspecies, there are two ways in which their present distribution might be explained.

We might claim that, since the Alders are nowhere found far from the sea today, that the Caspian and Mediterranean populations were once linked by a shore line that enabled them to extend from one area to the other. The Miocene appears to have been the last period in which the 'Caspian' and 'Mediterranean' were so linked (Map 2). At that time, according to Matthew (cf. Babcock, 1947, p. 91) the southern arm of the shrinking Tethys stretched from N. Persia westwards across Syria and Cyprus; the S. Caspian and Anatolian /

Anatolian areas both lay between the southern and northern arms of the Tethys. At the same time, Italy was a peninsula of Asia, being joined to Anatolia through the Balkans. There would thus have been an opportunity for A. subcordata and A. cordata (or their progenitors) to extend, by way of the Tethys shore lines, across areas where these Alders are no longer found. Since that time, A. subcordata would have died out between the Caspian and Turkish areas, due to uplift and desiccation, thus allowing the two populations to diverge morphologically.*

Though Miocene migration would help to explain the modern distribution of the Turkish and Caspian Alders, we cannot date the Cyprus and Lebanon populations from the Miocene; at that time those two regions apparently lay beneath the Tethys. If the Turkish Alder does date from the Miocene, then the Lebanon and Cyprus races must have resulted from a later migration from Southern Turkey.

On the other hand, it may not be necessary to go back as far as the Miocene for the origin of subsp. orientalis. During late Pliocene or early Pleistocene times, heavier rainfall and humidity (correlated with the spread of European Ice sheets) was no /

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* In connexion with the possible Miocene origin of the A. subcordata, I should like to record that Dr. J.B. Simpson (in verbis) has identified pollen in the Miocene deposits of Mull (West Scotland) that is almost indistinguishable from A. cordata and its close allies. At that time the locality (according to Dr. Simpson) had a climate like that of North Portugal at the present day.

no doubt accentuated by the greater extent of the Black, Caspian and Aral Seas, all of which were united (the first two north of the Caucasus) to form the extensive Hyrcanian Sea (Map 2). Conditions would then have been ideal for the union of the coastal Caspian and Bulgarian populations of A. subcordata. With the foundering of the Aegean land-mass during the Pleistocene, migration from the Black Sea or N. Balkans into Western Anatolia, and thence to the Taurus, would not have been difficult, thanks to a maritime climate. The fact that the broadest leaves in South Turkey come from Caria (the species' most westerly extension) gives some support for this suggested migration route, since the Carian outline is morphologically the closest to var. subcordata. Such migration, however, must have occurred not later than early Pleistocene times to explain easily the presence of the species on Cyprus since the island had no land connexion with the mainland after that time. Suess has considered the separation of Cyprus and Crete from the mainland to have taken place in late Pliocene times (i.e. before the final foundering of the Aegean land-mass), but the map of Matthew's shows Cyprus still united with the mainland in the early Pleistocene. Certainly the number and nature of the plants endemic to Cyprus suggest a later separation of the island from the mainland than the same type of 'evidence' suggests for Crete.

An objection to this theory of a Plio-Pleistocene origin for subsp. orientalis, is that we have no authentic modern records of Alnus subcordata from North or North-West Anatolia, where conditions look suitable for its survival - indeed, A. glutinosa (its associate by the Caspian) occurs abundantly in North Anatolia, and /

and locally in the West, where I have collected it on Lydian Boz Dağ (Tmolus). It may well be that A. subcordata (probably subsp. subcordata) will be discovered on the southern shores of the Black Sea, large stretches of which have not been botanised. Indeed, the North Anatolian record cited by Boissier (1879, 4, 1179) for 'A. cordata', makes it very likely that A. subcordata does occur in that region.

In short, the Turkish population may either be a relict of the Miocene shore line, or it may be derived from an early Pleistocene migration from the regions adjacent to the S.W. part of the Hyrcanian Sea, by way of Western Anatolia.

VII. DESCRIPTION AND ENUMERATION OF GATHERINGS EXAMINED.

An enumeration is given below of all the specimens examined, together with descriptions of the taxa I recognise and the major geographical races. In the descriptions, the range of variation is given (mean of individual), the median figure being the mean calculated from the available material of each taxon ~~of~~ or race. The means should be taken as relative rather than absolute.

Alnus subcordata C.A. Meyer, Verz. Pfl. Cauc. 43 (1831).

1. Subsp. subcordata. Stomata only present on the lower leaf-surface.

a. Var. subcordata. - Syn. var. typica Callier in Fedde, Repert. 10, 228 (1911), passim; var. villosa (Regel) Winkler in Engler, Pflanzenr. Betulaceae, 113 (1904).

Young /

Young shoots always slightly or moderately hairy. Leaves of short-shoots broadly elliptical-ovate, ± cordate at base, acute or very slightly acuminate, 4,1 - 6,6 - 8,8 cm. long, widest at about 45% up the midrib, width 29 - 33.6 - 36% of length; dentation regular, finely or coarsely serrate; number of veins 7,0 - 7,9 - 8,7 on long side. Ripe fruiting catkin black, length 1.7 times breadth. Fruit broadly winged.

U.S.S.R. (Transcaucasia): Lenkoran, Meyer (typus), Steven, Hohenacker, Pastuchow 415 & 666.

N. IRAN. Ghilan, Aucher-Eloy 327. Bender Ges (Prov. Asterabad), Sintenis 1387a. Rescht, Bornmüller 8241.

b. var. cerasifolia Bornm. in Bull. Herb. Boiss. Ser. 2, 8, 560 (1908).

Young shoots always slightly or moderately hairy. Leaves of short-shoots ovate, rounded or truncate (rarely subcordate) at base, shortly acuminate, 6.1 - 6.6 - 6.9 cm. long, broadest 40 - 45% up the midrib, width 23.7 - 26.0 - 28.5 % of length; dentation regular, finely serrate; number of veins 7.7 - 8.4 - 9.7 on long side. Fruitings ripe catkin black, length 1.59 - 1.67 - 1.81 times breadth. Fruit very narrowly winged.

N. IRAN. Between Guilan and Yehlan, Lindsay 1053. Caspian littoral, between Mazanderan and Bourke, Borrowes 23. Kudam near Rescht, Bornm. 8243 (typus).

2. Subsp. orientalis (Decaisne) P.H. Davis, comb. et stat. nov. - Syn. A. orientalis Decaisne in Ann. Sc. Nat. Ser. 2, 4, 348 (1835), et omnes varietates.

Stomata present on both leaf-surfaces, though more numerous below.

c. /

c. <u>Turkish Race</u>:

Young shoots generally slightly hairy or very hairy, but quite often glabrous. Leaves of short-shoots ovate, rounded at base, acute, 3.7 - 5.7 - 7.6 cm. long, broadest at 40 - 45% up midrib, width 24 - 28.7 - 37.7 % of length; dentation regularly serrate, or irregular coarse and subrepandate; number of veins 5.7 - 7.6 - 8.0 on long side. Ripe fruiting catkin black or sometimes dark brown, length 1.4 - 1.54 - 1.95 times breadth. Fruit generally winged, though less broadly so than in var. <u>sub-cordata</u>, rarely wingless.

TURKEY. Prov. Muğla, distr. Köyceğiz (Caria): Sandras Dağ at Ağla, 600 m., Davis 13588; Köyceğiz in <u>Liquidamber</u> forest, Davis 13575; between Dalaman and Köyceğiz, Davis 13569. Prov. Denizli, distr. Acipayam (Caria): Husniye, 6 hours walking S. of Abbas, Davis 13387 (collected by Turkish forester). Prov. Antalya; 5 km. W. of Antalya, Tengwall 70; banks of Boğa Cay between Antalya and Çakirlar, near sea level, Davis 15423; distr. Gebiz (Pisidia), on Bozburun Dağ by Sinni Çay (Nenni Çay) between Gebiz and Pinargazu Yaylâ, abundant on metamorphic and limestone soils by streams, Davis 15483; distr. Alanya (Pamphylia/Isauria), between Kizil Kaya Dibi and Kizil Alan (N.E. of Alanya), 700 m., Davis 14453, and by Kargi Çay at its confluence with Kozlu Dere (N.E. of Alanya), 840 m., Davis 14465. Prov. Mersin, distr. Anamur (Cilicia Trachea): between Kukur and Saridana, 700 m., Davis 16323 and 16326; distr. Silifke, by Goksü near Silifke, Kasapligil 11; Cilicia, in Guzel Dere, Balansa, and at Giosna, 1000 m. Siehe 310.

d. <u>Cyprus Race</u>:

Young /

Young shoots glabrous or hairy. Leaves of short-shoots elliptical, rounded at base, generally blunter than in Turkish or Lebanon races, 2.8 - 5.0 - 7.9 cm. long, broadest in middle, width 24 - 29.6 - 36.2% of length; dentation as in Turkish race, though regular small serrations (especially in small-leaved forms) are more common; number of veins 5.7 - 6.4 - 8.0 on long side. Ripe fruiting catkin generally brown, length 1.12 - 1.51 - 1.63 times width. Fruit always very narrowly winged.

CYPRUS. Mesopotamos (near Platres), 900 m., Kennedy 290. Evretou, Syngrassides 1716, E. Chapman 312. Kryos Potamos (near Platres) 1100 m., Kennedy 289, 288. Kakopetria, 900 m., Syngrassides 1083. Saita, Syngrassides 340. Platres, Kennedy 291. Prodromos, Lindberg. Galata, Sintenis & Rigo 685. Episcopi, etc. Kotschy 679, 681 (in Herb. Mus. Brit.). Troödos, Post. Xerofarkas gorge, Norman 425.

e. Lebanon Race:

Young shoots generally glabrous, but quite often hairy. Leaves of short-shoots ovate, rounded at base, generally more acute than in Turkish and Cyprus races, 5.7 - 7.4 - 8.6 cm. long, broadest at only 40% up the midrib, width 25 - 28.1 - 30% of length; dentation irregular, coarse and subrepandate; number of veins 7 - 7.5 - 8.5 on long side. Ripe fruiting catkin black, length 1.17 - 1.25 - 1.38 times breadth. Fruit most often wingless, but not uncommonly narrowly winged.

LEBANON. Beirut, Kotschy 372, Bové 496 (typus), Blanche, Boissier, Post. Sidon, Gaillardot 211. Bekfaya, 1000 m., Bornm. 1451.

VIII./

VIII. SUMMARY.

A critical account is given of the Alders generally recognised as A. subcordata and A. orientalis. Their distribution, ecology and cytology are outlined. Using biometrical methods, several characters are analysed for variation in each of the four isolated areas in which the Alders occur. The majority of these characters show an irregular cline from the Caspian, through Turkey, to Cyprus and Lebanon.

In the light of this analysis, the taxonomic position is discussed. It is concluded that A. orientalis must be considered a subspecies of A. subcordata. No varieties are recognised except for subsp. subcordata var. cerasifolia.

The origin of A. subcordata is discussed in relation to present and past distribution. It is concluded that the species may have had its origin in the Miocene, the Turkish and Caspian populations being relicts of the Miocene shoreline. On the other hand, it may be that the Turkish population has been derived by early Pleistocene migration from regions adjacent to the S.W. part of the Hyrcanian Sea of that time, by way of Western Anatolia. The Cyprus and Lebanon populations have probably been derived from South Turkey.

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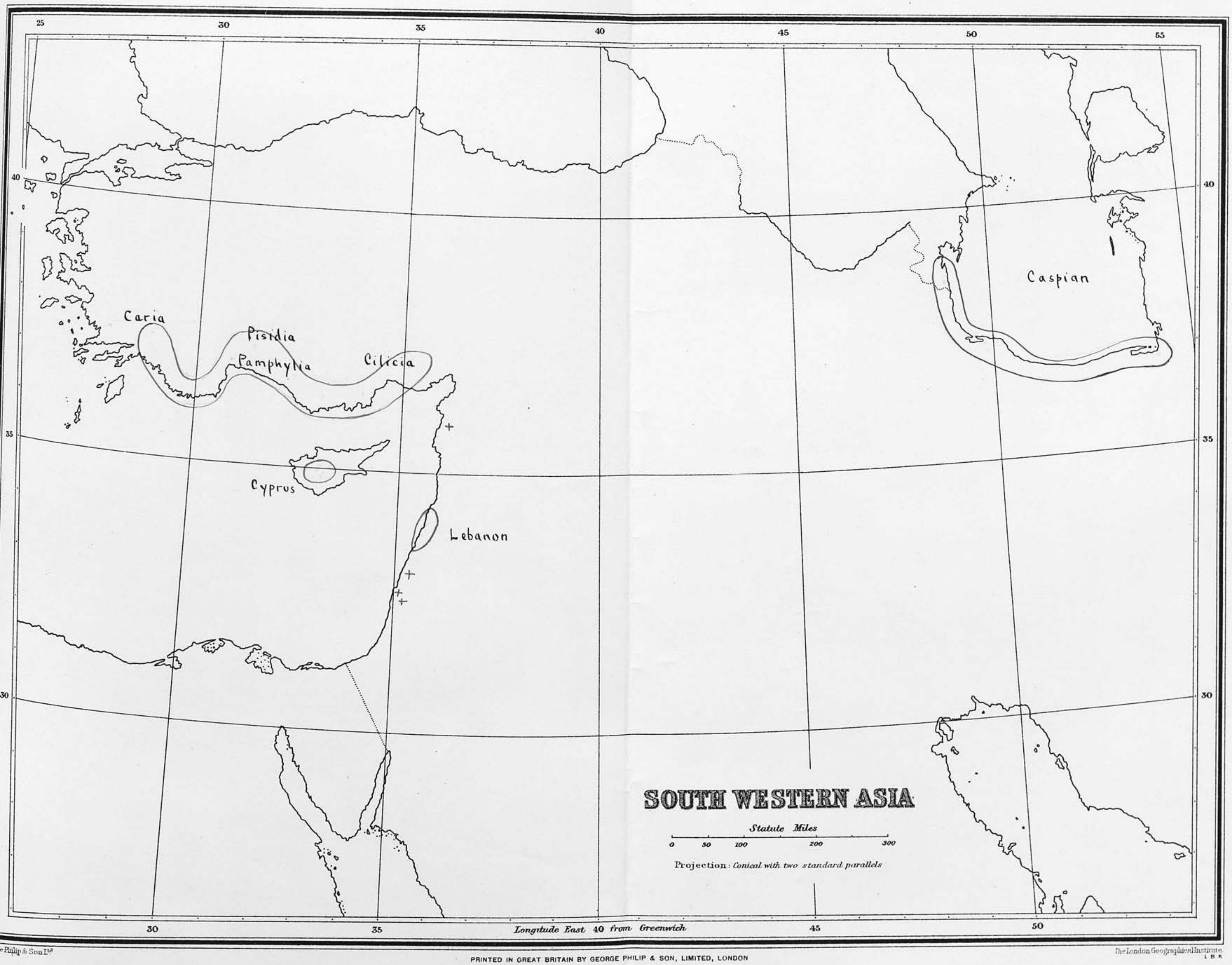
ILLUSTRATIONS

MAP I.

DISTRIBUTION OF

ALNUS SUBCORDATA.

ALNUS SUBCORDATA s. lato.

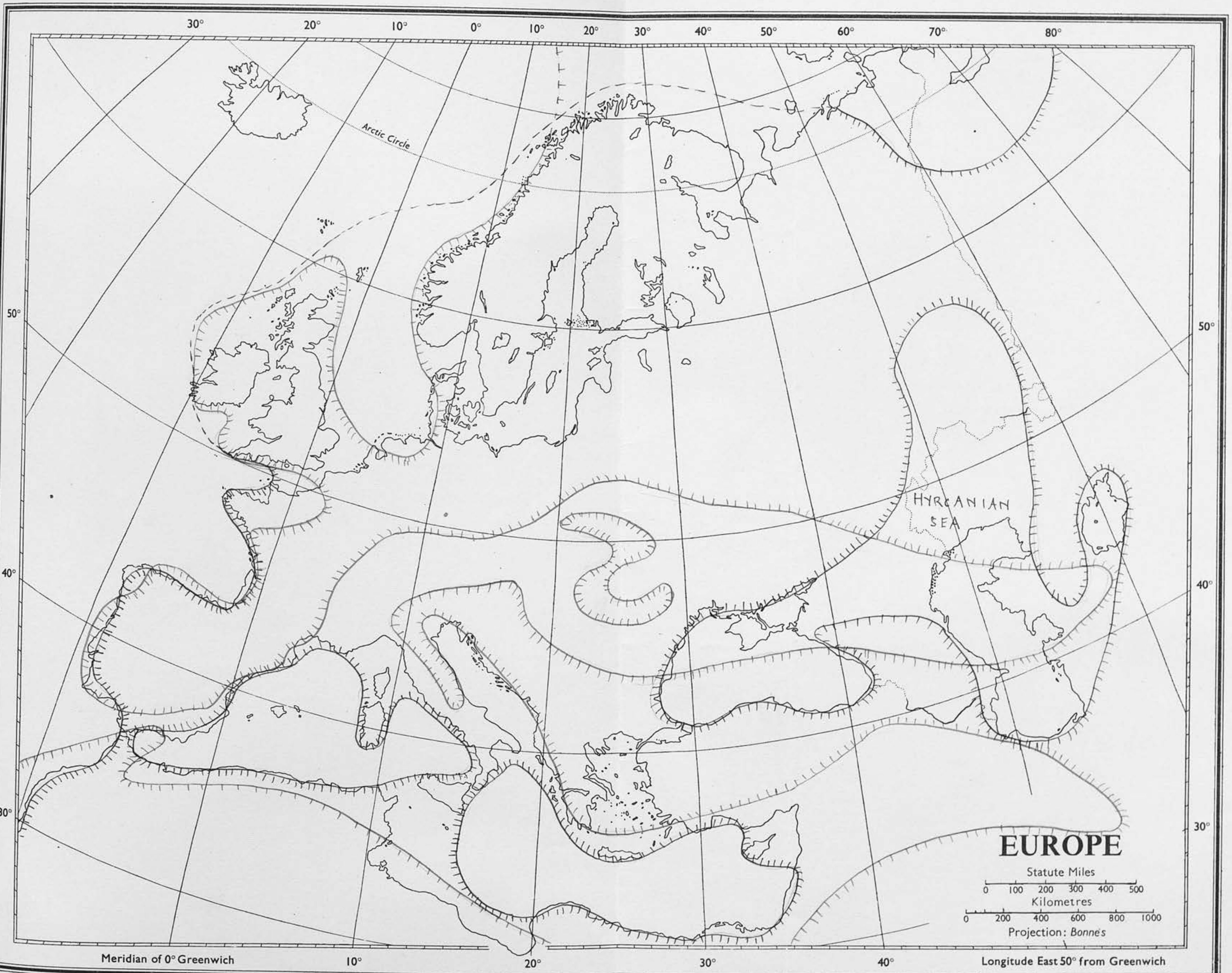


——— = subsp. subcordata.

——— = subsp. orientalis (+ = specimens not examined.)

MAP 2.

HYPOTHETICAL CONTINENTAL OUTLINES - AFTER MATTHEW.

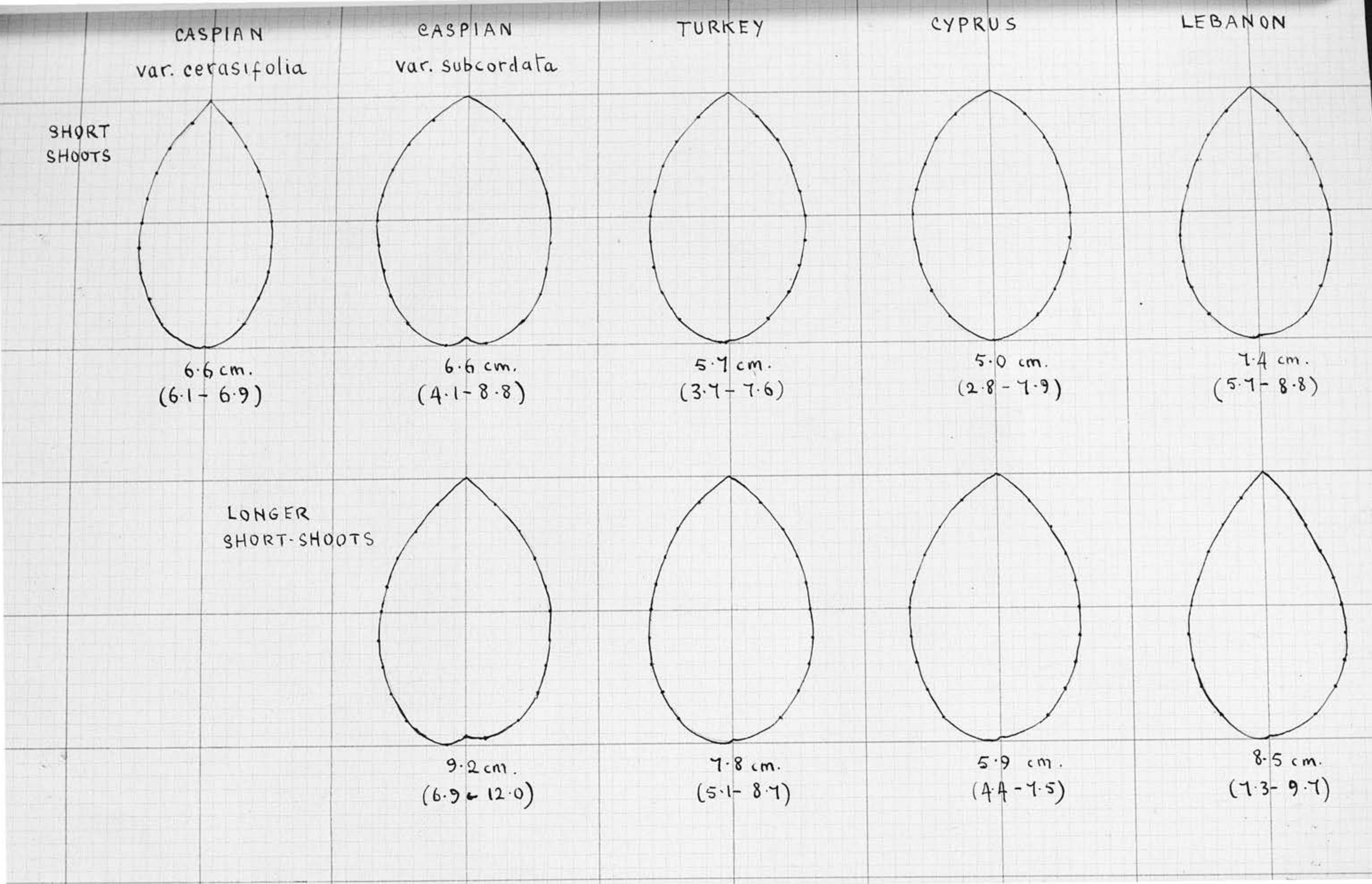


PRINTED IN GREAT BRITAIN BY GEORGE PHILIP & SON, LIMITED, LONDON.

The London Geographical Institute.
DEA

= MIOCENE shore line.

= EARLY PLEISTOCENE (Land side shaded).


CASPIAN
var. cerasifolia
CASPIAN
var. subcordata
TURKEY
CYPRUS
LEBANON
SHORT SHOOTS
6·6 cm.
(6·1 – 6·9)
6·6 cm.
(4·1 – 8·8)
5·7 cm.
(3·7 – 7·6)
5·0 cm.
(2·8 – 7·9)
7·4 cm.
(5·7 – 8·8)
LONGER SHORT-SHOOTS
9·2 cm.
(6·9 – 12·0)
7·8 cm.
(5·1 – 8·7)
5·9 cm.
(4·4 – 7·5)
8·5 cm.
(7·3 – 9·7)

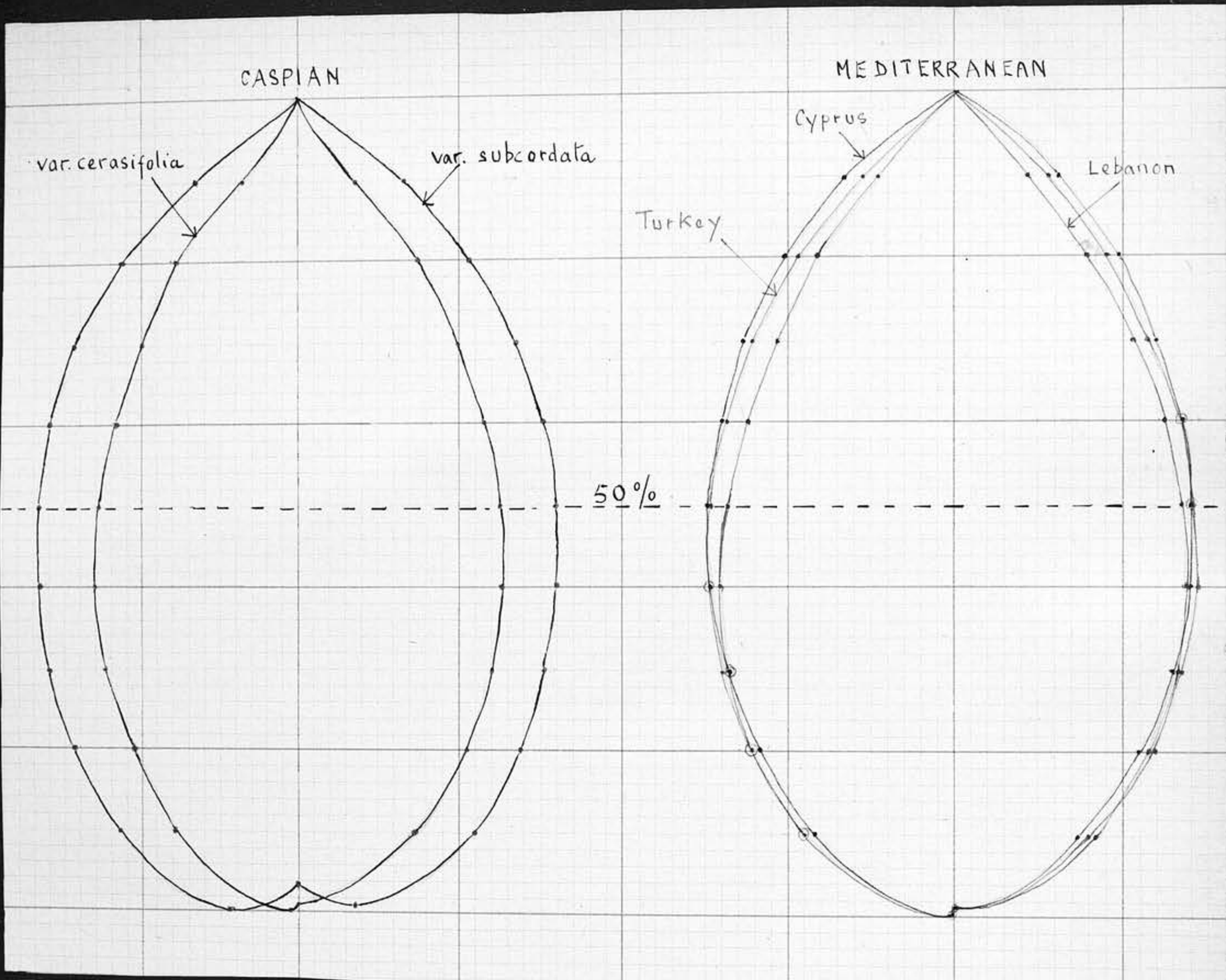

CASPIAN
var. cerasifolia
var. subcordata
MEDITERRANEAN
Cyprus
Lebanon
Turkey
50%

Fig. 2.

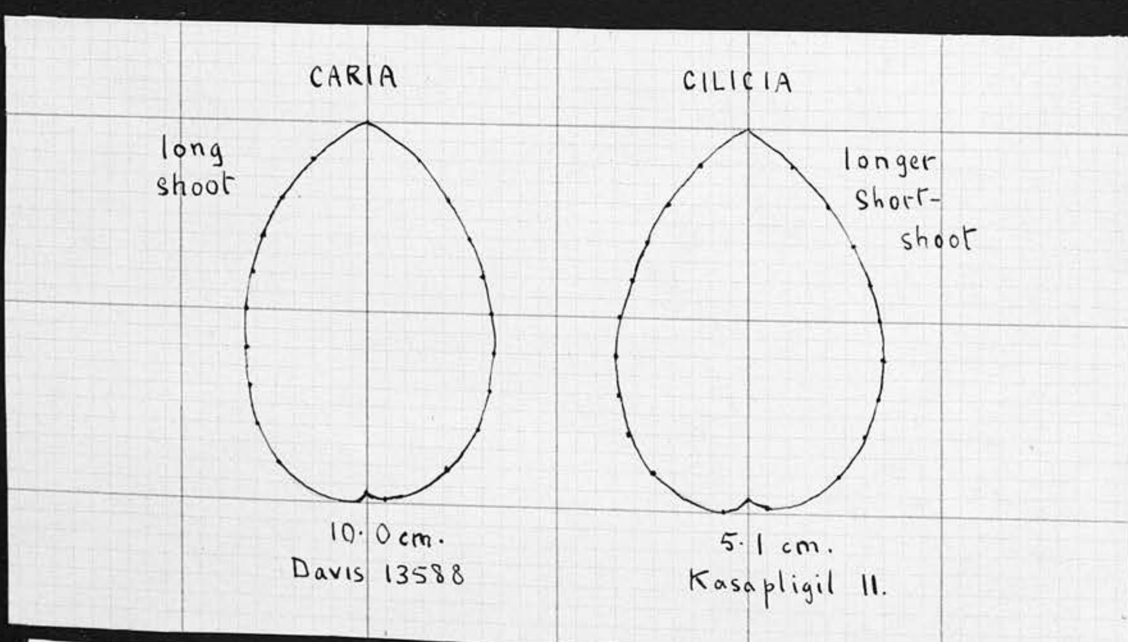

CARIA
long
shoot
10·0 cm.
Davis 13588
CILICIA
longer
Short-
shoot
5·1 cm.
Kasapligil 11.

Fig. 3.

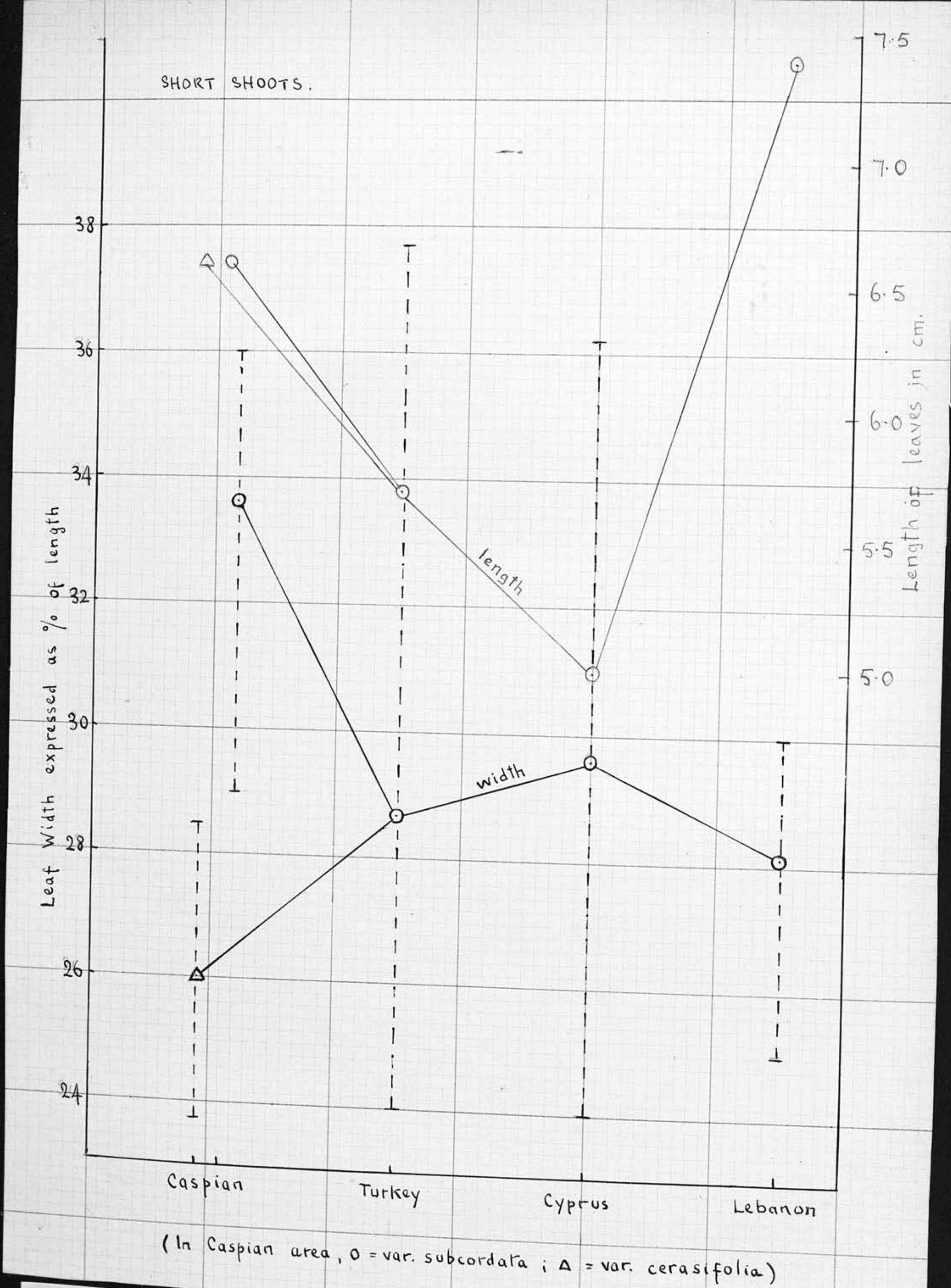

SHORT SHOOTS.
Leaf Width expressed as % of length
24
26
28
30
32
34
36
38
Length of leaves in cm.
5.0
5.5
6.0
6.5
7.0
7.5
length
width
Caspian
Turkey
Cyprus
Lebanon
(In Caspian area, O = var. subcordata ; Δ = var. cerasifolia)

Fig. 4.

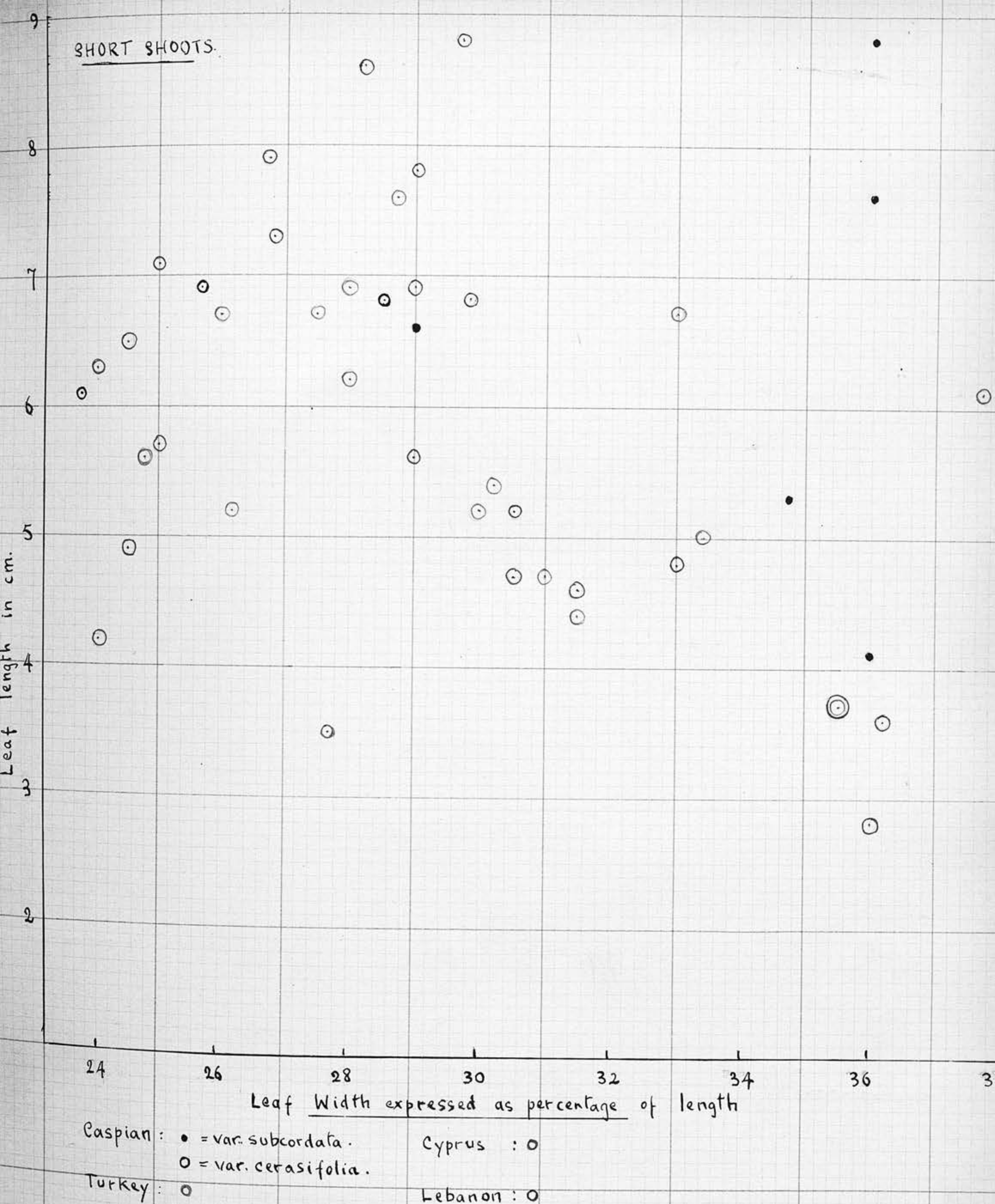

SHORT SHOOTS.
Leaf length in cm.
9
8
7
6
5
4
3
2
24
26
28
30
32
34
36
38
Leaf Width expressed as percentage of length
Caspian: • = var. subcordata.
O = var. cerasifolia.
Turkey: O
Cyprus : O
Lebanon : O

Fig. 5.

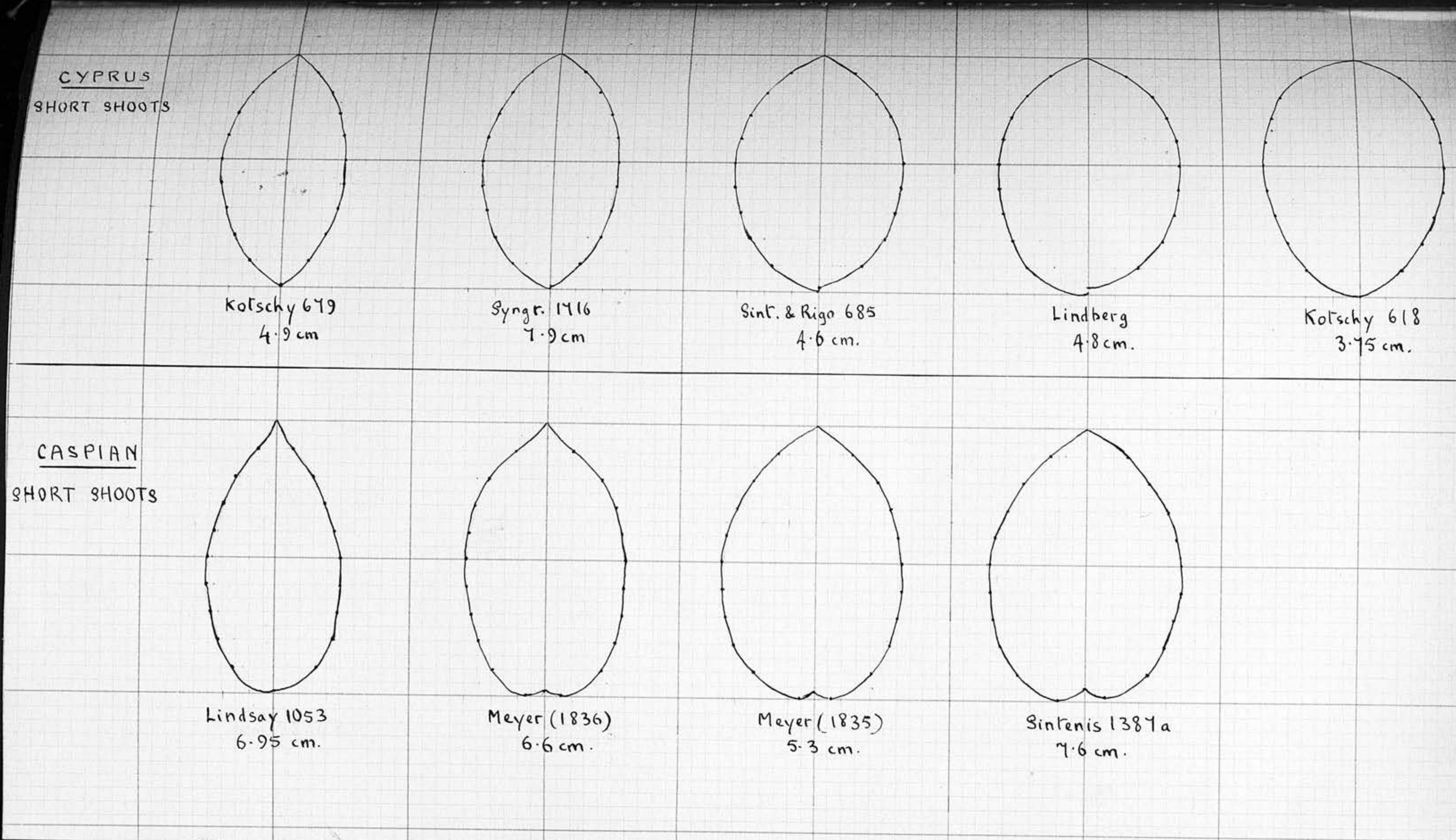

CYPRUS
SHORT SHOOTS
Kotschy 679
4·9 cm
Syngr. 1716
7·9 cm
Sint. & Rigo 685
4·6 cm.
Lindberg
4·8 cm.
Kotschy 618
3·75 cm.
CASPIAN
SHORT SHOOTS
Lindsay 1053
6·95 cm.
Meyer (1836)
6·6 cm.
Meyer (1835)
5·3 cm.
Sintenis 1387a
7·6 cm.

Fig. 6.

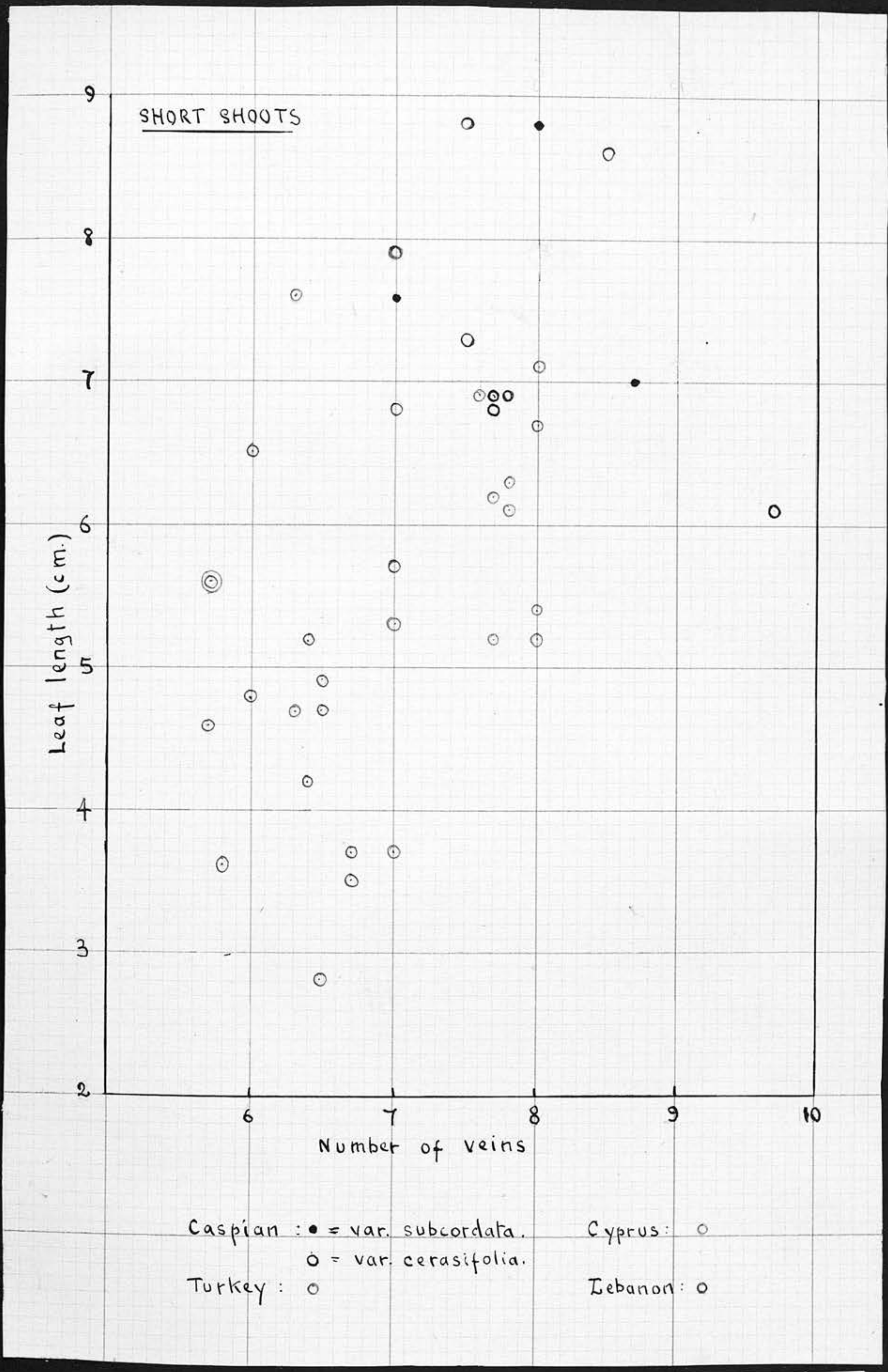

SHORT SHOOTS
Leaf length (cm.)
Number of veins
9
8
7
6
5
4
3
2
6
7
8
9
10
Caspian : • = var. subcordata.
o = var. cerasifolia.
Turkey : o
Cyprus : o
Lebanon : o

Fig. 7.

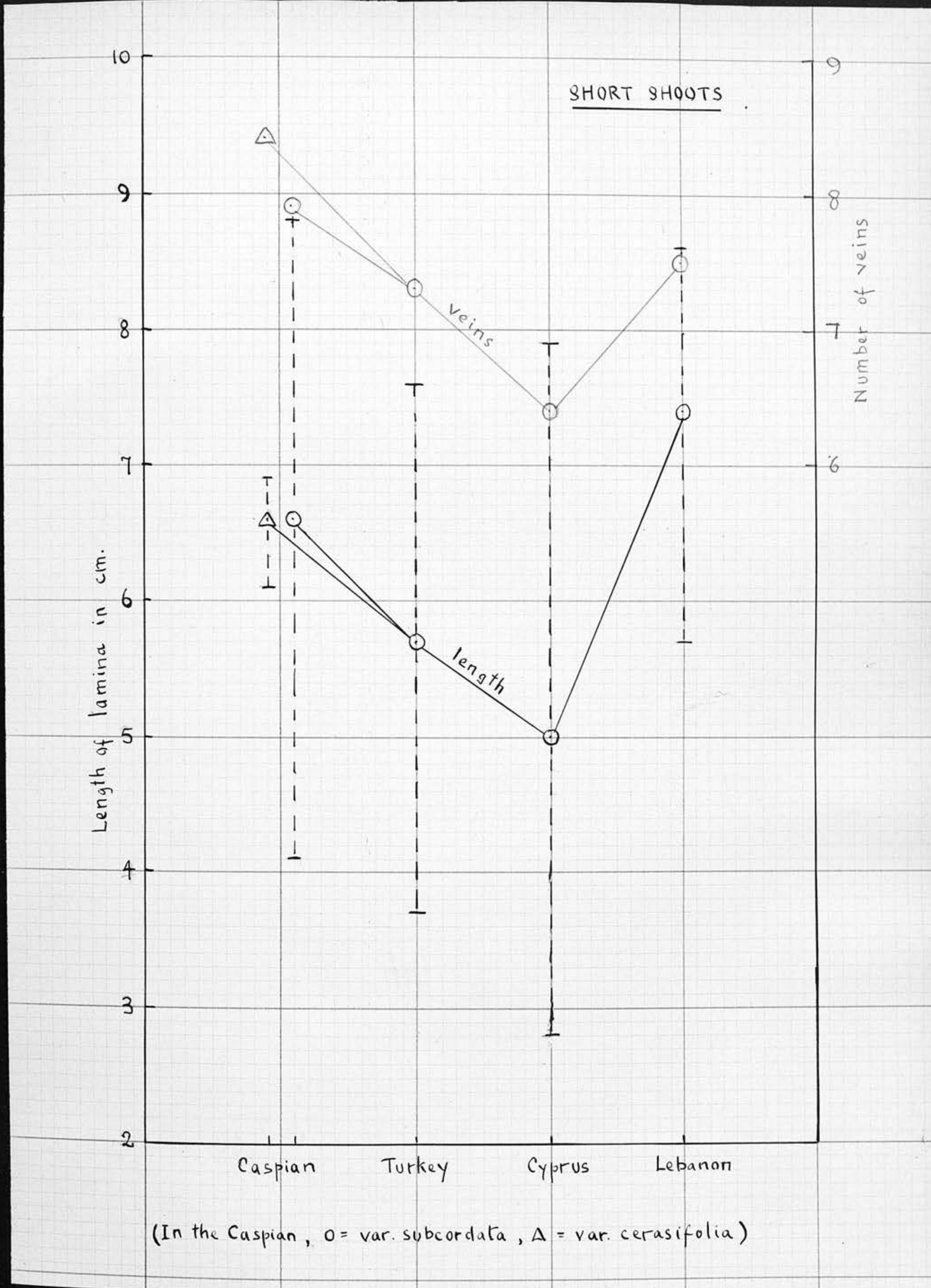
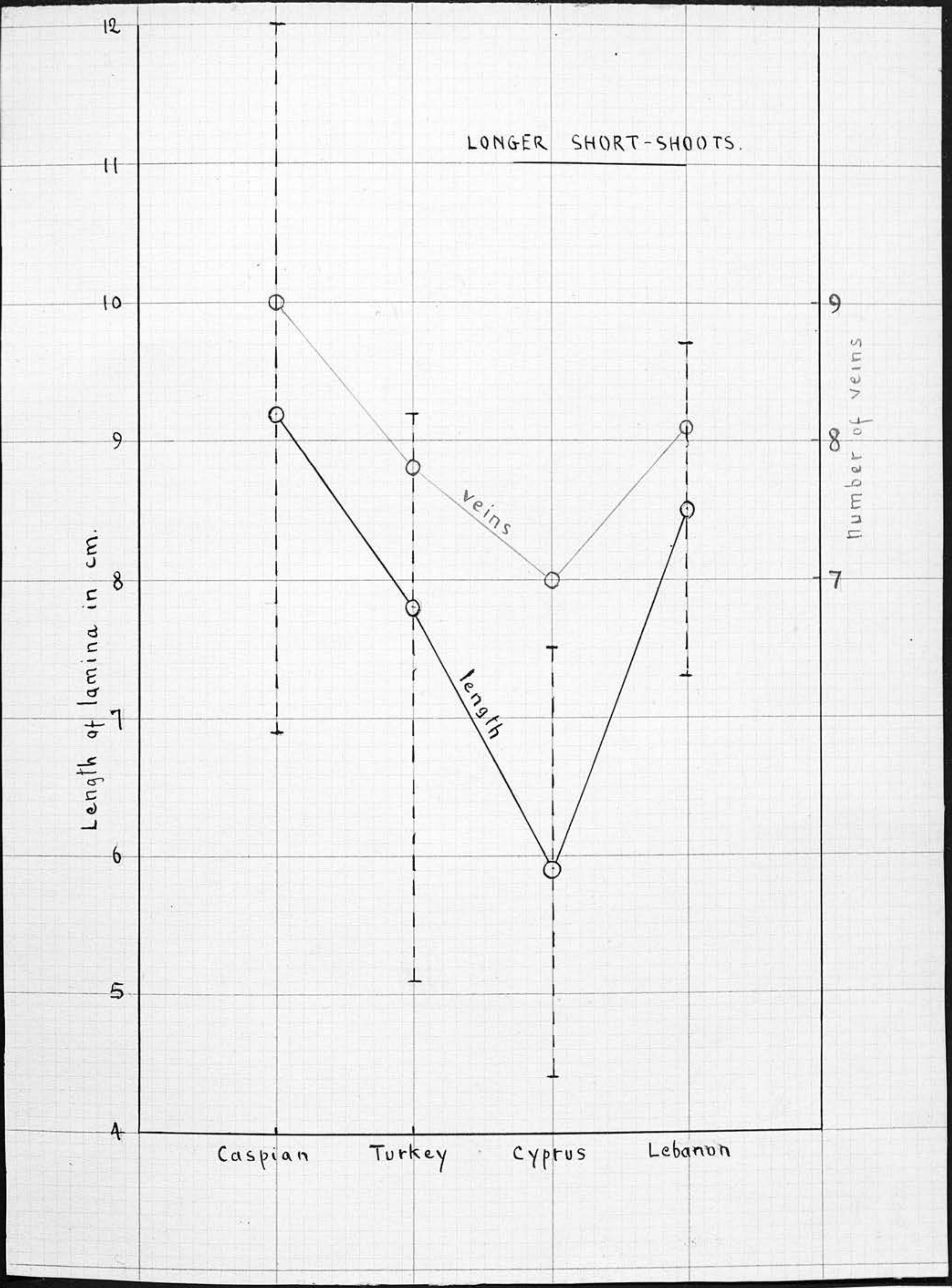
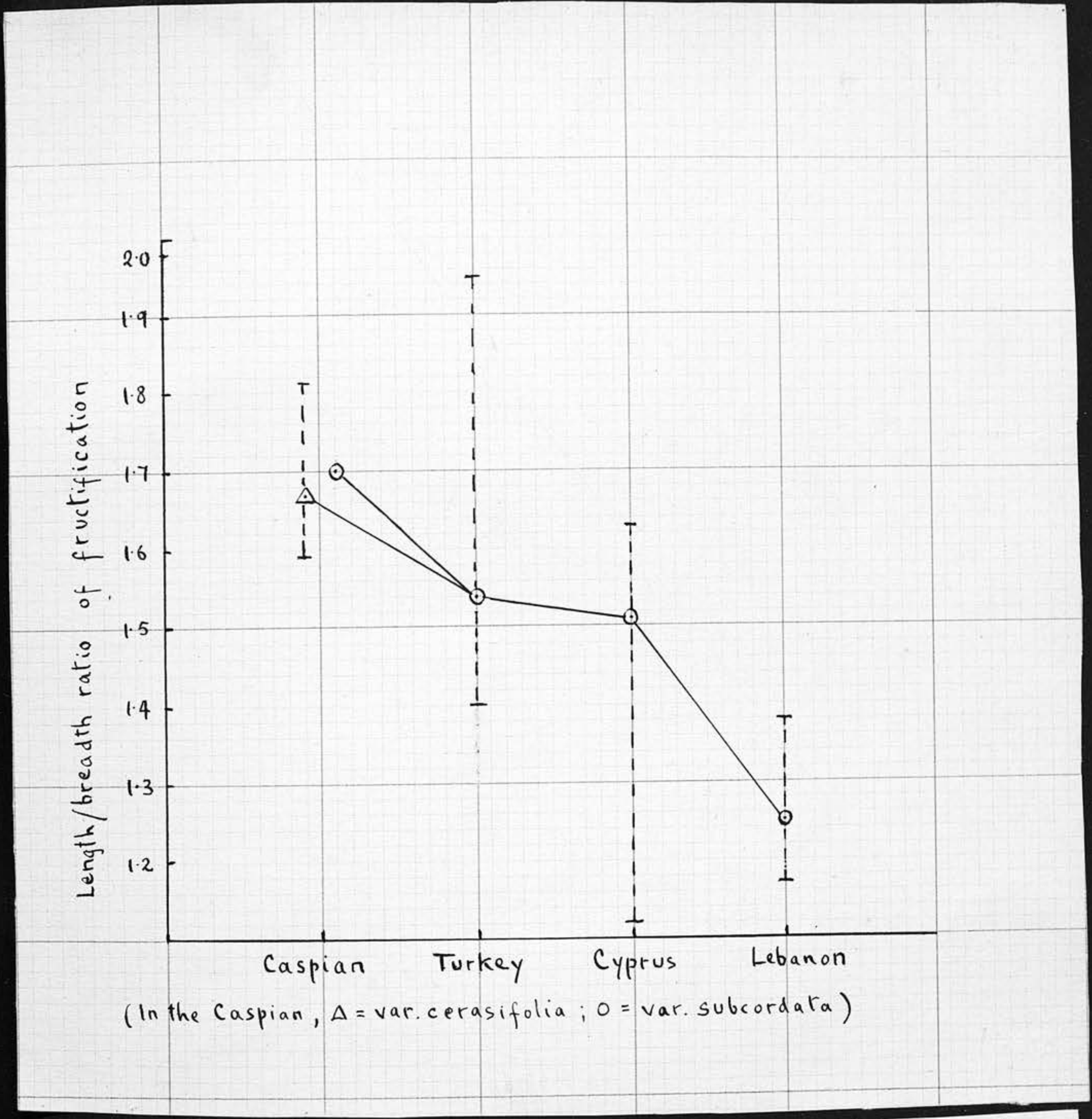

SHORT SHOOTS
10
9
8
7
6
5
4
3
2
Length of lamina in cm.
9
8
7
6
Number of veins
veins
length
Caspian
Turkey
Cyprus
Lebanon
(In the Caspian, O = var. subcordata, Δ = var. cerasifolia)

Fig. 8.



LONGER SHORT-SHOOTS.
12
11
10
9
8
7
6
5
4
Length of lamina in cm.
9
8
7
number of veins
veins
length
Caspian
Turkey
Cyprus
Lebanon

Fig. 9.



Length/breadth ratio of fructification
2·0
1·9
1·8
1·7
1·6
1·5
1·4
1·3
1·2
Caspian
Turkey
Cyprus
Lebanon
(In the Caspian, Δ = var. cerasifolia ; O = var. subcordata)

Fig. 10.

(In Caspian area, O = var. subcordata ; Δ = var. cerasifolia

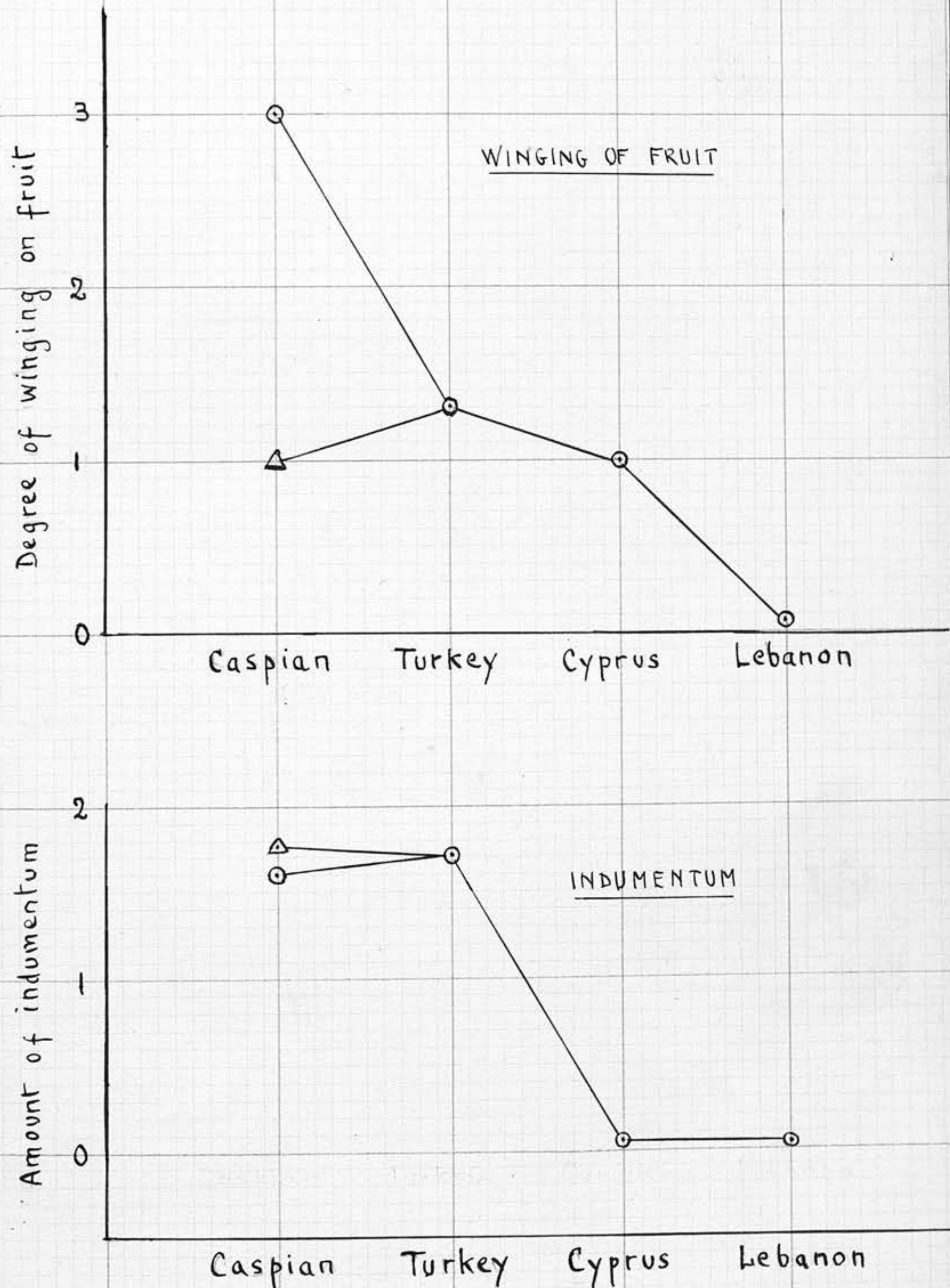
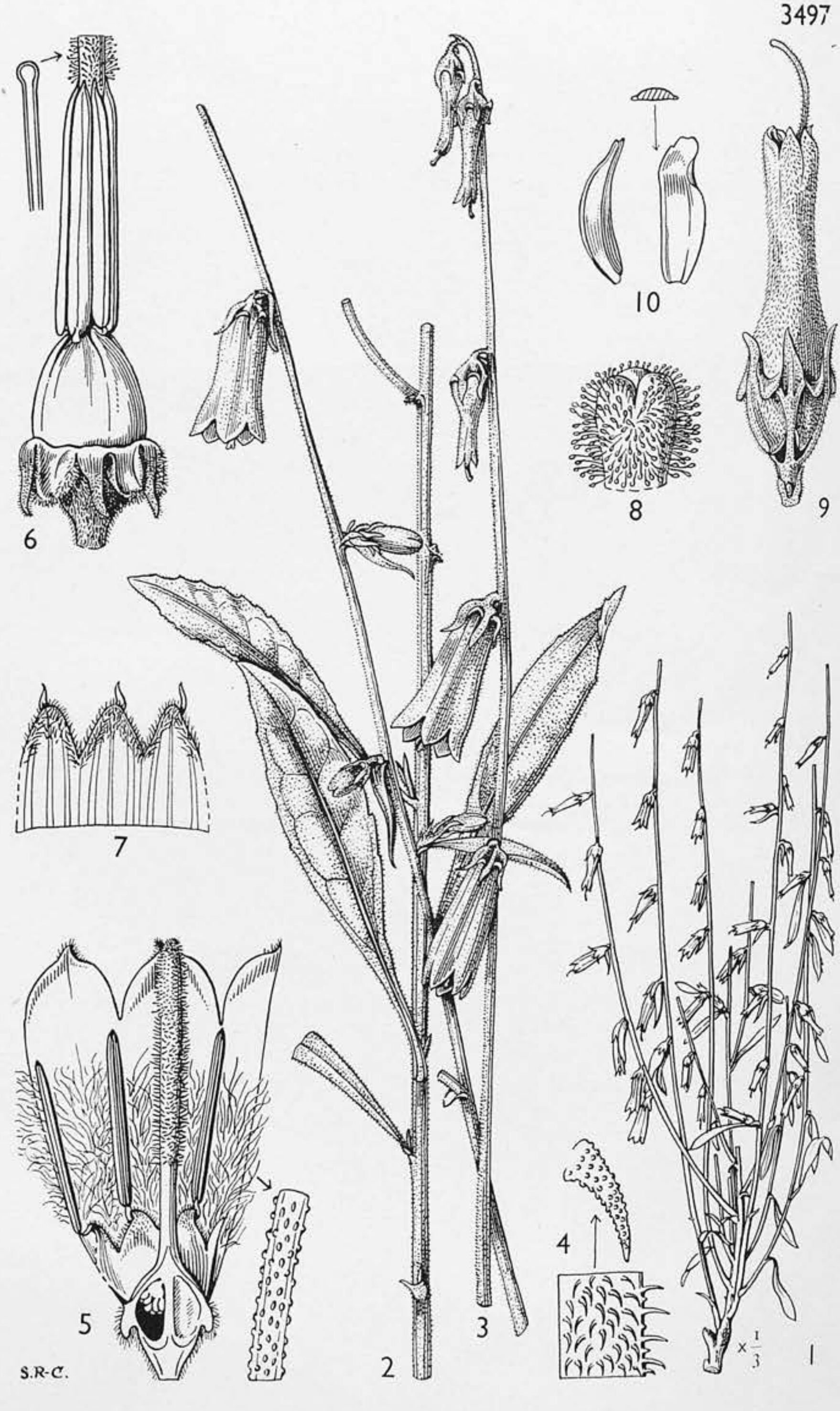


Fig. 11.

ZEUGANDRA IRANICA P.H.DAVIS

TRACHELIOPSIS ANTILIBANOTICA P.H.DAVIS


3497
1
2
3
4
5
6
7
8
9
10
× 1/3
S.R-C.

Tabula 3497.

ZEUGANDRA IRANICA *P. H. Davis.*

Campanulaceae. Tribus Campanuleae.

Zeugandra *P. H. Davis*, gen. nov. Genus hoc ad *Campanulam* ipsam approximat; ab illo genere filamentis in coronam firmam coalitis imprimis divergit; insuper corollae anguste infundibularis tubo intus villosissimo lobis pro tubo brevissimis haud reflexis, ramis styli brevissimis haud patentibus recedit.

Planta perennis. *Rhizoma* sublignosum. *Inflorescentia* centrifuga, floribus in paniculas ut videtur laxissime racemosas dispositis breviter pedicellatis nutantibus. *Calycis tubus* adnatus hemisphaericus turbinatus; limbus alte 5-fidus, sinubus in appendices linguiformes abeuntibus. *Corolla* anguste infundibularis (senectute, basi excepta, anguste tubiformis), crassiuscula, violacea, ad sextam vel septimam partem in lobos triangulares erectos quinquilobata, extra densissime ac adpresse retrorso-scabro-pubescens, intus supra glabrescens, in parte inferiore pilis longis haud septatis dense papillosis villosissima. *Stamina* 5, iuxta corollam toro inserta, inclusa, filamentis per duas partes vel paulo ultra in coronam firmam coalitis, partibus liberis infra medium triangularibus villosulis, superne linearibus, antheris liberis linearibus apiculo terminatis. *Stylus* tenuiter columnaris a basi sensim dilatatus, in statu ♀ recte exsertus, ad quadrantem glaber, ad apicem brevissime trifidum dense hirtellus, lobis haud patentibus. *Discus* nullus. *Ovarium* inferum, triloculare, placentis ex angulo superiore loculorum pendulis. *Capsula* nutans, infera, calycis lobis coronata, vertice manifeste convexa, prope basin inter costas valvulis singulis dehiscens. *Semina* subplana, ovato-oblonga, fulva, circa 15 per loculum.

Zeugandra iranica *P. H. Davis*, sp. nov.

Planta perennis. *Caudex* crassus, sublignosus, squamosus. *Caules* aliquantum numerosi erecti, 20–35 cm. alti, laxissime racemoso-ramosi (raro simplices), centrifugi, rigidissimi, canescentes, internodiis 1·5–4 cm. longis lineis decurrentibus striatis, pilis biformibus aliis brevibus dense adpressis retrorso-scabris aliis longioribus sparsis retrorso-strigosis hirti. *Folia* basalia non vidi; caulina inferiora pilis dense papillosis retrorso-strigosa, aliquantum evanescentia, plerumque 4–6 cm. longa, ad 1 cm. lata, anguste ovato-oblonga, in petiolum sensim

Fig. 1, whole plant, *one-third natural size*; 2 and 3, part of leafy stem and two inflorescences, *natural size*; 4, underside of leaf, × 8, and a single hair, *much enlarged*; 5, flower in longitudinal section, × 3, and part of one hair, *much enlarged*; 6, flower, with corolla and part of style removed, × 4, and one glandular hair from style, × 40; 7, three of the five filaments, inner surface, × 4; 8, stigma, × 12; 9, fruit with two valves open, × 3; 10, seed in front and three-quarter back view and in transverse section, × 8.

attenuata, irregulariter subdentata, subamplexicaulia fere decurrentia; superiora (et bracteae) parva, anguste oblongo-lanceolata, integra, sessilia, floribus breviora vel nunc superantia. *Flores* in axillis bractearum solitarii (vel raro bini), 1·5–2 cm. longi (vel paulo minores), brevipedicellati, nutantes, extra omnino adpresse retrorso-scabro-pubescentes; *calyx* hemisphaerico-turbinatus, 4–6 mm. longus, laciniis triangulari-lanceolatis receptaculo aequilongis vel sublongioribus, appendicibus breviter linguiformibus; *corolla* anguste infundibularis, 1·1–1·4 cm. longa, 0·4–0·6 cm. lata, violacea, extra propter pilos subalbicans, intus ad medium longe villosissima, lobis triangularibus erectis $\frac{1}{6}$–$\frac{1}{7}$ tubum aequantibus. *Stamina* inclusa, filamentis per duas partes vel paulo ultra in coronam firmam coalitis. *Stylus* exsertus, dense hirtellus, brevissime trifidus, lobis haud patentibus. *Capsula* trilocularis vix dilatata, prope basin inter costas valvulis singulis dehiscens. *Semina* subplana, ovato-oblonga, haud numerosa, 2 mm. longa, 1 mm. lata. Floret Jul.–Aug.

IRAN. On the pass between Khanikin and Kermanshah above the village of Shahabad, in stony calcareous ground, alt. *c.* 1400 m.; growing with *Linum* sp. aff. *rigidissimo* Post; 23 Jul. 1939, *Davis* 706. Ibid., 1 Sept. 1939, *Davis* 854 (Type in Kew Herb.).

The new monotypic genus described above was collected in Iran while I was travelling there with the Hon. Edward Gathorne-Hardy in 1939. It was almost the first plant we gathered in that country, and it was found, not in an inaccessible part of the mountains, but growing beside the main road that runs from Khanikin to Kermanshah; it was, in fact, seen from the car. That such a plant has been missed by previous travellers can only be explained by its time of flowering; it blooms in late summer—a season when, in so arid a region, few botanists are about.

Zeugandra is related most closely to *Campanula L.* It may be at once distinguished from that genus by the filaments; they are fused for the greater part of their length into a firm corona. In addition, the narrow funnel-shaped corolla is divided to only one-sixth or less into erect lobes, the tube being covered within in its lower part by very long hairs (non-septate and papillose) which surround the genitalia. Another distinguishing feature is that the exserted style (in itself not a unique character) is so very shortly trifid that the stigmas are not at all reflexed; the style therefore appears almost entire.

Besides the above characters there are others which in *Campanula L.* are found rarely or in less marked degree: the indumentum on the outside of the corolla is remarkably dense; the loculi contain comparatively few rather large seeds; the habit of the plant is uncommonly rigid, though in this respect *Campanula leucoclada* Boiss. is not dissimilar.

It may be seen from the characters cited that *Zeugandra* is a well distinguished genus. It differs from *Campanula L.* more markedly, for instance, than do *Symphyandra D.C.* or *Adenophora* Fischer. The structure of the flower would seem to indicate a higher degree of evolutionary development than is found in *Campanula L.*, and its elaborate hairiness suggests extreme xerophytic adaptation. The absence of a nectary may be correlated with the curious wadding of wool that fills the lower part of the corolla. Though it has no doubt evolved from an ancestral *Campanula* stock, the new genus, like so many Persian plants, seems likely to be fairly old.

Zeugandra belongs to the Irano-Turanian element and grows on rocky calcareous hillsides in company with *Linum* sp. aff. *rigidissimo* Post and *Acanthophyllum* sp. We collected seed on our way out of Iran, but, being probably unripe, it failed to germinate.

My thanks are due to Professor Sir William Wright Smith and to Dr. H. R. Fletcher for their advice in the preparation of the description.

P. H. Davis.

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TABULA 3498.

TRACHELIOPSIS ANTILIBANOTICA *P. H. Davis.*

CAMPANULACEAE.

Tracheliopsis antilibanotica *P. H. Davis*, sp. nov. Species haec a *T. tubulosa* (Boiss.) Buser statura nana, foliis minoribus $\pm$ orbicularibus semper integris enerviis, corymbis paucifloris, corolla tubulosa (haud anguste infundibulari) lobis haud patentibus inter alia differt. Planta elegantula habitu *Diosphaerae asperuloidi* (Boiss. et Orph.) Buser haud dissimilis.

Planta perennis, caespitosa, nana, petrophila. *Caudex* lignosus, brevis, caudiculis numerosis nodulosis. *Caules* simplices, numerosi, ascendentes, fragiles, 1–2·5 cm. longi, lineis decurrentibus angulati, dense foliosi. *Folia* imbricata, integra, basi subamplexicauli-sessilia, orbicularia vel late ovata vel obovata, ad 4 mm. longa et lata, crassiuscula, fere enervia, glabra nisi ad marginem et supra ad basin sparse ciliato-scabra, emarcida persistentia. *Inflorescentia* corymbosa, 4–14-flora, cymulis 1–3-floris e foliorum summorum axillis enatis. *Pedicelli* capillares, hirsuto-pubescentes, bracteolati, floribus breviores. *Calyx* 2–3 mm. longus, hirsuto-pubescens, sepalis triangulari-lanceolatis receptaculo turbinato-pyriformi aequilongis. *Corolla* tubulosa, glabra, lacteo-alba vel pallido-caerulescens, 3–5 mm. longa, 1–2 mm. lata, lobis triangularibus porrectis vel subconniventibus $\frac{1}{6}$–$\frac{1}{8}$ tubum aequantibus. *Filamenta* linearia pilosula saepe basi sensim paulo dilatata antheris inclusis longiora. *Stylus* longe exsertus, quam corolla plerumque duplo longior, in parte superiore pilosus, inferne glaber, apice 2–3-fidus, ramis patentibus vel revolutis. *Discus* manifeste annularis. *Capsula* pyriformis, 1·5–2 mm. longa, prope basin poris 2–3 dehiscens. *Semina* ignota. Floret Aug.

LEBANON. Antilebanon: E. side of Talaat Musa, *c.* 2500 m., on vertical rocks with *Veronica bombycina*, 22 Jun., 1943, *Davis* 6654; ibid., 11 Aug. 1945, *Davis* 9966 (Type in Kew Herb.); Talaat Musa, 2600 m., in rocks with *Veronica bombycina*, flowers white or pale bluish, 11 Aug. 1945, *Davis* 9942; Hursh Imarra between Talaat Musa and Bir Jebâb, *c.* 2400 m., 12 Aug. 1945, *Davis* 9793; top of Wadi Jebâb above Baalbek, *c.* 2400 m., flowers white, 12 Aug. 1945, *Davis* 9769.

The Syrio-Lebanese frontier bisects Talaat Musa, and it is therefore probable that the first two gatherings should be referred to Syria. The species occurs always within the zone of *Juniperus excelsa* which forms an open forest in the high Antilebanon unaccompanied by any other tree.

FIG. 1, flowering plant, *natural size*; 2, flowering branch, × 2; 3, leaf, × 6; 4, leaf-margin, × 16; 5, flower, × 6; 6, flower in longitudinal section, × 8; 7, young unopened stigma, × 8; 8, opened trifid stigma, × 16; 9, fruit, with one valve opening, × 6.

‡

A second new species of this interesting genus was collected by Professor O. Schwarz on his Anatolian journey of 1938. It is :—

Tracheliopsis fruticulosa *O. Schwarz et P. H. Davis*, sp. nov.

Planta fruticulosa. *Caudiculi* ramosi, lignosi, apicem versus caulium residuis squarruloso-nodulosi. *Caules* simplices, 2–12 cm. alti, fragilissimi e caudiculorum apicibus nascentes, dense et patentim villosi. *Folia* suborbicularia usque lanceolato-elliptica, ad 18 mm. longa et 12 mm. lata, tenerrima, obtusa vel acutiuscula, integra vel nunc serraturis minutis perpaucis denticulata, sessilia, pilis minutis albis $\pm$ appressis pubescentia, infima atque suprema diminuta. *Inflorescentia* corymbosa compacta, multiflora, cymulis in foliorum supremorum axillis saepe ad florem unicum reductis. *Pedicelli* villosuli bracteolati. *Calyx* 3–5 mm. longus, patule villosulus, laciniis lineari-subulatis tubo late obovato fere $1\frac{1}{2}$-plo longioribus. *Corolla* lactea, anguste infundibuliformis, extra sparsim puberula, 4–7 mm. longa, lobis lingulatis $\pm$ conniventibus rariusve porrectis acutiusculis quartem vel quintam tubi partem aequantibus. *Filamenta* linearia basi vix dilatata antheris subinclusis. *Stylus* corolla saltem duplo longior, in parte superiore initio brevissime pilosiusculus, apice bifidus vel trifidus, ramis deinde revolutis. *Capsula* ignota. Floret Aug.

ANATOLIA. Prov. Muğla, distr. Fethiye : on vertical calcareous rocks of Mt. Maşdadağ above the village of Maşdaköy, *c.* 2400 m., 4 Aug. 1938, *Schwarz* 446 (type), and of Mt. Teke Punari Dağ near Seki Yaylâ, *c.* 1800–2200 m., 25 Jul. 1938, *Schwarz* 161—a form with smaller, narrower, often denticulate leaves. Type in Berlin Herb. ; Isotype in Kew Herb. and Haussknecht Herb.

The description of *T. fruticulosa* has been made to cover both gatherings. The type—No. 446—is of more vigorous growth than No. 161. The latter is rather dwarf with short twigs that have been appressed to the rocks ; its leaves are narrower and smaller (12 $\times$ 5 mm.), generally a little denticulate, and the corymbs consist of only 4–7 flowers whilst those of the type have up to 30. It grew in a more sunny place than the type.

T. fruticulosa is related to *T. tubulosa* (Boiss.) Buser but differs in its extreme fragility, broader and generally more or less entire leaves with rather indistinct nervature, the pubescence of the calyx and corolla, and in its general villosity. Its habit is also rather different—the thick woody stems bear interlaced papery bark, and are densely covered above with the node-like remains of the twigs. In these characters it approaches *T. myrtifolia* (Boiss. et Heldr.) Schwarz et Davis* which, in

* **Tracheliopsis myrtifolia** (*Boiss. et Heldr.*) *Schwarz et Davis*, comb. nov.—*Campanula myrtifolia* Boiss. et Heldr. in Boiss., Diag. Pl. Orient. Ser. 1, (11) 69 (1849). *Trachelium myrtifolium* (Boiss. et Heldr.) Boiss. in Boiss., Fl. Orient. **3**, 962 (1875).
Schwarz and Davis are jointly responsible for the remarks on *T. fruticulosa*.

spite of its short style, is a close relative of our new Turkish species and of *T. tubulosa*. *T. fruticulosa* holds a place intermediate between *T. myrtifolia* and *T. tubulosa*.

Buser's revision of the genus *Trachelium* L. in 1894 (Bull. Herb. Boiss. [Ser. 1] **2,** 501–532) by no means settled the fate of the species formerly included in that genus. He placed the Oriental *Trachelia* of Boissier (Fl. Orient **3,** 960–962 : 1875) in two new genera, *Diosphaera* Buser and *Tracheliopsis* Buser,* with the exception of *Trachelium myrtifolium* (Boiss. et Heldr.) Boiss. which he transferred to *Campanula* L. In *Tracheliopsis*, Buser also included *Campanula petraea* L. and the very closely related *Tracheliopsis albicans* Buser ; these were placed in a separate section—Sect. *Codonosphaera* Buser. *Trachelium* L. he reduced to a bispecific genus containing *T. caeruleum* L. (West Mediterranean) and the Sicilian *T. lanceolatum* Guss., both species with very similar and characteristic flowers and between which a hybrid is known. He considered *Diosphaera* and *Tracheliopsis* to be most closely related to *Campanula* L.

Engler in 1897 (Pflanzenf, Nachtr. [1] 319) accepted Buser's concept of *Trachelium* but reduced *Diosphaera* and *Tracheliopsis* to subgenera (or sections) of *Campanula* L. while at the same time retaining the subgrouping of Buser within those subgenera. Engler's ruling has not been generally followed : Halácsy (Consp. Fl. Graecae, **2,** 278 : 1902), Hayek (Prodr. Fl. Balc. **2,** 552–553 : 1930), and K. H. Rechinger (Fl. Aegaea, 604 : 1943) have all treated *Diosphaera* as a separate genus ; similarly, *Tracheliopsis* was so recognized by Post (Fl. Syria, Palestine and Sinai : 1896).

Bornmüller, in a paper on *Asyneuma* (*Podanthum*) in 1921 (Beih. Bot. Centralbl. **38,** [2] 333–351), proposed a more natural grouping of the species placed by Buser in *Tracheliopsis* and *Diosphaera*. He tentatively recommended the merging of these two genera into one, but emphatically maintained that the two species composing *Tracheliopsis* Sect. *Codonosphaera* should in all circumstances be separated and placed in *Campanula*.

* Buser's classification (Bull. Herb. Boiss. [Ser. 1] **2,** 501–532 : 1894) was as follows :—

Diosphaera Buser

- Sect. *Eu-Diosphaera* : *D. jacquini* (Sieber) Buser, *D. rumeliana* (Hampe) Bornm., *D. chalcidica* Buser
- Sect. *Chamaetrachelium* : *D. asperuloides* (Boiss. et Orph.) Buser

Tracheliopsis Buser

- Sect. *Eu-Tracheliopsis* : *T. tubulosa* (Boiss.) Buser, *T. postii* (Boiss.) Buser
- Sect. *Codonosphaera* : *T. petraea* (L.) Buser, *T. albicans* Buser

Diosphaera is confined to the Balkan Peninsula, and *Tracheliopsis* Sect. *Eu-Tracheliopsis* to the Levant ; *Tracheliopsis* Sect. *Codonosphaera* occurs only on the southern rim of the Alps. The Moroccan *Trachelium angustifolium* Schousboe, on account of the apical dehiscence of its capsule, was removed by Buser from this alliance and made the type of a new monotypic genus—*Feeria* Buser—related to *Jasione* L. *Trachelium sensu stricto* has a very slender corolla tube and a characteristic style.

Tracheliopsis antilibanotica is a very distinct plant evidently most closely related to *T. tubulosa* (Boiss.) Buser—a rather polymorphic species showing considerable geographical variation. Certain features of *T. antilibanotica* confirm the opinion that Bornmüller's concept of *Diosphaera* and *Tracheliopsis* is the most natural hitherto proposed. In view, however, of the repercussions that might ensue in the interrelationship of allied groups, it seems to me that a satisfactory grouping of the Oriental *Trachelia* can only be achieved by a monographer of *Campanula* and related genera. In the meantime, in placing the two new species in *Tracheliopsis*, Buser's classification has been followed.

The differences between *Diosphaera* and *Tracheliopsis* as specified by Buser are extremely slight. *Diosphaera* is characterized by having a corolla that is divided to the middle into linear spreading lobes, and has a cylindrical tube; the filaments are linear and undilated, and the stigmas of the exserted style are scarcely revolute. *Tracheliopsis*, on the other hand, is described as having an infundibular corolla divided to a variable depth, filaments dilated towards the base, and the stigmas of the exserted style as being markedly revolute. Both genera are exclusively saxatile, and, with the exception of *Tracheliopsis* Sect. *Codonosphaera*, have overlapping sessile stem leaves of firm texture, erect flowers borne in a corymbose inflorescence, bracteoles, and a similar facies.

Even the slender differences between the two genera scarcely hold. I have found that the filaments of *Tracheliopsis tubulosa* (Boiss.) Buser and of the two new species described here are frequently undilated, and that the stigmas of *Diosphaera* may be eventually revolute. So far as the corolla is concerned, that of *Tracheliopsis postii* (Boiss.) Buser* is divided to the middle and closely resembles that of a *Diosphaera*. In *T. antilibanotica* the very shortly lobed corolla is entirely tubular, not funnel-shaped. The inflorescence is a modified corymb; in this, as well as in its general habit, the Antilebanon species recalls *Diosphaera asperuloides* (Boiss. et Orph.) Buser from the Styx gorge. The gynoecium, as in *T. fruticulosa*, is 2–3-merous—a condition noted by Buser for *Diosphaera* but not for *Tracheliopsis*, which he described as having a trimerous gynoecium.

Tracheliopsis Sect. *Codonosphaera* seems to me much less closely related to the other species of *Tracheliopsis* (Sect. *Eu-Tracheliopsis*) than those species are to *Diosphaera*. The two species of Sect. *Codonosphaera*—*T. petraea* (L.) Buser and *T. albicans* Buser—have a capitate inflorescence, pedicels without bracteoles, and the corolla and general facies of *Campanula*. Their character of the exserted style is of course an unusual one in *Campanula*. This, however, should certainly not preclude the placing of Sect. *Codonosphaera* in the latter genus, for

* I have not seen flowering material of this rare species, but a sheet has been found in the Kew Herbarium (under *Teucrium*) in early bud, which matches very well Buser's description and illustration of *Tracheliopsis postii* except for the rather more dense indumentum of the upper leaf-surface. The specimen was collected by Sintenis (Iter Orientale 1888), and the label reads " Mardin : Lurgberg, 28. 7. 88."

some few species of *Campanula*, such as *C. elatines* L. and *C. affinis* Roem. et Schult., do have the style well exserted.

On the other hand the position of *Tracheliopsis myrtifolia* (Boiss. et Heldr.) Schwarz et Davis presents problems to which Bornmüller did not refer. This rare species from the Isaurian Taurus undoubtedly holds a position somewhat intermediate between *Campanula* and *Tracheliopsis* Sect. *Eu-Tracheliopsis*. Boisser, having described it in *Campanula*, later transferred it to *Trachelium*. Buser, owing to its sturdy included style (which is not glabrous as Boissier supposed), replaced it in *Campanula*. Apart from the shortness of its style, it appears to Schwarz and me, especially in the shape of its corolla and filaments, and in its characteristic habit, certainly more closely related to *Tracheliopsis fruticulosa* (and, through the latter, to *T. tubulosa* (Boiss.) Buser) than it is to any species of *Campanula*. Consequently a classification that would widely separate this Isaurian endemic from *Tracheliopsis* Sect. *Eu-Tracheliopsis* would be unnatural. The species has therefore been transferred here to the latter genus, the exserted style being abandoned as a generic character. If the description of *Tracheliopsis* as understood here (comprising *T. tubulosa, postii, fruticulosa, antilibanotica, myrtifolia*) were amplified to include *Diosphaera* (or the latter made to include *Tracheliopsis*), a more natural grouping might be attained ; but whether or not such a group should be kept generically distinct from *Campanula* (or even from *Trachelium sensu stricto*, which shows marked similarities in habit) is another matter. It is unfortunate that, although several species are in cultivation, the cytology of Boissier's Oriental *Trachelia* is still uninvestigated.

I am indebted to Professor O. Schwarz for giving me joint authorship of his new Turkish species, to Professor Sir William Wright Smith and Dr. H. R. Fletcher for their advice, and to the Keeper of the Kew Herbarium for the loan of material.—P. H. DAVIS.

Since the above was written, I have been able to collect *Tracheliopsis myrtifolia* in the Isaurian Taurus and (taking the Göksu as the boundary) the adjacent part of Cilicia Trachea. The following gatherings were made, and seed obtained for cultivation.

Prov. Konya, distr. Ermenek (Isauria): Ermenek at Meydan Kebeni çesmesi, 1400 m., in crevices of sloping or vertical limestone rock with *Teucrium cavernarum* Davis, flowers white, 13 Aug. 1949, No. 16136 ; Kamiș dere, between Ermenek and Oyuklu dağ, 1400–1500 m., vertical rocks, local, 14 Aug. 1949, No. 16173.

Prov. Mersin, distr. Anamur (Cilicia Trachea) ; near Çamurlu yaylâ, between Anamur and Ermenek, 2100 m., rocks, flowers blue, 17 Aug. 1949, No. 16260.

This new Begonia with triangular-lobed leaves seems to be nearly related to the polymorphic *Begonia laciniata* Roxb. but differs from that species in the subacaulescent habit, the female flowers with three or four tepals, and the simpler two-branched stigma.

This new species is named in honour of Prof. Sir William Wright Smith, Regius Keeper of the Royal Botanic Garden, Edinburgh, to whom I wish to express my sincere gratitude for guidance and encouragement.

Grateful acknowledgement is due to Prof. Dr. Edgar Irmscher for kindly confirming many of my determinations and for valuable suggestions concerning my work on this genus. (T.T.Yü.)

THREE NEW SPECIES FROM THE NEARER EAST

Three New Species from the Nearer East

BY

P. H. Davis

(*with text figure*)

Stachys megalodonta *Haussk. et Bornm. ex P. H. Davis*, sp. nov. (Subsect. *Fragiles* Boiss. emend Rech. fil.).

Affinis *S. Benthamianae* Boiss. et *S. viscosae* Montbr. et Auch. ex Benth; a priore calyce majore papillis glandulosis et pilis longis eglandulosis munito, dentibus tubum aequantibus vel paulo eo longioribus flexuoso-patentibus differt; ab altera verticillastris superioribus inter se congestis, calyce plerumque majore, dentibus longioribus flexuoso-patentibus haud spinulo terminatis recedit.

Caules ascendenti-erecti, simplices vel superne ramosi, subflexuosi, quadrangulares, 20–35 cm. alti, medio 1·0–1·25 mm. lati, papillis glandulosis et pilis longis eglandulosis retrorsis hirsuti. Folia ovata, acuta, basi cordata vel in typo profunde cordata ad sinum inflexo-auriculata, breviter petiolata, mediana 2–5 cm. longa, 1·0–3·2 cm. lata, simpliciter vel irregulariter biserrato-crenata pilis longis eglandulosis et papillis glandulosis appresse hirsuta. Folia floralia caulinis minora, inferiora calycibus longiora, superiora diminuta ovato-lanceolata acuta vel acuminata subintegra calyces ± aequantia. Verticillastra 2–7-nata, superiora in spicam breviter ovato-oblongam, 2–4·5 cm. longam, 2·5 cm. latam, inter se condensata, inferiora 1–3 saepe distantia. Bracteae setaceae ciliatae, ad 2 mm. longae, vel in exemplis ex ditione Mosul lectis lineari-setaceae 5–10 mm. longae. Flores brevissime pedicellati. Calyx statu florifero 9–12 mm. longus, fructu 11–14 mm. longus, papillis glandulosis plerumque numerosis et praesertim ad nervaturam et marginem dentum pilis paucis longis eglandulosis patentibus munitus, ad medium vel fere ultra in dentes lanceolato-subulatos ciliatos flexuosos subaequales acutos in fructu praesertim patentes fissus, tubo anguste infundibulare indistincte nervoso. Corolla 12–14 mm. longa, flava, fauce rubro-notata; tubus ad faciem anteriorem subsaccatus, intus piloso-annulatus; labium superius late ellipticum obtusissimum, 4–5 mm. longum, extus pubescens; labium inferius 5·5–7·0 mm. longum, trilobatum, lobo mediano subreniforme retuso sinuato lobis lateralibus brevioribus circ. 2 mm. latis apice truncatulis multo longiore. Stamina 2·5–3·0 vel 4–4·5 mm. longa. Nuculae late oblongo-ovatae, 2 mm. longae, 1·5 mm. latae, subtriquetrae, apice obtusissimae, basi truncatae, fuscae.—Floret Mai.—Jun.

Iraq (Kurdistan). Prov. Erbil: in montis Kuh Sefin reg. infer. supra pagum Schaklava [Shaqlawa], 30 May. 1893 (*Bornmüller* 1692—*type* in Herb. Kew); ibid. (*Bornmüller* 1674—*β. remota* Bornm. *in sched.*); ibid., 1100 m., on limestone rocks, common, corolla yellow with crimson markings in throat, 9 May 1947 (*J. B. Gillett* 8079); ibid., ravine on limestone mountain, corolla cream, 19 June 1947 (*A. Rawi* 9082); Salahaddin forestry enclosure on Pirmum Dagh, 900 m., limestone mountain copiced with *Quercus Aegilops Brantii* forest, south aspect, occasional, fl. sulphur yellow with crimson markings in throat, 31 May 1948 (*J. B. Gillett* 11277).

Prov. Mosul: Kaira near Shar, corolla yellow with crimson markings, 10 May 1947 (*A. Rawi* 8602).

In the indumentum of its calyx the new species resembles *S. viscosa* Montbr. et Auch. ex Benth., from which it differs by having the upper whorls condensed into a short spike, and by the longer, flexuous-patent, calycine teeth that are not tipped by a small spine. The inflorescence of *S. megalodonta* Hausskn. et Bornm. ex Davis is like that of *S. Benthamiana* Boiss.; but the former differs from *S. Benthamiana* in having a larger calyx that has glandular papillae (instead of short glandular hairs) mixed with the long eglandular hairs, and somewhat longer, flexuous-spreading, calycine teeth. A specimen of *S. Benthamiana*, collected by Field and Lazar (No. 883) on Jebel Baradost near Diana Rowanduz (Prov. Erbil) has larger calyces with longer teeth than is usual in that species, thereby approaching *S. megalodonta*.

The gatherings of the new *Stachys* show considerable variation in leaf-shape, those from the type-locality (Sefin Dagh, between Erbil and Rowanduz) having more deeply cordate laminae (actually inflexed at the sinus) than those from Pirmum Dagh and Kaira; specimens from the latter locality have much longer bracts than in the other gatherings, and a more sparsely papillose calyx.

Mr. J. B. Gillett tells me that in Iraq the species in this group of *Stachys* are very variable, even in single localities. The material in the Kew Herbarium certainly bears out his observation, and the difficulty of finding constantly correlated characters suggests that hybridisation may have obscured the species-patterns. More material, supplemented by field studies, is required before several of the species can be satisfactorily circumscribed.

This critical group has been partially revised by Dr. K. H. Rechinger (Bot. Jahr. **71** (4) 526: 1941) who has provided a key to most of the species in his emended Subsect. *Fragiles* Boiss. The species fall naturally into two series:

(1) With terete or subquadrangular stems, usually pendulous, and bearing rounded obtuse leaves. (This includes the two species on which Boissier originally based the subsection—*S. Pinardi* Boiss. et Bal. and *S. longiflora* Boiss. et Bal.)

(2) With manifestly quadrangular, ascending stems bearing ovate or lanceolate, usually acute, leaves. (Originally part of Subsect. *Rectae* Boiss., this includes *S. megalodonta*.)

Linking these two series, though referable to the last, are *S. ballotiformis* Vatke (excluding *S. plebeia* Vatke which may prove specifically distinct) and *S. Brantii* Benth. The latter was transferred by Boissier to the genus *Betonica* L., included in *Stachys* L. by many authors. I have seen, though not dissected, the holotype of *S. Brantii* in the Kew Herbarium, and consider that this rare Kurdish species should certainly be placed in *Stachys* Subsect. *Fragiles* Boiss. as circumscribed by Rechinger (*l. c. supra*). It is, indeed, most closely related to *S. megalodonta*, from which it differs by its somewhat thicker stem, denser silky indumentum of long eglandular and short glandular hairs, usually longer bracts, and shorter (though flexuous) calyx-teeth that are without glandular papillae. In habit the two plants are similar, and I feel sure that if more of these rare saxatile species of *Stachys* had been discovered in Boissier's time, he would have related *S. Brantii* to them.

Teucrium stachyophyllum *P. H. Davis*, sp. nov. (Sect. *Stachyobotrys* Benth.).

Valde affinis *T. lamiifolio* Urv. sed indumento densiore canescente, lamina foliorum ovato-oblonga (haud late triangulari-ovata) quam latitudine 2–2½-plo longiore, apice obtusissima, margine obtuse crenata, calyce in parte superiore longius hispido-villoso, dente mediano labii superioris quam latitudine plerumque paulo latiore obtusiore (sed subapiculato) recedit.—Planta in agris et locis saxosis (haud in sylvis) crescens.

Planta annua vel subperennis (1–2 (3) annos persistens), basi haud vel paulo indurata caules 1–5 emittens. Caulis erectus (20) 30–40 cm. altus, internodiis superioribus 5–7 (10) cm. longis, spica unica terminatus vel superne in ramulos breves unispiciferos divisus, pilis eglandulosis patentibus dense tomentosulo-hirsutus, prope basin turiones steriles parvos tomentosos emittens. Folia caulina 3–5-juga, 4·5–7 (10) cm. longa; lamina oblongo-ovata, latitudine 2–2½-plo longior, apice obtusissima, basi truncato-cordata, margine obtuse crenata, appresse hirsuto-tomentosula, canescens, petiolo plerumque 2½-3-plo longior. Spicae 1–7, valde farctae, 3–8 (11) cm. longae, canescentes. Bracteae calyces aequantes vel etiam breviores, anguste lineares, acutissimae, ciliatae. Flores brevissime pedicellati, paulo nutantes. Calyx basi saccatus, 7 mm. longus (vel paulo brevior), pilis brevibus glandulosis et praesertim in parte superiore pilis longissimis eglandulosis patentibus hispido-villosus, prope ad medium bilabiatus; labium superius tridentatum dente mediano late orbiculare 2·5–3·0 mm. lato replicato obtusissimo brevissime subapiculato in fructu prominenter reticulato-nervoso, dentibus lateralibus mediano 2–2½-plo brevioribus ovatis obtusissimis; labium inferius superiore subduplo brevius, ad basin in dentes 1·75 mm. longos lanceolatos acutos fissum. Corolla 6–7 mm. longa calycem aequans, albida; tubus 1·25 mm. latus, prope basin subsaccatus; labium superius subretusum; labium inferius 5-lobatum, lobo mediano orbiculare sinuato-lobulato vix 2 mm. lato, lobis lateralibus anterioribus ovato-triangularibus ciliatis, posterioribus late triangularibus acuminatis ciliatis. Stamina 3 vel 4 mm. longa. Nuculae suborbiculares, 1 mm. longae, leviter reticulato-malleatae, glabrae, pallide fuscae.—Floret Mai—Jun.

SYRIA: Beled Schekif, entre Kefour et El Zahrani. pr. Damascus (*Gaillardot* 741); Bahamra, 15. km. E. of Ladikie, 300 m. (*Haradjian* 2684), near Qardabah, 300 m., hills, 31 May 1939 (*Dinsmore* 7305); 30 km. S. of Antioch, 800 m., 6 June 1938 (*Dinsmore* 20390)—this record is near the Turkish-Syrian frontier by Mount Cassius.

LEBANON: Au bord du ravin qui traverse les jardins et forme le lit du torrent appelé El Kamlé, près de Saïda, 8 June 1855 (*Gaillordot* 89—*type* in Herb. Kew); Beirut, 1871 (*Post*); in rup. reg. inf. Brummana, 7 June 1897 (*Bornmüller* 1333); Bhamdoon [Hamdun] ,2 June 1871 (*Post*); Ehden, June 1846 (*Boissier*); Baynu [E. of Tripoli], 700 m., rocky slopes, fl. white, 15 June 1943 (*P. H. Davis* 6353); Nahr el Kelb, shady places at foot of rocks among brambles, scarce, fl. dirty white, 15 May 1943 (*P. H. Davis* 6076).

PALESTINE: Beit Mahsir, 18 May 1912 (*Meyers*); Mezra [near Acre] 50 m., fields (*Dinsmore* 5305); Jerusalem, rocks (*Dinsmore* 3305).

T. stachyophyllum has previously been included in the more western *T. lamiifolium* Urv. (*T. cordifolium* Čel.) to which it is certainly very closely related. Nevertheless, fairly abundant material shows that the two can always be separated by their leaf shape, and by the indumentum of their leaves and calyces; in addition, they can usually be distinguished by the length of their bracts and by the shape of the median tooth of the upper calyx-lip (fig. 1). Their areas do not overlap: *T. lamiifolium* is a woodland plant occurring locally from Bulgaria (*locus classicus*) to the Isaurian (and probably Cilician) Taurus; *T. stachyophyllum* extends from N. W. Syria (and on Mount Cassius may occur in Turkey) to Central Palestine, being a denizen of fallow fields and rocky places within the Mediterranean phytogeographical region in the narrow sense. Neither plant has been found in the Amanus Mountains which connect these two areas. It therefore seems justifiable, on taxonomic, geographical and ecological grounds, to give *S. stachyophyllum* a biverbal name; however, if intermediate populations should be found, it might be necessary to treat it as a subspecies of *S. lamiifolium*.

In early days *T. lamiifolium* was confused with *T. Arduini* L., a plant of the Eastern Balkans (Dalmatia, Montenegro, Herzegovina and Albania) which apparently grows on rocky slopes and in rock-crevices. A table (p. 52) is given to show the main morphological differences between these three, closely related species. It can be seen from it that *T. Arduini* is better distinguished from *T. lamiifolium* than the latter is from *T. stachyophyllum*. In addition to the differences in the calyx-shape and bract-length (the latter rather variable) noted by Boissier (Fl. Or. **4,** 811: 1871) to distinguish *T. Arduini* from *T. lamiifolium*, important differences are found in the average number of leaves (and correlated length of the internodes), leaf-size, the length of the petiole relative to the lamina, and the habit of the two plants: *T. Arduini* is a long-lived perennial, and does not produce the sterile shoots we find in *T. lamiifolium* and *T. stachyophyllum*.

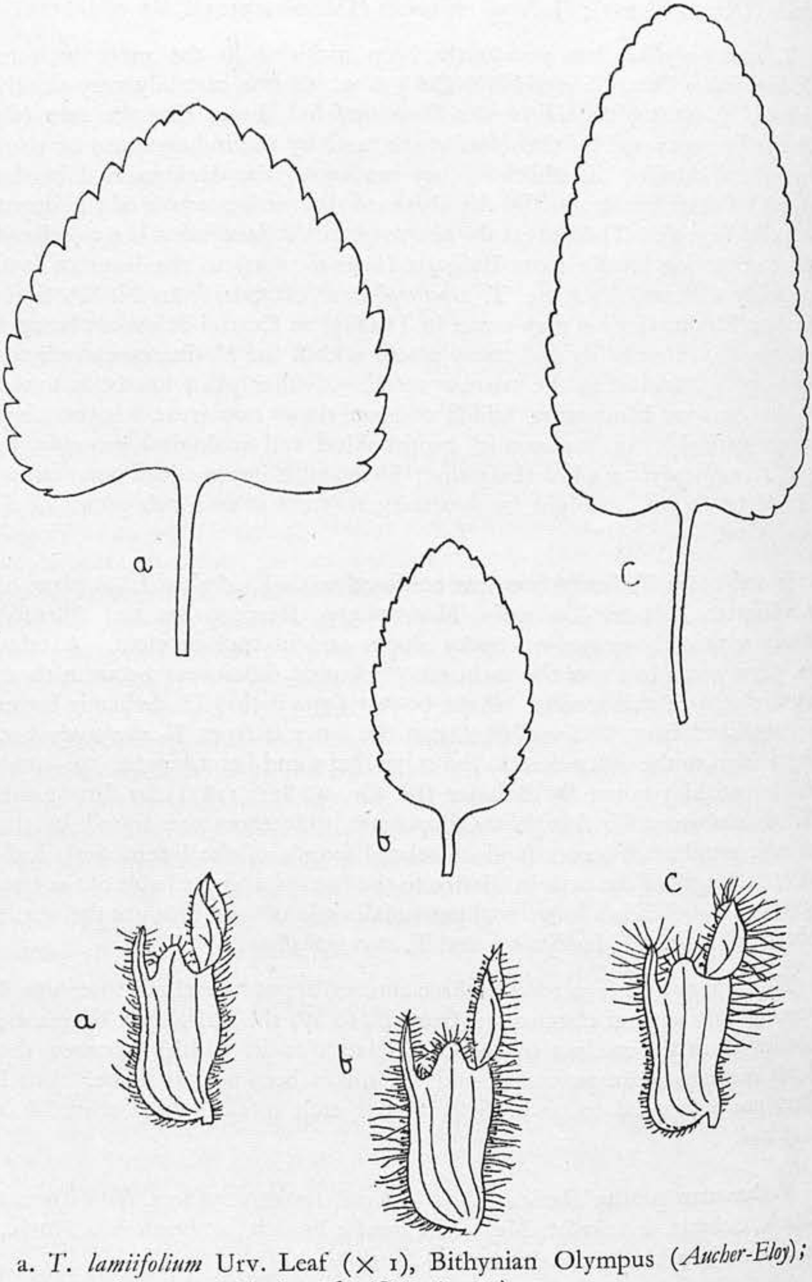
The three species (regarded as three entities) appear to show interrupted topoclines in several characters: from E. to W. the leaf-length decreases, the length of the median calyx-tooth (relative to its width) increases, the habit becomes more perennial, and the spikes become less dense. But I have not attempted to trace clines within each species; more material is required.

Verbascum petrae *Davis et Huber-Morath*, sp. nov. (Sect. *Bothrosperma* Murb., Subsect. *Fasciculata* Murb., *B. Isandra* Franch., a. *Bracteolata* Murb., α *Umbellulifera* Murb., 1. *Adenanthera* Murb.).

Affinis *V. galilaeo* Boiss. sed foliis caulinis decurrentibus, fasciculis remotis, floribus parvis, bracteis et bracteolis angustis inter alia differt.

Planta biennis, pluricaulis, 40–60 cm. alta., virescens, tota tomento brevi, aut denso cinereo vel lutescente aut parciore griseo vestita, eglandulosa. Caules virgati, erecti vel secundarii adscendenti-erecti, teretes, foliosi, in inflorescentiam spiciformem interruptam simplicem vel basi parce ramosam abeuntes. Folia basalia longe petiolata, crassiuscula; lamina 10–20 cm.

FIG. I



a. *T. lamiifolium* Urv. Leaf (× 1), Bithynian Olympus (*Aucher-Eloy*); calyx (× 4) Trojan Ida (*Sintenis* 580).

b. *T.* ***arduini*** L. Leaf (× 1), Dalmatia (*Petter* 372); calyx (× 4), Dalmatia.

c. *T. stachyophyllum* Davis. Leaf (× 1) and calyx (× 4), Sidon, *Gaillardot* 89 (*Type*).

longa, 4–6 cm. lata, oblongo-lanceolata vel lanceolata, obtusiuscula, integra, plana vel undulato-plicata vel repando-lobata, basi breviter cuneata vel sensim attenuata. Folia caulina inferiora basalibus conformia vel minora, brevius petiolata; media lanceolata integerrima acutiuscula sessilia, basi in alas angustas irregulariter decurrentia; superiora e basi lanceolata vel cordata, acuta vel acuminata vel breviter cuspidata. Fasciculi (1–) 2–4 (–5)-flori, distincti, remoti, bractea lanceolata acuta vel cordata acuminata glomerulum aequante vel superante fulcrati. Pedicellus floris primarii fasciculorum 2–4 mm. longus, ima basi bracteolis binis majusculis linearibus vel anguste lanceolatis, 10–13 mm. longis, 1–2·5 mm. latis, superne tantum denudatis praeditus; flores ceteri sessiles. Calyx sub anthesi 8–10 mm. postea usque ad 15 mm. longus, ad $\frac{3}{4}$ in lacinias lineari-lanceolatas acutas vel acuminatas divisus. Corolla lutea, parva (ad 2 cm. diam.?) non pellucido-punctata, extus stellato-tomentosa, intus glabra; tubus indistinctus. Filamenta inter se libera, antica sicut postica per totam longitudinem papillis longis purpureo-violaceis non clavatis dense lanata. Antherae omnes reniformes, mediofixae; connectivum etiam anticarum papillis longis non clavatis obsitum. Stylus 10 mm. longus basi laxe tomentosus, superne incrassatus, stigmate obovato-spathulato terminatus. Ovarium ovatum dense tomentosum. Capsula ovoidea, glabrescens, 4–5 mm. longa.—Floret Apr.—Grana pollinis omnia fertilia!

TRANSJORDAN. Edom: Petra, with *Retama* in the ruined town, 16 April 1945 (*P. H. Davis* 8754—*type* in Herb. Kew).

I am indebted to Dr. A. Huber-Morath for giving me co-authorship in this species. The name has already been published (*sine descr.*) in Candollea, **12**, 187 (1949).

TEUCRIUM STACHYOPHYLLUM AND ITS ALLIES *

T. Arduini L.	T. lamiifolium Urv.	T. stachyophyllum P. H. Davis
Plant manifestly perennial, green or canescent, producing no sterile shoots; base woody.	*Plant* subperennial, green, producing sterile shoots; base indurated.	*Plant* annual or subperennial, canescent, producing no sterile shoots; base scarcely indurated.
Stems subsimple, median internodes 2–5 cm. long.	*Stems* often branched, median internodes 5–8 cm. long.	*Stems* often shortly branched, median internodes 5–11 cm. long.
Leaves in 6–10 pairs, average length 3·6 cm.; lamina narrowly ovate, length 1·75–2·5 times width, 3·5–6 times petiole, apex acute, base broadly cuneate or truncate, margin shallowly crenate-serrate.	*Leaves* in 3–5 pairs, average length 5·3 cm.; lamina broadly triangular-ovate, length about 1·5 times width, usually 1·5–2·5 times petiole, apex subobtuse, base truncate-cordate, margin rather deeply crenate-serrate.	*Leaves* in 3–5 pairs, average length 6·2 cm.; lamina oblong-ovate, length 2–2·5 times width, 2·5–3·0 times petiole, apex very obtuse, base truncate-cordate, margin obtusely crenate.
Indumentum of stem and leaves sparsely or densely velutinous.	*Indumentum* of stem and leaves hirsute.	*Indumentum* of stem and leaves copious, tomentose.
Spike 4–13 (20) cm. long, dense.	*Spike* 3–7 cm. long, very dense.	*Spike* 3–8 (11) cm. long, extremely dense.
Bracts usually equal to or shorter than calyx.	*Bracts* usually equal to or longer than calyx.	*Bracts* shorter than (rarely equal to) calyx.
Calyx covered throughout with long, eglandular spreading hairs, longest on the tube. Upper lip with median tooth longer than broad, acuminate-spinulose, scarcely replicate; lateral teeth obtuse.	*Calyx* covered equally throughout with long, eglandular, rather spreading hairs. Upper lip with median tooth as broad as long, rather obtuse, apiculate, replicate; lateral teeth very obtuse.	*Calyx* covered, except in the saccate portion, with very long, stiffly spreading, eglandular hairs, longest on teeth and dorsal nerve. Upper lip with median tooth a little broader than long, very obtuse, subapiculate, replicate; lateral teeth very obtuse.

* The calyces of the three species bear short glandular hairs as well as the long eglandular ones referred to in the table.

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TWO NEW CHASMOPHYTES FROM THE ANTILEBANON

ALBERT BRUCE JACKSON.—We much regret to record the death at his home, 3 The Avenue, Kew Gardens, on 14 January 1947, of Mr. A. B. Jackson. Bruce Jackson was well known at Kew in connection with his work on cultivated trees. He was born on 14 February 1876 at Newbury, where he was brought up by his mother. After leaving school he was occupied in journalism till February 1907 when he was appointed to a temporary post in the Herbarium at Kew. Shortly afterwards he became assistant to H. J. Elwes and A. Henry in their work on " The Trees of Great Britain and Ireland," a work whose preparation was centred at Kew. From 1910 to 1932 he was employed as a technical assistant at the Imperial Institute, and from 1932 to the time of his death he worked as a part-time specialist in the Department of Botany, British Museum (Natural History). The knowledge and experience he accumulated while working with Elwes and Henry was turned to good

CHASMOPHYTES FROM THE ANTILEBANON.

PETER HADLAND DAVIS

The new species described in this paper were collected during a traverse of the Antilebanon, on foot, from Neb'k to Baalbek in June, 1943, and again, by a somewhat different route, in August, 1945. An account of the earlier journey appeared in the Journal of the Royal Horticultural Society, January, 1944.*

Ajuga chasmophila *P. H. Davis* sp. nov. (Sect. *Chamaepithys* Benth.).

Affinis *A. chiae* Schreb. praesertim *A. chiae* Schreb. var. *latilobae* Boiss., sed habitu robustiore hemispherico villosissimo, laciniis calycis tubo 3–5-plo longioribus distinguitur. Species facie distincta, eximie rupicola.

Perennis, pluricaulis, basi lignosa, saxatilis, habitu hemispherico, aromatica, caulibus foliisque pilis longis patulis et breviter glandulosis molliter villosissimis. *Caules* floriferi simplices, fragiles, ± flexuosi, 5–10 cm. longi, 1 mm. lati, trientibus duobus superioribus vel saltem dimidio superiore racemos densos oblongo-ovatos simplices efformantes, verticillastris bifloris. *Folia* radicalia obovata, in petiolum laminam aequantem attenuata, integra vel 1–3-crenata, evanescentia, caulina spathulato-cuneata aliquantum breviter trilobata vel indivisa, emarcida

* DAVIS, P. H. "Through the Antilebanon." *Journ. Roy. Hort. Soc.* **69**. 7–13 (1944).

persistentia congesta, floralia late cuneato-attenuata trinervia ad marginem revoluta, 1.5–3 cm. longa, 1–2 cm. lata, ad $\frac{1}{3}$–$\frac{1}{2}$ tripartita lobis obtusis ovato-oblongis 2–5 mm. latis. *Flores* brevipedicellati folia floralia superantes. *Calyx* tenuis, 6–10 mm. longus, patule villosus, laciniis inaequalibus lineari-lanceolatis quam tubo triplo- aut quintuplo- longioribus. *Corolla* magna, sparse hisuta, 2.3–3 cm. longa, calycem circa quadruplo superans, aurea, inferne rubro-striata, tubo manifeste exserto, labio superiore (haud tubo) ad basin fisso, lobo labii inferioris medio superne orbiculari emarginato tubum aequante vel paulo longiore. *Nuculae* transverse corrugatae, 2–3 mm. longae. Floret Mai.-Aug.

SYRIA. Antilebanon : Falîta above Neb'k, circ. 1800 m., in crevices of vertical cliffs ; perennial herb, hemispherical ; corolla bright yellow with reddish spots, 21.6.1943, *P. H. Davis* 6591 (typus in Herb. Kew.) ; ibid., 10.8.1945, *P. H. Davis* 9911.

Boissier, though fully aware of the polymorphic character of *Ajuga chia* Schreb., considered *A. vestita* Boiss., *A. bombycina* Boiss. and *A. laevigata* Boiss. to merit specific rank, and Dr. W. B. Turrill in his revision of this group* has followed Boissier's classification. The new species described above is so distinct in general habit from any of the varieties of *A. chia* Schreb. or its closely related species that there seems good reason for giving it specific status. I have related the new Irano-Turanian species to *A. chia* Schreb. var. *latiloba* Boiss., to which, on account of its wide bracts and large flowers, it has the closest taxonomic affinity. Besides its distinct facies, however, *A. chasmophila* has much longer calyx lobes than are usually found in the polymorphic *A. chia* Schreb. The form of the basal leaves (described from a cultivated plant) may also be a distinctive character.

Ecologically *A. chasmophila* is perhaps unique in Sect. *Chamaepithys*, being confined to crevices of vertical cliffs, where it is accompanied by *Hypericum nanum*. Though I have in the Near East frequently found forms of *A. chia* Schreb. in rocky places, I have never observed them on vertical rock—a habitat characterised by distinct and conservative plant communities. It should be noted that *A. chia* Schreb. var. *suffrutescens* Boiss. was collected on the slopes below the cliffs on which the new species was found.

In cultivation *A. chasmophila* retains the taxonomic characters cited in the diagnosis, but is difficult to grow.

Euphorbia promecocarpa *P. H. Davis* sp. nov. (Sect. *Tithymalus* Boiss. §*Esulae* Boiss.).

Ab *E. caudiculosa* Boiss. et *E. bounophila* Boiss. species haec habitu pulvinari, pubescentia, caulibus brevioribus fere ad basin dense foliosis, foliis tenuibus (haud crassiusculis), inflorescentia dichotoma, capsula minore rectangulari-oblonga, forma seminum inter alia differt.

Planta pulvinaris, petrophila, pallide virens, dense vel sparse pubescens, caulibus e rhizomate crasso lignoso numerosissimis tenuibus flexuosis, 3–7 cm. longis, fere ad basin crebre foliosis. *Folia* exstipulata, alterna, subsessilia, integra, 1–4 mm. longa, 0.8–3 mm. lata, infima minima

* TURRILL, W. B. "The correlation of morphological variation with distribution in some species of Ajuga." *New Phytol.* **33**, 218–230 (1933).

suborbicularia, superiora obovata ; floralia opposita orbiculari-rhomboidea, mucronulata, 3–6 mm. longa, 2–5 mm. lata. *Inflorescentia* breviter dichotoma, saepe ad cymam 1–3-floram reducta. *Involucrum* turbinatum, circ. 1.5 mm. longum, lobis linguiformibus emarginatis hirtis, glandulis transverse ovato-ellipticis fuscis, cornibus tenuibus latitudinem glandularum aequantibus, bracteolis inter flores masculos plumosis. *Styli* divisi. *Capsula* rectangulari-oblonga, 2–2.5 mm. longa, 1.5 mm. lata, pubescens, trisulcata, laevis, coccis dorso haud alatis. *Semen* pallide griseum, breviter cylindricum, 1.5–2 mm. longum, fere laeve aut superficialissime sparse malleatum, dorso vix carinato, carunculo manifeste subgloboso $\frac{1}{3}$–$\frac{1}{5}$ semen aequante. Floret Mai.-Aug.

SYRIA. Antilebanon : Falîta above Neb'k, circ. 1800 mm., vertical rocks, 21.6.1943, *P. H. Davis* 6573 (typus in Herb. Kew.) ; Ibid., 10.8.1945, *P. H. Davis* 9907 ; Yebrûd, circ. 1500 m., dry rocks, 10.8.1945, *P. H. Davis* 9897.

The specimens from Yebrûd are less pubescent and have somewhat shorter fruits than those from Falîta.

E. promecocarpa is taxonomically very distinct. Apart from its cushion habit and pubescent indumentum, the unusual shape of its rectangular-oblong capsule at once distinguishes it from *E. caudiculosa* Boiss. and *E. bounophila* Boiss. (from the Lebanon and S. Persia respectively), to which it appears to be most closely related. The seeds are so lightly sculptured as to be almost smooth, in this respect resembling *E. caudiculosa* Boiss. rather than *E. bounophila* Boiss., though the seeds differ from both in their shape and size. To *E. herniariifolia* Willd. the new species seems more distantly related, owing to the winged carpels of the latter's fruit and the deep pitting of its seeds.

E. promecocarpa prefers the driest rocks, being generally accompanied there by *Reutera tenuis*. In arid overhangs it is often the only species found.

I should like to thank Professor Sir William Wright-Smith and Dr. H. R. Fletcher for their advice in the preparation of the diagnoses.

NEW PLANTS FROM THE NEARER EAST.

M. Zohary and P. H. Davis.

1. Sonchus

A remarkable woody *Sonchus*, apparently endemic to cliffs in the Judean Desert and Moab, appears to have eluded the earlier botanists. The species now described is an exceptionally interesting one, not only ecologically but also in its habit and taxonomy, presumably constituting a link between *Lactuca* and *Sonchus*.

The dividing line between these two genera is a difficult one to draw, the beaked nature of the achene in *Lactuca* having several exceptions in the Near East. G. Ledyard Stebbins, Jr., in " Critical Notes on *Lactuca* and Related Genera " (Journ. Bot. 1937, p. 12), states of *Lactuca* that " the achene is definitely flattened, and has two strong lateral ribs or wings, with a varying number of lesser ribs on each face. Whether beaked or not, moreover, it possesses a strongly expanded pappus disk." The achenes of *Sonchus*, on the other hand, " are flattened or four-sided, as are those of *Lactuca*, but lack the expanded pappus disk."

Despite its unusual habit and shortly attenuated achenes (reminiscent of some *Lactuca*), we have decided to place our plant in *Sonchus* owing to the absence of an expanded disk. It should be noted that *S. pustulatus* Willk. [*S. tenerrimus* L. ssp. *pustulatus* (Willk.) Bat.] and the microspecies *S. dianae* Lacaita are somewhat suffrutescent chasmophytes from N. Africa and Spain. These have truncated achenes of typical *Sonchus* shape, but they possess several vegetative characters (such as the wool in the axils of the leaves) which are found also in our plant. In its woody habit, and even in the form of its leaves, *S. pinnatifidus* Cavanilles, from the rocks of S.W. Morocco and the Canaries, shows some resemblance to the plant here described, and confirms our view that the new species is better placed in *Sonchus* than in *Lactuca*. It must, however, be considered a very isolated type, and, though its nearest affinity may be with the *S. tenerrimus* L. group, it seems advisable for the present not to relate it to any species previously described.

Sonchus suberosus *Zohary et Davis* sp. nov.

Species insignis, saxatilis, suffrutescens. Probabiliter inter *Sonchum* et *Lactucam* species intermedia est.

Planta suffruticosa, a basi lignosa, foetida. *Caulis* lactifer, inaequaliter ramosus, usque 40 cm. altus et 2 cm. crassus, valde suberosus ; suber longitudinaliter fissum. *Rami* hornotini, 30–70 cm. longi, 2–7 mm. crassi, teretes, eburneo-albi, lucentes. *Folia* oblonga, runcinato-pinnatifida, 5–10 cm. longa (inferiora saepe longiora), glabra, 6–12-lobata ; lobi laterales ovato-oblongi vel lanceolati, irregulariter dentati, terminalis latior, ovato-triangularis. *Folia* vernalia alterna, remota, petiolata, petiolo basi dilatato vaginato et semiamplexicauli ; folia autumnalia 5–7 fasciculata in axillis foliorum vernalium lanigeris disposita. *Cymae* paniculatae, ex axillis foliorum vernalium enatae ; interdum inflorescentia ad capitulum unicum reducta. *Pedunculi* ± elongati, superne foliolis remotis minutis lineari-lanceolatis praediti.

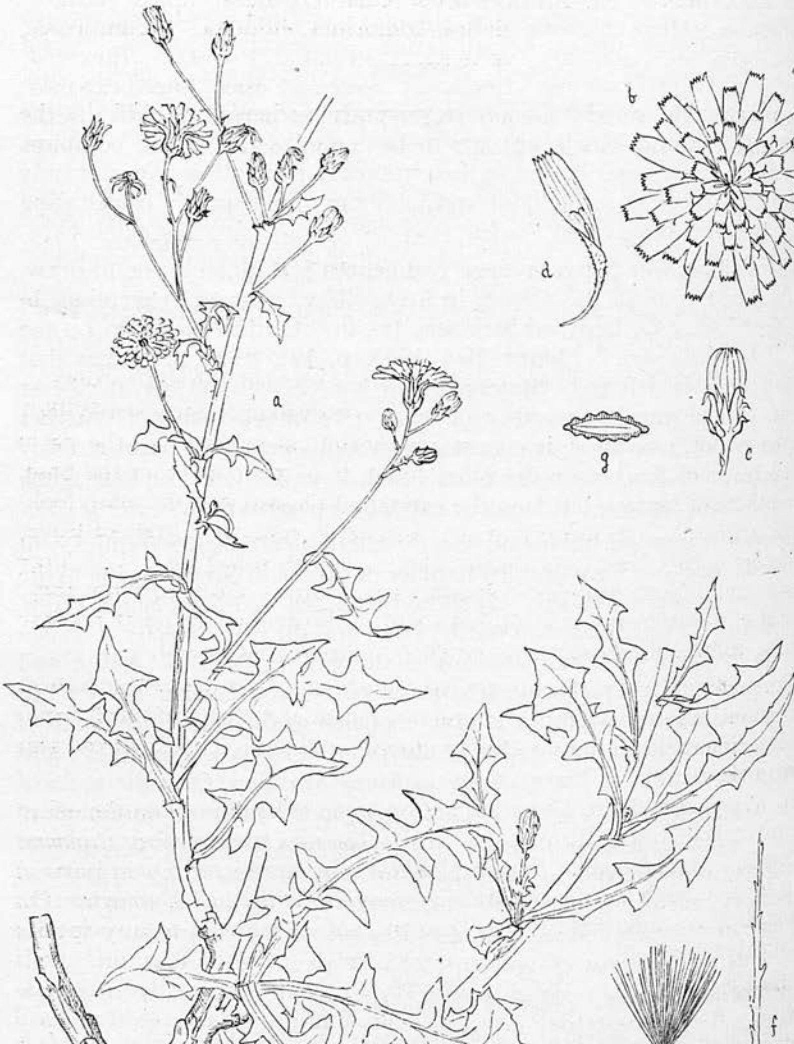


FIG. 1.—*Sonchus suberosus* Zohary et Davis sp. nov. a, general habit of the plant ($\times \frac{1}{10}$); b, c, capitulum (nat. size) ; d, floret ($\times 2$) ; e, achene ($\times 3\frac{1}{2}$) ; f, single hair of pappus (much enlarged) ; g, cross section of achene ($\times 12$).

Capitula multiflora, 2–3 cm. diametro. *Flosculi* lutei, inferne hirsuti. *Involucrum* ±campanulatum, ca. 10 mm. longum et 5–6 mm. basi latum ; phylla exteriora ad quadrantem vel ad duas partes longitudinis phyllorum interiorum, interiora superne minute ciliata, obtusa, apice recurva. *Receptaculum* nudum. *Achaenia* glabra, conformia, elliptica, ± compressa, 4 mm. longa, vix 1 mm. lata, fusca, ca. 12-striata, 3–4 -costata, transverse vix rugosa, apice breviter attenuata, erostrata, disco haud expanso. *Pappus* albus, deciduus, achaenio aequilongus vel parum longior ; setae conformes, tenues, flexuosae, sub lente setoso-denticulatae. Floret Oct.-Febr.

PALESTINE. Judean Desert : Wadi Qelt cliffs, 1931, 1932, *Eig* ; ibidem, 1941, *Daniel Zohary* ; Wadi Haritun, S.E. of Bethlehem, 1942, *Davis et Kushnir* (type) ; Jebel Qarantal cliffs, 1942, *Davis*.

TRANSJORDAN. Moab : Wadi Zerka Maïn, 1945, *Davis* ; Wadi Heidan cliffs, 1945, *Davis*.

Type in Herb. Hebr. Univers., Jerusalem. Co-types in Herb. Kew.

Sonchus suberosus is woody at the base (more so than *S. pustulatus* Willk.) the wood being covered by an elastic corky substance. In the early spring new stems, bearing alternate leaves only, grow up from the base, but at the approach of summer these shed their leaves and the plant looks dead throughout the dry season. In the early autumn clusters of leaves and inflorescences develop in the axils of the dead foliage. The large flowers continue to bloom throughout the winter. After seeding, these branches die back towards the base and only their lower parts become woody, from which arise new branches the following season.

The plant occurs chiefly in the Irano-Turanian territory of the Judean Desert and Moab, where it is confined to cliffs, generally of hard Cenomanean limestone and preferably in complete shade ; it ranges from sea-level to about 650 m.

In Wadi Haritun (Judea) *Sonchus suberosus* is locally co-dominant in small vertical cracks and holes with *Podonosma syriaca* and *Centaurea eryngioides* ; while in Wadi Qelt it is found only in the narrowest parts of the chasm, where it grows with *Podonosma* and *Capparis aegyptiaca*. On the even drier rocks of Jebel Qarantal it is found in the same association, but is not as luxuriant as on the cooler rocks of Wadi Haritun. It is particularly abundant in Wadi Zerka Maïn (Moab), especially in association with *Podonosma* on the hard limestone, but also occurs there on local intrusions of Quaternary basalt with *Euphorbia thamnoides*.

Our plant may be considered a " rigid " Tertiary relict.

2. FERULA

The genus *Ferula* is one of those plant groups abundantly represented both in the Mediterranean and the Irano-Turanian countries of the Nearer East. There is, however, no doubt that the Irano-Turanian region constitutes the main and primary centre of this genus, and that the Mediterranean species are to be referred both genetically and historically to Irano-Turanian stock. Similar phytogeographical relations have been found for a series of Mediterrano—Irano-Turanian genera or subgeneric groups such as *Dianthus*, *Phlomis*, *Verbascum*, and

Asphodeline. This opinion is based, among other points, on the fact that the genera in question have produced many species in the Irano-Turanian Region and fewer in the Mediterranean Region.

In *Ferula* we find seven very restricted endemic species in the Syrian Desert and only two in the adjacent Mediterranean territory of Syria and Palestine. The same proportion of endemics is to be found in Turkey.

The section *Peucedanoides* Boiss. of the genus *Ferula* is the section most richly represented in our district, and the following two species from Palestine and Turkey also belong to this group.

Ferula (Sect. **Peucedanoides**) **amani** *Zohary et Davis* sp. nov.

A *F. cassii* Zohary et Davis* foliis minus decompositis, foliorum laciniis crassioribus magis divergentibus, vaginis oblongo-lanceolatis (non late ovatis), pedunculo umbellae centralis longiore differt. A *F. anatolica* Boiss. foliis dense hispidulis, dentibus calycinis obsoletis, vaginae forma divergit. A *F. cachroide* (Schlecht.) Zohary et Davis† laciniis divergentibus brevioribus latioribus dense hispidulis, umbellis centralibus pedunculatis inter alia recedit. A *F. orientali* L. (planta Tournefortii ad Erzerum collecta) laciniis brevioribus, vaginis oblongo-lanceolatis, stylis brevioribus discrepat. A *F. samariae* Zohary et Davis caulibus glaucescentibus, vaginis oblongo-lanceolatis, laciniis brevioribus dense hispidulis praeter alia signa distinguitur.

Perennis. *Caules* 1.5–2 m. alti, laeves, striati, superne glaucescentes, subverticillatim ramosi ; rami tenues, usque ad 20 cm. longi. *Folia* basalia 40 cm. longa, ambitu late ovata, griseo-viridia, longe petiolata ; petiolus superne incrassatus ; foliorum divisiones primariae oblongae petiolulis 5 cm. longis praeditae ; divisiones secundariae oblongo-ovatae ; tertiariae ovatae ; laciniae oblongo-lineares, acutae, margine revolutae, valde divergentes, griseo-virides, 1.5–2.5 mm. longae, 0.5 mm. latae, e toto cum parte rhachidis superiore dense hispidulae ; folia caulina vaginis turgidis coriaceis oblongo-lanceolatis striatis glaucescentibus 8–15 cm. longis, 2.5–4 cm. latis ; foliorum superiorum laciniae longiores et laxiores quam laciniae foliorum basalium. *Bracteae* plerumque binae, subulatae, 3–8 mm. longae, 1–1.5 mm. latae. *Involucelli* phylla triangulari-subulata, usque 2 mm. longa. *Umbella* centralis fertilis, 10–20-radiata, 8–10 cm. lata, pedunculis 5–12 mm. (rarius 40 mm.) longis, 2 mm. crassis, radiis 3–4 cm. longis ; umbellae steriles 2–4, longe pedunculatae. *Flores* ignoti ; calyx obsoletus. *Diachaenium* pedicello suo aequale, ellipticum, atrofuscum, glaucescens, 9–10 mm. longum, 3.5–5 mm. latum, apicem versus parum inflatum ; styli stylopodio conico depresso 2.5–3-plo longiores ; juga interiora crassiuscula, approximata, exteriora in marginem crassum abeuntia ; alae ca. 1 mm. latae ; vittae latae valleculas implentes, commissurales binae.

TURKEY. Amanus Mts. : above Karaksieh, 500–800 m. in a Pinetum Brutiae ; Achagi Zarkoun, about 1,800 m. in a Pinetum Brutiae and P.

* **Ferula cassii** *Zohary et Davis*, nom. nov. *F. meifolia* (Fenzl) Boiss. Fl. Or. **2**, 984 (1872)—nec Eckl. et Zeyh. Enum. 348 (1835).

† **Ferula cachroides** (*Schlecht.*) *Zohary et Davis*, comb. nov. *Polycyrtus cachroides* Schlecht. in Linnaea, **17**, 126 (1843). *Ferula schlechtendalii* Boiss. Fl. Or. **2**, 985 (1872). (Haud *F. cachroides* Fisch. in Hort. Gorenk. ed. 2, 46 (1812), nom. nud. = *F. caspica* Bieb.)

Laricio (type); eastern slopes of ascent to Achagi Zarkoun, 1,000–1,500 m., all 1932, *Eig and Zohary*. Type in Herb. Hebr. Univers., Jerusalem. Co-type in Herb. Kew.

F. amani is both morphologically and geographically closely related to *F. cassii* Zohary et Davis from Mt. Cassius (Syria). In Pal. Journ. of Bot. 2: 170 (1941) some sheets of *F. amani* were erroneously referred to *F. meifolia* Fenzl (i.e. *F. cassii*).

Ferula (Sect. **Peucedanoides**) **samariae** *Zohary et Davis* sp. nov.

Affinis *F. anatolicae* Boiss., laciniis flaccidis divaricatis haud falcatis, vaginis stramineis (non glaucis), dentibus calycinis brevibus et triangularibus recedit. A *F. cachroide* (Schlecht.) Zohary et Davis laciniis longioribus divaricatis, involucellis persistentibus, vaginis minus inflatis divergit. A *F. orientali* L. (specimine Tournefortii) laciniis multo longioribus sparsim scabridulis, vaginis ovato-oblongis (non ample ovatis, haud cucullatis), stylis longioribus discrepat.

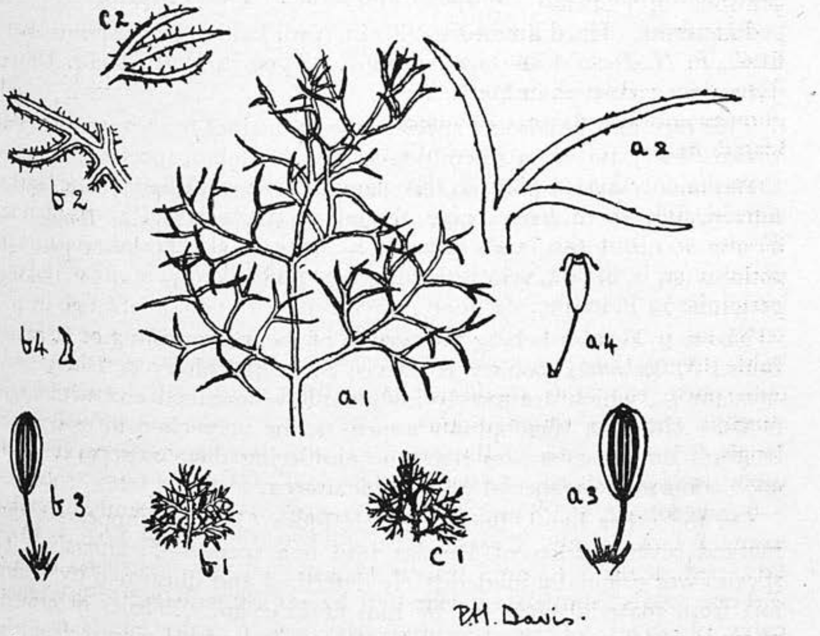


FIG. 2—a_1–a_4 *Ferula samariae* Zohary et Davis, sp. nov. a_1, leaf ($\times 1$) ; a_2, laciniae of leaf ($\times 4$) ; a_3, diachenium ($\times 1$) ; a_4, young fruit showing stylopodium and styles ($\times 1$).
b_1–b_4 *Ferula amani* Zohary et Davis, sp. nov. b_1, leaf ($\times 1$) ; b_2, laciniae of leaf ($\times 6$); b_3, diachenium ($\times 1$); b_4, involucel bract ($\times 5$).
c_1–c_2 *Ferula cassii* Zohary et Davis. c_1, leaf ($\times 1$) ; c_2, laciniae of leaf ($\times 4$).

Perennis. *Caules* 1–4-enati, 1–1.5 m. alti, laeves, striati, virides, superne subverticillatim ramosi. *Rami* usque 18 cm. longi, 2–3 mm. crassi. *Folia* basalia flaccida, ambitu late ovata, viridia, post anthesim evanida, 80 cm. longa ; petiolus glaber, striatus, inferne incrassatus, in vaginam lanceolatam abiens ; divisiones primariae ternatae, obovatae, petiolulis usque ad 10 cm. longis ; divisiones secundariae obovatae, petiolulis ad 8 cm. longis ; laciniae lineares, flaccidae, planae, parce scabrae, angulo acuto divergentes, plerumque 5–10 mm. longae, 0.3–0.5 mm. latae, acutae ; folia caulina vaginis ovato-oblongis turgidis membranaceis pallide stramineis striatis transverse venosis amplexicaulibus, 9–12 cm. longis, 5 cm. latis suffulta ; laciniis laxis, plerumque 1–3 cm. longis, 1 mm. maxime latis. *Bracteae* binae, oppositae, filiformes, acutae, 0.8—1.5 cm. longae, 0.5–1.0 mm. latae, deciduae. Involucri phylla obsoleta, decidua. Involucelli phylla triangularia vel triangulari-subulata, 1 mm. longa vel longiora. *Umbellae* 10–30-radiatae, 5–8 cm. diametro ; pedunculus centralis 2–4 cm. longus, 2–3 mm. latus ; radii plerumque 2–3 cm. longi, 1 mm. crassi ; umbellae externae steriles, 5–6 cm. longae. Flores lutei. Calycis dentes brevissimi triangulares petalis quadruplo breviores. *Fructus* pedicellis 5–10 cm. longis praediti, elliptici, pallide fusci (non glauci), ca. 11 mm. longi, 5–6 mm. lati, apicem versus parce inflati. Styli stylopodio depresso conico 2–2.5-plo longiores ; juga interiora tria, crassiuscula, approximata, exteriora in marginem crassam abeuntia ; alae 1 mm. latae vel paulo ultro ; vittae valleculas implentes ; commissurales binae. Floret Mart.-April.

PALESTINE. Hard limestone cliffs in Wadi Beidan near Nablus, 400 m., 1942, *P. H. Davis* 4580 (type); 4860. Type in Herb. Hebr. Univers., Jerusalem ; co-type in Herb. Kew.

This rare and handsome species is very distinct from any other Palestinian *Ferula*, and even resembles certain Anatolian species more closely than the only Syrian plant in this group—*F. hermonis* Boiss. The feathery, flaccid, pale-green leaves give the plant a superficial resemblance to *F. communis*, but the fruits place it at once in the *Peucedanoides* section. *F. samariae*, is, in fact, very isolated geographically, and is one of the rarest endemics in Palestine.

The new Ferulas belong to a group of species consisting of *F. anatolica* Boiss., *F. cachroides* Zohary & Davis, *F. cassii* Zohary & Davis and *F. orientalis* L., which are mostly inadequately described and without ripe fruits. Although these plants appear to be very close to one another it seems that Boissier was right in considering them as separate species each confined to a special geographical area.

On the other hand, Boissier in his Flora Orientalis appears to have merged several different Ferulas into one species—*F. orientalis*. This species was originally inadequately described and illustrated by Tournefort from material collected by him at Erzerum. Boissier described it anew in 1844 as *Peucedanum orientale* Boiss., and added several details not mentioned in Tournefort's original description. In his Diagnoses Plantarum Orientalium Novarum (1854–59) Boissier described another new *Peucedanum*—*P. rupestre*, collected in Cappadocia and formerly published as *F. rupestris* in Plantae Anatoliae Exsiccatae by Boissier and Balansa. He apparently considered this plant sufficiently distinct from *P. orientale*, etc., to make it a new species. Later, in Flora Orientalis, he united these two plants and also other slightly differing specimens from the Crimea and Caucasus under the name of *Ferula orientalis* L. In this way Boissier amplified the original description of Tournefort's plant from Erzerum to include the other specimens mentioned ; but, in spite of the mixed character of the description, Boissier, when referring to allied species in Flora Orientalis apparently took *F. orientalis* sensu lato as a basis for comparison. Boissier's *F. orientalis* as understood by us is a collective species.

As regards other Ferulas of the *F. orientalis* group, we have examined specimens of *F. cassii* collected by Post from the *locus classicus*— Mt. Cassius—which fully agree with Boissier's description of that plant. We have also seen material from the environs of Belled el Sheikh near Antioch which we must tentatively retain as *F. orientalis* L. until this species has been revised. In Post's herbarium there is a plant named *F. meifolia* Fenzl (i.e. *F. cassii*) collected by him from " Karakillissa—Genskum " which may constitute another species near to *F. amani*; but the material is insufficient for description. Incomplete specimens determined by Freyn as *F. schlechtendalii* Boiss (i.e. *F. cachroides*) from Turkish Armenia (Kyl-Maghara-Dagh and Kota) by no means resemble the type in the Kew Herbarium.

F. amani, like *F. cassii*, is obviously a true Mediterranean species; *F. samariae*, however, grows on the Irano-Turanian edge of Palestine's Mediterranean zone. The slopes below the cliffs now support a decidedly Irano-Turanian vegetation, but a few remnants of *Quercus calliprinos* indicate a Mediterranean vegetation at a fairly recent date, and relict plants of such woodlanders as *Lonicera etrusca* and *Smilax aspera* on shadier parts of the cliff confirm this view.

3. Thymus

Thymus syriacus *Boiss.* subsp. **eigii** *Zohary et Davis* subsp. nov.

A *T. syriaco* ipso haec subspecies habitu robustiore minus glanduloso, foliis floralibus inferioribus majoribus late ovatis breviter acuminatis quam floribus longioribus, calycis dentibus tenuioribus inter alia divergit.

Caules lignosi, usque ad 2 cm. crassi. *Rami* floriferi inferni saepe horizontales, superni erecti, plerumque 15–20 cm. longi, 1–2 cm. crassi, quadrangulares, goniotrichii. *Folia caulina* lanceolata vel lineari-lanceolata, acuta, 2 cm. longa (vel paulo ultro), 2–6 mm. lata (nunc latiora), subsessilia, integra vel remote denticulata, rigida, plana vel plicata, glabra, margine scabriuscula, glanduloso-punctata, parte inferiore 7–9-nervosa et sparsim longe ciliata. *Inflorescentia* capitata, late ovata, ca. 2 cm. longa et lata. *Folia floralia* late ovata, breviter acuminata, interdum purpurea, inferiora 15 mm. longa, 7–10 mm. lata, floribus

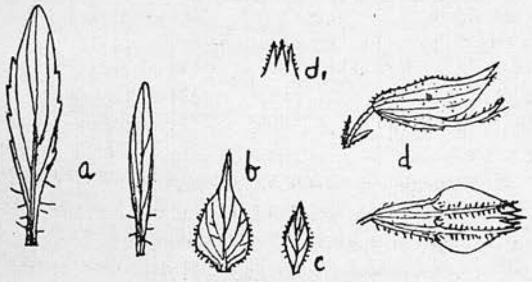


Fig. 3.—*Thymus syriacus* Boiss. subsp. *eigii* Zohary et Davis, subsp. nov.: a, stem leaves; b, floral leaf; c, bract; d, calyx; d_1, upper calyx teeth.

longiora, 9–12-nervosa, ciliata. *Flores* breviter pedicellati ; pedicelli 2–4 mm. longi. *Calyx* 6–7 mm. longus, saepe purpureus, pubescens, minutissime glandulosus, infra medium bifidus ; labium superius late ovatum, minute ciliatum, 3-dentatum ; dentes triangulari-lanceolati ; dens medius longior, labio plus quadruplo brevior ; labium inferius superiori aequilongum vel brevius, usque ad basin fissum ; dentes subulati, ciliati. *Corolla* exserta, usque ad 10 mm. longa, rosea, glanduloso-pubescens ; labia aequilonga, superius ovatum, emarginatum, inferius 3-lobatum ; tubus obconicus, calyci fere aequilongus. *Stamina* longe exserta, filamentis purpureis sparsim hirsutis.

TURKEY. Amanus Mts : Prope Beilan, in adscensu ad vineta versus fontem Tschaush Kaȓa, alt. 900 m., 1862, *Kotschy* ; above Karaksieh, 500–800 m., in Pinetum Brutiae, 1932, *Eig and Zohary* (type).

SYRIA. Between Belled el Sheikh and el Ourdou (S. of Antioch), on Cenomanian rocks in a *Quercetum infectoriae* and *Q. calliprini*, 1932, *Eig and Zohary*.

Type in Herb. Hebr. Univers., Jerusalem ; co-type in Herb. Kew.

T. syriacus subsp. *eigii* is superficially so distinct from *T. syriacus* as represented by material from the Baalbek district that at first we did not recognise it even as allied to that species. But it was considered as *T. syriacus* by Boissier ; in his Flora Orientalis he refers to Kotschy's specimens of *T. syriacus* from Amanus (which we have seen in the Kew Herbarium), remarking " forma bracteis majoribus, calycis dentibus longioribus." We have had the opportunity of examining a large series of specimens of *T. syriacus* from the environs of the Syrian Desert, and realise that this species is a very polymorphic one in every respect. Intermediate forms between typical *T. syriacus* and the subspecies described above are not rare. Nevertheless, the specimens from Amanus and Northern Syria are so distinct from typical *T. syriacus* that we consider them to deserve at least subspecific rank. The two plants are also separated ecologically ; the type is an Irano-Turanian element, whereas the subspecies is centred in the Mediterranean zone.

ON THE FLORA OF THE NEARER EAST : XXIII.*

MISCELLANEOUS NEW SPECIES AND RECORDS.

B. L. BURTT AND P. H. DAVIS.

The following notes include 5 new endemic species from Cyprus, as well as one new subspecies, one variety and 4 new records from this island. The remaining new species and other notes refer to various parts of the eastern Mediterranean and are based largely on P. H. Davis's collections.

Individual responsibility is designated by initials at the end of the appropriate notes. The orchids have been determined by Mr. V. S. Summerhayes (V. S. S.). The types of the new species are in the herbarium of the Royal Botanic Gardens, Kew.

The new Turkish species were collected by P. H. Davis with the assistance of a grant from the Percy Sladen Trust, and his work in determining them has been aided by a Royal Society grant. A general account of the Anatolian journey appears in the Journal of the Royal Horticultural Society for March and April 1949, which also contains descriptions of two new species : *Teucrium sandrasicum* O. Schwarz and *Digitalis davisiana* Heywood. Other new Turkish plants will be published later.

DELPHINIUM L.

D. pusillum *Lab.* Ic. Pl. Syriae, **4,** 5, t. 2 (1812) ; DC. Syst. Veg. **1,** 344 (1818) ; Huth in Engl. Bot. Jahrb. **20,** 382 (1895). *D. pygmaeum* Poir. Encycl. Méth. Suppl. **2,** 458 (1812) ; Dinsmore in Post, Fl. Syr. Pal. & Sinai, ed. 2, **1,** 22 (1932).

SYRIAN DESERT. Between Neb'k and Falîta, in fallow calcareous field ; 1380 m. ; flowers pink ; June 1943, *Davis* 6448.

This gathering differs from the type in having its bracteoles not reaching up to the base of the flower. Huth, in his monograph of *Delphinium*, places *D. pusillum* with the allied *D. tomentosum* Aucher in his "tribus" *Longibracteolata* which is characterized by having bracteoles which overtop the base of the flower ; in Labillardière's illustration *D. pusillum* is figured as having bracteoles about equalling it. Until further material is available we refrain from giving a name to this form of *D. pusillum* with short bracteoles and would point out that the length of these organs scarcely seems a satisfactory character on which to base subdivisions of the genus. It may be mentioned that there is no essential difference in the shape of the petal of *D. pusillum* and that of *D. tomentosum* Aucher (type).

There is some doubt as to the correct name of this species. *D. pusillum* was published in 1812. The title page of the second volume of the supplement to Poiret's Encyclopédie Méthodique bears the date 1811, but Sherborn and Woodward state (J. Bot., Lond. **44,** 319 : 1906) that it appeared in 2 parts, the second of these (containing *Delphinium pygmaeum*

* Continued from K.B. **1940**, 266.

Poir.) appearing in 1812. As it is therefore impossible to say which name has priority, the course is here followed of using the name chosen by the author who first united them. De Candolle (Syst. Veg. **1,** 344: 1818) was, it is believed, the first to do so : he used the name *D. pusillum* Lab.

P. H. D.

Ranunculus L.

R. chius *DC.* var. **leiocarpus** *P. H. Davis*, var. nov. a typo fructibus laevibus (haud tuberculatis) distinguitur.

Cyprus. Trypilos (Paphos forest), by damp roadside in the cedar forest ; 1080 m. ; 17 May 1941, *Davis* 3487 (type).

Turkey. Antalya (Adalia), in graminosis ; 14 Apr. 1860, *Bourgeau* (sub *R. parvifloro* L.) cum forma typica.

P. H. D.

Papaver L.

P. postii *Fedde* in Bull. Herb. Boiss. 2 sér., **5,** 447 (1905) ; in Engler, Pflanzenr. Papaveraceae, 323 (1909).

Cyprus. Kamlos village on the way to Karavosteri, on rocky metallic soils or roadsides ; 750 m. ; root fleshy thick and long, sepals more or less purple-spotted, petals of an open-brick colour ; 8 May 1937, *Syngrassides* 1599. Trypilos (Paphos forest), locally abundant on igneous stony slopes between Kykko and Stavros-tis-Psochas ; 840 m. ; annual with bright orange red flowers ; 17 May 1941, *Davis* 3491.

Turkey. 6 km. west of Antalya (Adalia) ; 10 m. ; 23 Apr. 1936, *Tengwall* 422.

This species was until recently represented at Kew only by a duplicate of the original collecting from the Nusairy Mountains, Syria. The above records therefore constitute a considerable extension of the specific range. The characteristic tufted habit, to which Fedde drew particular attention, is constant throughout the material examined. Fedde was unable to see flowers of this species and his description may therefore be supplemented as follows (noting, however, that the characters are taken from Cyprus material) :—*Petala* obovata, circiter 1-1·5 cm. longa et 8–10 mm. lata, basi cuneata. *Filamenta* ut videtur purpurea, setacea, antheras flavas 0·75 mm. longas gerentia. *Ovarium* 3 mm. longum, glabrum.

B. L. B.

P. decaisnei *Hochst. et Steud. ex Boiss.* in Ann. Sc. Nat. 2 sér., **16,** 372 (1841).

Transjordan. Edom, Wadi Ram ; 900 m. ; rocky granite slope in *Anabasis articulata–Noaea mucronata* association ; 15 Apr. 1945, *Davis* 9035. Ibid., granite slope in *Anabasis articulata* association ; 15 Apr. 1945, *Davis* 9094.

This is apparently a new record for Transjordan.

P. H. D.

Hypecoum DC.

H. deuteroparviflorum *Fedde* in Engler, Pflanzenr. Papaveraceae, 90 (1909).

Egypt. Gebel Asfar (near Bir Gindali between Cairo and Suez); on hill of flint gravel, only 1 plant found; flowers yellowish; 8 Apr. 1945, *Davis* 10319.

It is a littoral species in Egypt and has not previously been recorded for the eastern desert, the area " D.a. sept." of Muschler's Flora of Egypt.

P. H. D.

H. procumbens *L.* Sp. Pl. 124 (1753).

Cyprus. Agios Philon, near Rizokarpaso; sand-dunes; annual with glaucous leaves and bright yellow flowers; 19 Feb. 1941, *Davis* 2208.

Not previously recorded from the island.

P. H. D.

Alyssum L.

Extensive studies on *Alyssum* sect. *Odontarrhena* have been carried out in recent years by E. J. Nyárády (see Bul. Grâd. Bot. Cluj, **7, 8, 9, 18** : 1927–1938).

Unfortunately this author did not have access to all the species described by Boissier (Fl. Or. **1** : 1867); indeed, so many of these figure in the list of species unknown to him that it is very difficult to correlate the two accounts. Confusion is made worse by the fact that some of the material described by Nyárády had already been published under the generic name *Odontarrhena* by Jordan and Fourreau (Brev. Pl. Nov. **2** : 1868).

The following notes chiefly concern the Cyprian representatives of the section, but a few of the more straightforward points concerning the mainland forms have been included.

A. condensatum *Boiss. et Hausskn.* in Boiss. Fl. Or. **1,** 268 (1867). *A. serpyllifolium* Desf. forma, sec. Boiss. in Ann. Sc. Nat. 2 sér. **17,** 151 (1842).

S.E. Turkey. Ak Dagh*, *Aucher-Eloy* 266 (lectotype). Akher Dagh; 1800 m.; July 1907, *Haradjian* 1592. Jehan Keupri, between Marash and Zeytun; 750 m.; acid sandstone rock; flowers small, bright yellow in loose heads ½″–1″ in diameter, leaves grey; 9 May 1934, *Balls* 1003.

This species is characterised by its obtuse oblong capsules and in this respect differs from the Cyprian material hitherto referred to it. The plant from Cyprus has elliptic acute capsules and is identified below as *A. cypricum* Nyárády. Three other species accepted by Nyárády are very closely allied to *A. condensatum*. These are *A. anatolicum* Hausskn. ex Nyárády, *A. filiforme* Nyárády and *A. venustum* Nyárády. It should be

*Of the many mountains so named this is probably the one lying north of Gaziantep, which the account of Aucher-Eloy's travels shows he visited.

noted however that the earliest specific name amongst these three is provided by *Odontarrhena lycia* Jord. et Fourr. (Brev. Pl. Nov. **2,** 3: 1868); this was based on Bourgeau, *Plantae Lyciae* no. 28 (in lacunosis subalpinis montis Elmalu), the same collecting which was named *A. venustum* var. *nebrodensiforme* by Nyárády. For the present I propose to leave the question of the specific limits of these plants in abeyance, and I am not transferring *Odontarrhena lycia* to *Alyssum* until its existence as a species distinct from *A. condensatum* can be more satisfactorily demonstrated.

A. cypricum *Nyárády* in Bul. Grâd. Bot. Cluj, **7,** 156 (1927). "*A. condensatum* Boiss. et Hausskn." sec. Boiss. Fl. Or. Suppl. 49 (1888); Holmboe, Stud. Veg. Cyprus, 89 (1914); Lindberg, Iter Cyprium, 17 (1946)—non Boiss. et Hausskn. *A. virgatum* Nyárády var. *mutabile* Nyárády, op. cit. 116.

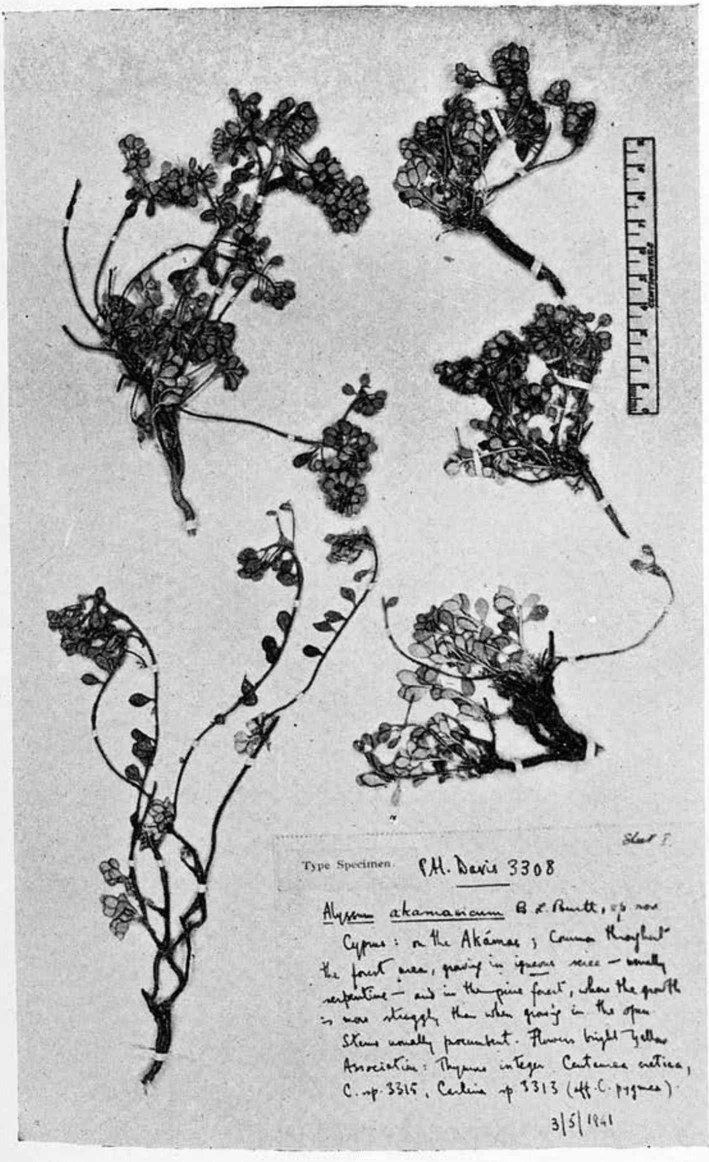
CYPRUS. Common on Mt. Troödos from 900–1920 m., the following herbarium numbers may be cited:—*Sintenis & Rigo* 843; *Kotschy* 703; *Ussher* 26; *Tracey* 22; *Syngrassides* 752; *Chapman* 60; *Davis* 1784, 1867, 3156, 3207; *Kennedy* 487, 488, 489, 490, 491, 492, 496.

Kotschy 703 is the type number of *A. virgatum* var. *mutabile* Nyárády; it is however nothing more than a shade form of *A. cypricum*. In the copious material of this group from the Troodos area which is now available for study, there is no suggestion of any other species occurring beyond *A. cypricum* and *A. troodi*. The type specimen of *A. cypricum* was collected by E. Deschamps in 1893 and is now in Freyn's herbarium at Brno. I have not examined it, but Nyárády's description and figures leave no doubt as to its identity.

A. akamasicum *B. L. Burtt*, sp. nov. inter species humiliores sectionis *Odontarrhenae* (C. A. Mey.) Koch ramis procumbentibus, indumento et caulium et foliorum et fructuum e pilis stellatis appressis subsquamiformibus composito insignis et nulli arcte accedens.

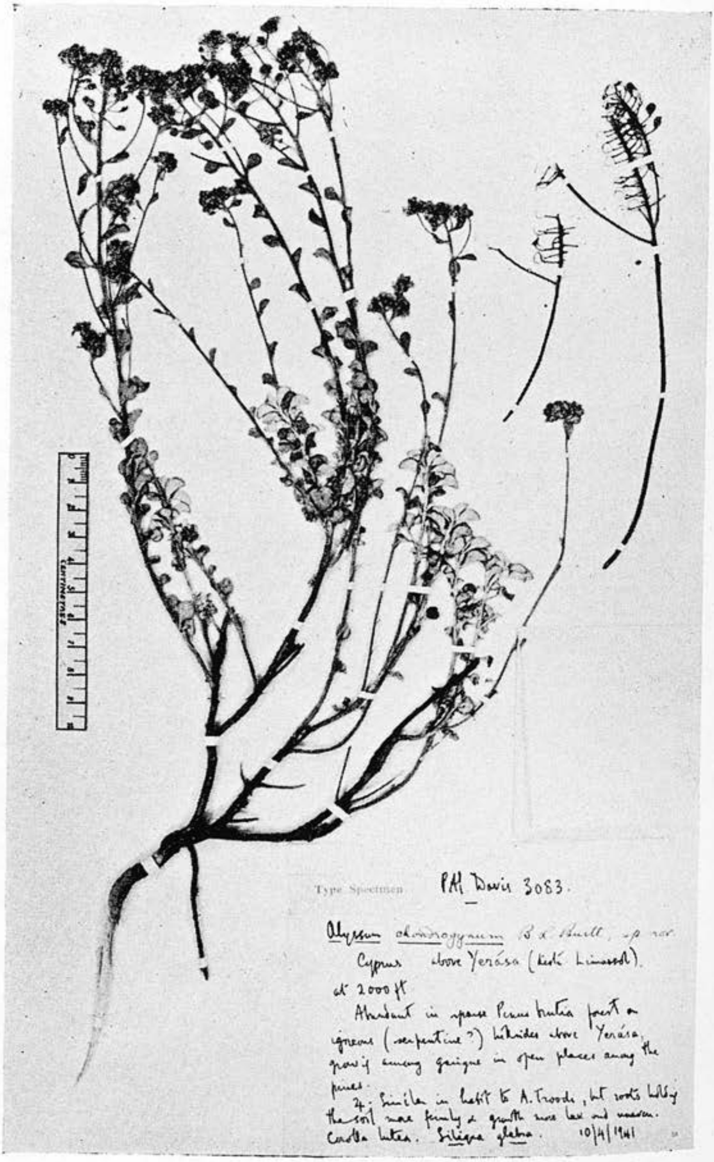
Herba perennis, suffruticosa, e basi ramosa; rami alii breves erecti 10 cm. usque alti, alii procumbentes 8–15 cm. vel ultra longi, omnes pilis albis stellatis multiradiatis valdissime appressis subsquamati. *Folia* obovata, circiter 1 cm. longa et 0·5 cm. lata, basi attenuata, apice obtusa, margine integerrima, plana, supra dense subtus densissime uti rami stellato-subsquamata. *Racemi* simplices vel ramis 2–3 angulo subrecto patentibus basi praediti; axis florifer brevis circiter 5 mm. longus, flores congesti circiter 15 gerens. *Pedicelli* floriferi circiter 2 mm. longi; fructiferi 5 mm. usque. *Sepala* 2·25 mm. longa, vix 1 mm. lata, oblonga, obtusa, navicularia, extra dense stellato-pilosa. *Petala* 3·25 mm. longa, 1·25 mm. lata, spatulata, apice leviter retusa, nervo medio utrinsecus 1 vel 2 laterales gerente percursa, glabra, lutea. *Filamenta longa* 2 mm., appendice tertiam partem aequante et ad medium filamentum cohaerente. *Filamenta brevia* 1·5 mm. longa, appendice medium filamentum aequante sed ad basin usque libera. *Antherae* vix 0·5 mm. longae. *Ovarium* obovato-suborbiculare, valdissime compressum, 1·5 mm. altum, 1·25 mm. latum, dense stellato-subsquamatum. *Stylus* 1 mm. longus, glaber. *Ovula* 2–3. *Fructus* 4·5 mm. longus, 4 mm. latus.

PLATE 3.



Alyssum akamasicum B. L. Burtt

PLATE 4.



Alyssum chondrogynum B. L. Burtt

CYPRUS. Akamas peninsula ; common throughout the forest area growing in igneous scree—usually serpentine—and in the pine forest (*Pinus brutia*), where the growth is more straggly than when growing in the open ; stem usually procumbent, flowers bright yellow ; in association with *Thymus integer*, *Aegialophila cretica*, *Centaurea veneris* and *Carlina pygmaea* ; 3 May 1941, *Davis* 3308 (type). Akamas forest ; 300 m. ; minute white [sic] flower confined to diallagitic rocks ; April 1937, *Chapman* 284.

A. chondrogynum *B. L. Burtt*, sp. nov. in sectione *Odontarrhena* (C. A. Mey.) Koch ovario tuberculato-papilloso insignis. Ceterum ad *A. elatum* Boiss. accedens sed illa species inflorescentia elatiore, pedicellis gracilioribus, ovario omnino glabro, inter alia distinguitur.

Herba suffruticosa, perennis, e basi ramosa ; rami erecti vel ascendentes, 20–30 cm. alti, pilis albis stellatis multiradiatis valdissime appressis subsquamati. *Folia* orbiculari-obovata, circiter 10 mm. longa et 8 mm. lata, basi subito attenuata, apice apiculo recurvo emarginata, margine integerrima, secundum costam plicata, supra dense subtus densissime uti rami stellato-subsquamata. *Racemi* terminales et ex axillis foliorum supremorum laterales, corymbum terminalem formantes. *Flores* dense congesti, post anthesin distantiores. *Pedicelli* floriferi circiter 2·5 mm. longi, ascendentes ; fructiferi 5 mm. usque, recte patentes. *Sepala* 2·5 mm. longa, 1·25 mm. lata, oblonga, obtusa, navicularia, extra dense stellato-pilosa. *Petala* 3·25 mm. longa, 0·75 mm. lata, obtuse oblanceolata, apice rotundata, nervo medio utrinsecus lateralem unum gerente percursa, glabra, lutea. *Filamenta longa* 2·5 mm. longa, appendice subaequilongo ad medium filamentum usque cohaerente. *Filamenta brevia* 2 mm. longa, appendice fere 2·5 mm. longa ad basin usque libera. *Antherae* 1 mm. longae. *Ovarium* obovato-suborbiculare, valdissime compressum, 1·5 mm. longum, 1·25 mm. latum, tuberculato-papillosum. *Stylus* 1 mm. longus, glaber. *Ovula* 2. *Fructus* primum tuberculato-papillosus, demum glabrescens, obovato-suborbicularis, 4 mm. longus et 4 mm. latus, basi abrupte angustatus, apice leviter emarginato, stylo persistente. *Semina* exalata.

CYPRUS. Limassol district, above Yerása ; 600 m. ; abundant in sparse *Pinus brutia* forest on igneous (serpentine ?) hillsides, growing among garigue in open places among the pines ; perennial ; similar in habit to *A. troodi* but the roots holding the soil more firmly and growth more lax and uneven ; flowers yellow ; 10 Apr. 1941, *Davis & Kennedy* (*Davis* 3083 : type).

A. rhodopense *Formanek* in Deutsch. Bot. Monatschr. **16,** 20 (1898) subsp. **armeniacum** *Nyárády* in Bul. Grâd. Bot. Cluj. **8,** 156 (1928).

Nyárády quotes under this subspecies Bourgeau *Pl. Armen.* 1862, no. 38. This number is, however, the type of *Odontarrhena bourgaei* Jord. & Fourr. (Brev. Pl. Nov. **2,** 4 : 1868). If the Armenian plant is really conspecific with Formanek's *A. rhodopense*, then the epithet proposed by Jordan and Fourreau has priority and must be taken up in *Alyssum*. I have not seen any material of the Armenian plant, however, and therefore refrain from taking any definite action pending an opportunity of its full investigation.

A. rubricaule (*Jord. et Fourr.*) *B. L. Burtt*, comb. nov. *Odontarrhena rubricaulis* Jord. et Fourr. Brev. Pl. Nov. **2,** 6 (1868).

TURKEY. Prov. Antalya (Lycia) : in lacunosis, Elmalu ; 17 May 1860 ; *Bourgeau*, Plantae Lyciae no. 25 (type). Armenia : Gumuschkane, Islavros ; 9 Aug. 1889 ; *Sintenis* 1683. Prov. Ankara (Galatia) : Beynam ; ledge of limestone rock in *Quercus* macchie ; 5 July 1947, *Davis* 13026.

This appears to be a good species. It is characterised by almost orbicular pods with sparse appressed stellate hairs and reddish stems with a similar indumentum. It is not mentioned by Nyárády.

A. troodi *Boiss*. Fl. Or. Suppl. 49 (1888) ; Holmboe, Stud. Veg. Cyprus, 89 (1914) ; Schulz in Fedde, Rep. Sp. Nov. **33,** 183 (1933) ; Lindberg, Iter Cyprium, 17 (1946). *A. coriaceum* Nyárády in Bul. Grâd. Bot. Cluj, **9,** 46 (1929), e descriptione.

CYPRUS. Common on Mt. Troödos from 1500–1920 m. ; the following herbarium numbers may be cited :—*Sintenis & Rigo* 844, *Chapman* 79, *Ussher* 49, *Wyatt* 19, *Syngrassides* 730, *Kennedy* 493, 494, 495, *Davis* 1783, 1805.

The type specimen of *A. coriaceum* Nyárády is *Kotschy* 771, which I have not seen. Nyárády was unacquainted with *A. troodi* except from Boissier's brief description. Comparing the copious material of *A. troodi* now available at Kew with Nyárády's description of *A. coriaceum*, there can be no doubt that they are conspecific.

B. L. B.

HYPERICUM L.

H. perfoliatum *L.* Syst. ed. 12, 510 (1767) ; Stefanoff in Jahrb. Land. Forst-wiss. Fak. Univ. Sofia, **11,** 32 (1933) ; Rechinger, Fl. Aegaea, 264 (1943). *H. ciliatum* Lam. Encycl. Méth. **4,** 170 (1796) ; Desf. Choix Pl. t. 53 (1808).

CYPRUS. Stavros-tis-Psochas, Paphos forest ; in woods ; perennial 1½ ft.high, leaves irregularly perforated ; 3 July 1940 ; *Davis* 1765.

This is apprently a new record for Cyprus. The specimen has been compared with the type in the Linnean herbarium ; it also agrees well with Desfontaines' illustration of Tournefort's Cretan plant which was described as *H. ciliatum* by Lamarck. *H. perfoliatum* has been recorded by Stefanoff for Central Spain and France, Italy, Istria, Dalmatia, Albania, Greece, Crete, Asia Minor (Lydia, Pamphylia), N. Africa and Madeira.

B. L. B.

GALIUM L.

G. exstipulatum *P. H. Davis*, sp. nov. *G. sinaico* (Decaisne) Boiss. affinis, sed foliis ellipticis et ovario floccoso differt.

Planta perennis, saxatilis, e basi suffrutescente pluricaulis. *Caules* decumbentes, tenues, 7–15 cm. longi, ad 1 mm. crassi, quadrangulares, scabri, internodiis 0·5–2·5 cm. longis. *Folia* opposita, bina, exstipulata, elliptica, 3–10 mm. longa, 1·5–4 mm. lata, subsessilia, plana, ±

mucronata, subtus prominenter uninervia ; folia floralia cymis breviora. *Cymae* aliquantum confertae, pauciflorae, in axillis longe pedunculatae, pedicellis capillaribus floribus brevioribus vel aequilongis. *Corolla* rotata, lutescens, laciniis oblongo-ovatis 1 mm. vel paulo ultra longis trinerviis extus sub lente scabriusculis in mucronem incurvum tenuiter abeuntibus. *Antherae* ovatae, 0·5 mm. longae. *Ovarium* pilis hamatis breviter albo-floccosum. *Fructus* ignotus.

TRANSJORDAN. Edom : Wadi Ram ; ca. 1000 m. ; in shady rocks of Nubian sandstone near the fort of the Arab Legion ; 15 Apr. 1945, *Davis* 9038 (type).

In its exstipulate leaves the new species approaches *G. sinaicum* (Decaisne) Boiss., from which it may be distinguished by its differently shaped foliage and floccose ovary ; it differs further in its more lax habit, generally longer peduncles and larger anthers. Whereas *G. sinaicum* is endemic to the rocks of southern Sinai, *G. exstipulatum* occurs in the Saharo–Sindian territory of Edom near the Arabian frontier. Both species are apparently reduced types, and owe their survival to their specialised habitats.

P. H. D.

CARLINA L.

C. barnebiana *Burtt et Davis*, sp. nov. ex affinitate *C. lanatae* L. et *C. pygmeae* (Post) Holmboe, ab illa habitu perenni, caule minus lanato, foliis angustioribus lineari-oblanceolatis (nec ovatis) segmentis lateralibus basi latioribus canaliculatis marginibus spinulosis in spinam desinentibus ; ab hac foliis subglabris summis capitula valde superantibus profunde pinnatisectis ad basin angustatis differt.

Herba nana, basi lignosa, ramosa, 8 cm. usque alta, perennis. *Caules* densiuscule foliati, tenuiter araneosi. *Folia* pinnatisecta, ambitu leviter oblanceolata, inferiora circiter 8–9 cm. longa et 2 cm. lata (segmentis basi 5 mm. latis inclusis), superiora paulo breviora et latiora segmentis basi angustioribus ; superiora inferioribus duriora magis pungentibus segmentis canaliculato-plicatis saepe basi margine distali segmenti spina decurva praeditis ; folia omnia marginibus spinoso-denticulata, utrinque primum leviter araneosa, glabrescentia ; folia summa capitulum superantia. *Capitula* terminalia, solitaria, supra folia sessilia, circiter 2 cm. longa et 1·5–2 cm. lata, extra araneosa. *Involucri bracteae* extimae elliptico-lanceolatae, 6 mm. longae, apice pungente acuminatae, per totam longitudinem capitulo appressae ; mediae sensim elongatae ; intimae apice conspicuo rubro-nitente 7 mm. longo praeditae. *Receptaculi paleae* albae, nitentes, in segmentis setiformibus ultra mediam fissae. *Flores* omnes hermaphroditi, corollis tubulosis 8 mm. longis apice 5-lobatis (lobis 2 mm. longis). *Antherae* 5 mm. longae, basi caudis ciliatis praeditae. *Stylus* 8 mm. longus apice biramosus, infra ramis annulo crasso pilifero praedito, rami breves, obtusi. *Pappi setae* circiter 50, pulchre plumosae, 8 mm. longae, basi leviter coalitae. *Achaenia* immatura cylindracea, 3 mm. longa, pilis appressis fulvo-sericeis obtecta et eis apicem superantibus pseudo-coronata.

E. CRETE. In schistosis maritimis inter claustrum Toplou et Siteia, copiose ; 19 Sept. 1938, *Barneby & Davis*, 1991 (type).

C. barnebiana is allied to the Cyprian *C. pygmaea* (Post) Holmboe with which it agrees in dwarf stature and perennial habit and to which it forms a parallel insular endemic. It is also related to *C. lanata* L., an annual species widespread in the Mediterranean and found both on Cyprus and on Crete.

B. L. B. & P. H. D.

C. corymbosa *L.* subsp. **graeca** (*Heldr. et Sart.*) *Rech. fil.* × **C. pygmaea** (*Post*) *Holmboe.*

Planta perennis inter parentes ± intermedia, variabilis. A *C. corymbosa* subsp. *graeca* statura nana (4–12 cm. alta), capitulis minoribus, phyllis externis brevioribus, radiis flavis plerumque extra macula purpurea notatis differt. A *C. pygmaea* foliis plerumque minus lanatis, phyllis externis acutioribus et saepe radios dissimiliter coloratos aequantibus recedit.

Cyprus. Kythrea, occurring sporadically among the parents on arid hills of shale and sandstone ; 22 Sept. 1940, *Davis* 1961. Ibid., 16 Sept. 1940, *Davis* 1954.

The specimens of this new hybrid were found scattered over a fairly large area round Kythrea, and show a wide range of characters intermediate between the parents. It should be noted here that *C. pygmaea* has a perennial fusiform root, a character which further distinguishes this attractive Cyprian endemic from *C. lanata* L. One plant of a white-flowered form of *C. pygmaea* (Davis 1959) was collected at Kythrea, though it retains the purple spot on the reverse of the *radii* characteristic of the type.

In the igneous Central range and Akamas peninsula of Cyprus forms of *C. pygmaea* were collected which differ somewhat from those of the Kythrean sandstones of the Northern range. The leaves tend to be more ample, are often purplish, and have a more sparse indumentum ; the outer involucral bracts tend to be broader. As it is possible that these characters are modifications—the igneous form occurs in woods of *Pinus brutia*—this form does not seem to warrant, in the absence of experimental data, taxonomic status. Gatherings of it may be seen in the Kew Herbarium.

In cultivation at Kew plants of *C. pygmaea* raised from seeds gathered at Kythrea have retained their perennial habit but grow considerably taller than in Cyprus.

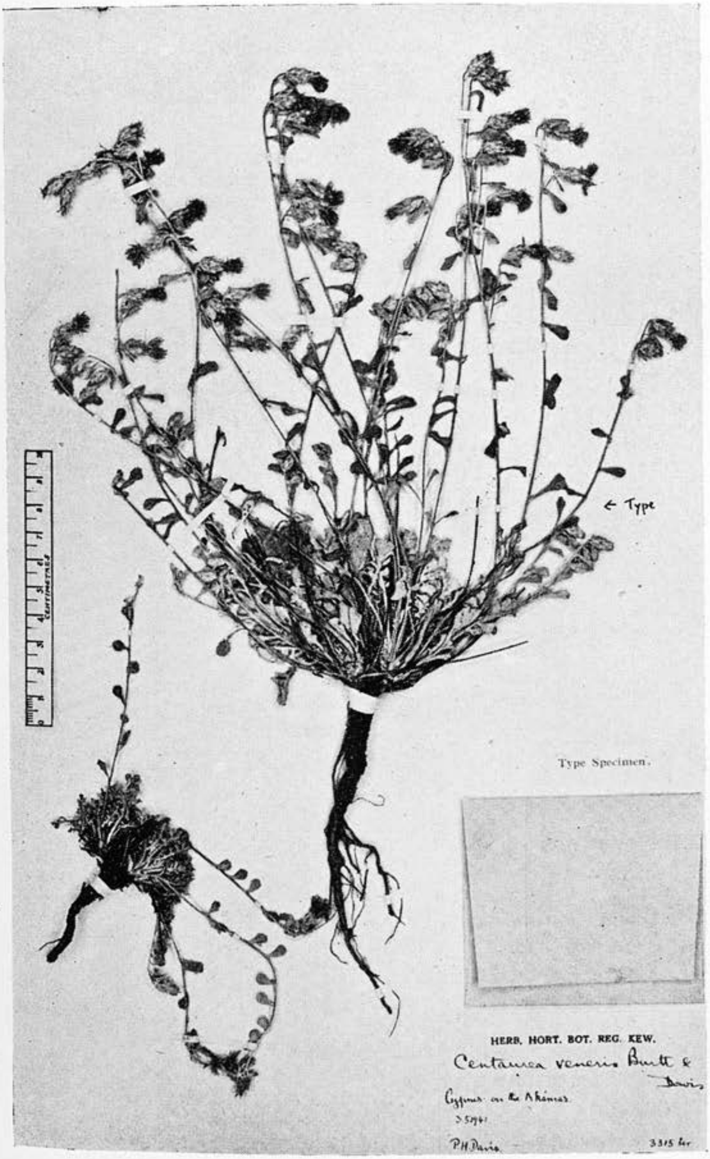
P. H. D.

Centaurea L.

C. veneris *Burtt et Davis*, sp. nov. in sectione *Acrolopho* (Cass.) Boiss. ponenda. A *C. cuneifolia* Sibth. et Sm. sens. lat. (Hayek, Prodr. Fl. Pen. Balc. **2,** 763 : 1931) caulibus e rhizomate valde perenni numerosis prostratis, segmentis foliorum basalium semper simplicibus, capitulis secundis vix paniculatis, pappo longitudine dimidium achaenii paulo excedente inter alia recedit.

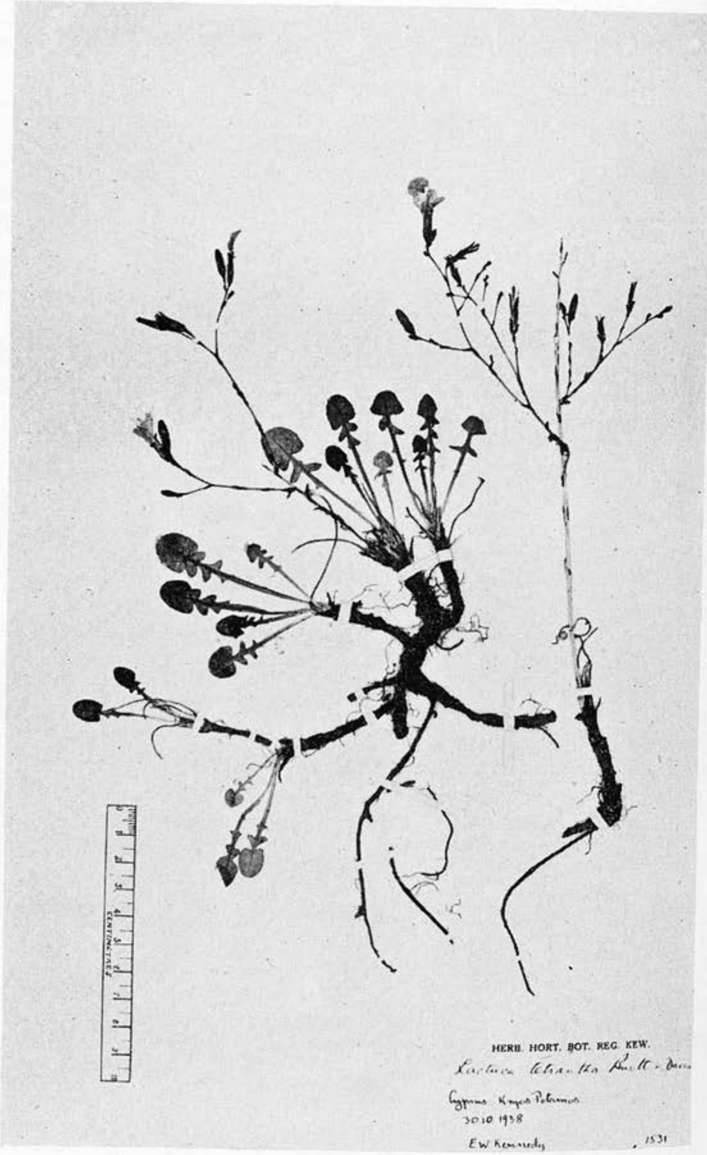
Planta perennis, caulibus e rhizomate lignoso ± numerosis 10–30 cm. longis gracilibus prostratis. *Folia* basalia albo-tomentosa, pinnatifida, ad 5 cm. longa, segmentis simplicibus vel integris vel subdentatis, terminali

PLATE 5.



Centaurea veneris Burtt et Davis

PLATE 6.



Lactuca tetrantha Burtt et Davis

suborbiculari quam lateralibus obovatis saepe majore ; folia caulina griseo-lanata, inferiora simplicia vel subpinnatifida, superiora omnia simplicia obovata integra, 1–1·5 cm. longa et 3–5 mm. lata, basi attenuata. *Capitula* pedunculata, ob caules prostrati secunda, unica, raro pauca in ramis brevibus ex axillis foliorum caulinum superiorum orientibus disposita, ovato-cylindrica, 8–12 mm. longa (floribus exclusis). *Involucri bracteae* appressae ; exteriores ovatae, acutae c. 5 mm. longae, pallidae, superne arachnoideae, nervis haud prominentibus ± 7-ciliato-pectinatae, mucrone terminali quam ciliis lateralibus albidis vix 1 mm. longis haud longiore ; interiores longiores (10 mm. attinentes), lineares, in appendicem subintegrum abeuntes. *Receptaculum* paleis 1·5 cm. longis dense setiferum. *Flores* roseo-lilacini, c. 20, involucro vix duplo longiores, marginales 7 radiantes, neutri ; interiores hermaphroditi, corollis c. 13 mm. longis ad 4 mm. 5-fidis, filamentis dense tuberculato-pilosis, antheris 5·5 mm. longis (appendice sterili 2 mm. longo incluso), stylo 11 mm. longo ramis brevibus obtusis. *Pappus* e setis rigidis supra albidis infra purpurascentibus externis 2 mm. longis quam internis saltem duplo longioribus compositus. *Achaenia* obovato-elliptica, nitida, fusca (immatura olivacea), hilo supra basin laterali, 3 mm. longa et 1·5 mm. lata.

CYPRUS. Akamas forest : April 1937, *Chapman* 283. Akamas peninsula ; locally abundant within the pine forest area, but found only on serpentine, growing in screes and rocky places with *Thymus integer*, *Carlina pygmaea* and *Alyssum* sp. [*A. akamasicum* B. L. Burtt—see p. 100]; 3 May 1941, *Davis* 3315 (type).

This rare and attractive species is apparently entirely confined to serpentine outcrops of the Akamas peninsula, avoiding not only the limestone but also adjacent igneous rocks other than serpentine. Its prostrate habit and undivided upper leaves render it very distinct from the erect *C. cuneifolia* S. & S. which has all its leaves pinnatisect. *C. veneris* is, in fact, an isolated species without any very close affinity.

B. L. B. & P. H. D.

LACTUCA L.

L. tetrantha *Burtt et Davis* sp. nov., *L. vimineae* (L.) Presl valde affinis sed habitu perenni, statura humili, caulibus collo lanigeris, in parte superiore subcorymbosis, foliorum basalium lobo terminali ovato-triangulari, foliis caulinis minus decurrentibus, capitulis semper quadrifloris, ligulis luteis extra cupreis divergit.

Radix perennis, ramosus. *Caules* 1–3, erecti, pallidi, glabri, 7–12 cm. alti (solum in umbrosis altiores) inferne haud ramosi, superne in inflorescentiam subcorymbosam abeuntes. *Folia* (axillis lanigeris exclusis) glabra, purpurescentia : basalia tandem marcescentia, plerumque 2·5–6 cm. longa, lyrata, runcinato-pinnatifida, ± 5-lobata, lobo terminali ovato-triangulari quam lobis lateralibus triangularibus ± reflexis multo majore, lano in axillis petiolorum attenuatorum valde conspicuo ; caulina parva, lanceolata, aliquantum breviter auriculato-decurrentia, superiora integra (summa diminutissima), inferiora, in axillis lanigera, saepe paucilobata. *Capitula* omnia quadriflora. *Involucrum* cylindricum, ad 1·8 mm. longum, purpurascens, phyllis paucis infimis ovatis internis linearibus. *Flores* 17 mm. longi : tubus 8 mm. longus, superne paulo inflatus pilosulus, inferne glaber, ligula 9 mm. longa, fere 4 mm. lata, lutea, extra cuprea, 6-nervata, apice abrupte truncata breviter 5-dentata, in dentes triangulares 0·5 mm. longos fissa ; antherae 5 mm. longae ; stylus 15 mm. longus, in parte superiore pilis ascendentibus pilosulus, apice biramosus, ramis fere 1·5 mm. longis recurvis obtusis. *Achaenia* (cum rostro) 10–12·5 mm. longa, inferne anguste elliptica 5–6 mm. longa, 1 mm. lata, nigra, 10–12 costata, transverse minutissime rugulosa, superne in rostrum aequilongum nigrum disco pallido terminatum sensim attenuata. *Pappus* 6 mm. longus, niveo-bombycinus ; setae sub lente barbellatae, conformes.

CYPRUS. Chionistra, due south ; 1620 m. ; in rock on the bare mountainside ; 20 Aug. 1937, *Kennedy* 997. Kryos Potamos ; 1650 m. ; in rock on the mountainside above the stream ; flowers golden yellow before drying ; 4 Sept. 1937, *Kennedy* 998. Chionistra ; 1890 m. ; in rock on the steep northern slope ; 10 Aug. 1937, *Kennedy* 1008. Kryos Potamos ; 1770 m. ; cracks of rock by the wintertime source of the river, now dry ; rocks joining ; 1 July 1939, *Kennedy* 1480, 1481. Kryos Potamos ; 1620 m., cracks of rock 50 ft. above the river ; 10 July 1938, *Kennedy* 1482. Chionistra, north-east ; 1800 m. ; cracks of rock in a rain gulley : 12 July 1938, *Kennedy* 1483. Kryos Potamos ; 1770 m. ; bare rock above the highest source of the river ; petals red outside ; 17 July 1938, *Kennedy* 1520. Kryos Potamos ; 1710 m. ; rock beside the dry river-bed, petals red outside ; 20 July 1938, *Kennedy* 1521. Kryos Potamos, 1680 m. ; bare rock ; flowers reddish ; the most frequent form above 1500 m., many patches of few plants ; 19 Aug. 1938, *Kennedy* 1525. Pass of Troödos, eastward ; 1650 m. ; rock under pine trees ; 26 Sept. 1938, *Kennedy* 1527. Kryos Potamos, 1695 m. ; beneath cool shady rocks on gentle slope to the river bed ; flowers reddish gold ; the usual form in small colonies ; 30 Oct. 1938, *Kennedy* 1531. Chionistra, 1800 m. ; under shrubs ; flowers golden purple yellow ; 6 Oct. 1937, *Syngrassides* 1688. Chionistra ; 1650–1860 ; serpentine screes and in open woods of black pine ; perennial ; capitula 4-flowered, ligules yellow with coppery reverse ; 19 Oct. 1940, *Davis* 1941 (type).

L. tetrantha, which is endemic to the high serpentine area of Chionistra (Troödos), can be distinguished at a glance from *L. viminea* (L.) Presl which also occurs there sporadically in a dwarfed but otherwise typical form. The new species can be recognized by the following features ; its perennial habit ; more or less corymbose inflorescence borne on stems unbranched below ; the woolly collar ; the comparatively large terminal lobe of the often purplish basal leaves ; the shortly decurrent cauline leaves ; the constantly four-flowered capitula with their characteristically coloured ligules (bright yellow with a coppery reverse). Although the achene of the new species is indistinguishable from that of *L. viminea* (L.) Presl, we consider the *ensemble* of other distinguishing characters justifies specific status. Alpine forms of *L. viminea* (L.) Presl have been seen, both in the herbarium and the field, from Morocco, Spain and the Antilebanon, but apparently do not differ from the typical form of that species in anything but their dwarf stature.

In comparison with *L. tetrantha*, it is interesting to note that *L. alpestris* (Gandoger) Rech. fil., with achenes distinct from those of *L. viminea* (L.) Presl, is confined to the high limestone mountains of Crete.

B. L. B. & P. H. D.

STAEHELINA L.

S. lobelii *DC.* in Ann. Mus. Paris, **16,** 194 (1810). *S. apiculata* Labill. Ic. Pl. Syr. **4,** 3, t. 1 (1812).

CYPRUS. Yaïla, Northern range ; 750 m. ; very rare, found only in crevices in large limestone rocks facing west, between Halefka forest station and the summit cliff of Yaïla, growing with *Umbilicus cyprius* ; forms a saxatile congested shrub up to 4 ft. across, with trunks like those of *S. fruticosa* ; flowering stems herbaceous, leaves bright green, viscid when young ; not more than 50 plants seen ; 27 Mar. 1941, *Davis* 2834.

This woody Composite has hitherto only been known from cliffs of Lebanon and Southern Anatolia. The species belongs to a small Mediterranean genus of dwarf, late-flowering shrubs ; of the six species four occur in the Eastern Mediterranean ; these are so distinct from one another that the great antiquity of the group cannot be doubted. The woodiest species in the genus, *S. arborescens* L., is endemic to the shady limestone precipices of Crete, where it occupies the northern side of the island, being replaced by *S. fruticosa* L. (which also occurs in a few small islands in the Dodecanese and S. Cyclades) on the vertical cliffs of the southern part. These two plants are so utterly unlike each other that one can hardly be considered as derived from the other ; they are evidently relict types, and their degree of affinity is not comparable to that of several other twin species in Crete [such as *Chionodoxa cretica* Boiss. and *C. nana* (Roem. & Schult.) Boiss., *Helichrysum siculum* (Spreng.) Boiss. and *H. heldreichii* Boiss., *Bellis longifolia* Boiss. et Heldr. and *B. silvestris* Cyr., *Hypericum empetrifolium* Willd. and *H. amblycalyx* Coust. & Gandog.] in which the relationship is very close. It is to one of these Aegean *Staehelinae* —*S. fruticosa* L.—that *S. lobelii* DC. is probably most closely related. In this connection it seems worth noting that the white flowers of both species smell strongly of Cherry Pie (*Heliotropium*). The fourth eastern species is *S. uniflosculosa* Sibth. & Sm. which has a fairly wide distribution in the Balkan peninsula, though not reaching the Cyclades or Crete ; it is not a cliff plant, but grows in open rocky woods. In the Western Mediterranean *S. dubia* L. occurs on open calcareous hillsides from Italy to Portugal and Morocco. *S. baetica* DC., a rare plant from Southern Spain (Estepona), is stated to grow in rocky and gravelly places, and is certainly very closely related to the widespread *S. dubia* L. In this calciphilous genus, as in many others, the saxatile habit is directly correlated with the rarity of the species and the development of woody stems. There is no doubt that the saxatile way of life is vital to the survival of such relicts. It reduces competition with larger life-forms, eliminates the effects of grazing and provides shade. Some Mediterranean plants exhibit a not very extreme saxicolous habit which is developed only at the edge of their range (as with *Hypericum lanuginosum* Lam. in Palestine) ; in such cases this habit is not a characteristic of the species as a whole, but is locally acquired in response to unfavourable conditions. In the case of *Staehelina lobelii* DC., *S. fruticosa* L. and *S. arborescens* L., however, the absolute fixity of an extreme chasmophytic habit in such widely different species suggests that this manner of living has been established for a very long time and may even have characterised an ancestral stock.

P. H. D.

Asyneuma Griseb.

A. pulvinatum *P. H. Davis* sp. nov. valde insignis, dense pulvinaris, foliis minutis rosulatis et inflorescentiis racemosis brevissimis saepe ad floram unicam reductis, valvulis in mediam capsulam sitis distinguitur.

Planta perennis, dense pulvinaris, saxatilis, ramis numerosis pseudo-dichotomis dense foliatis hemisphaeram ad 25 cm. diam. formantibus. *Folia* minuta, ad 8 mm. longa et 1·5 (1·75) mm. lata, lineari-elliptica, acuta, integra, basi paulo dilatata, sessilia, glaucescentia, margine ciliato excluso glabra, superne rosulata, inferne in senectute basibus pallidis solum persistentibus imbricata columnas formantia. *Inflorescentiae* 2–15 (20) mm. altae, simplices rigidae, pubescentes, foliis paucis vel nullis ut bracteis oblongo-lanceolatis minutissimis ; flores in racemum brevissimum 1–7-florum dispositi. *Pedicelli* 1–2 mm. longi, in axillis bractearum singuli, bracteolis lineari-lanceolatis minutissimis muniti. *Calyx* breviter pilosus, receptaculo late pyriformi 1–1·5 mm. longo, laciniis 2–3 mm. longis lanceolatis integris. *Corolla* pallide lilacino-caerulea fere ad basin in laciniis lanceolato-linearibus acutis 6 mm. longis 1·5 mm. latis glabrescentibus patentibus fissa. *Stamina* 5 mm. longa ; anthera oblonga, 3·5 mm. longa; filamenta dilatata, ciliata, 1·5 mm. longa. *Stylus* exsertus, 8 mm. longus, superne pilosulus, ad $\frac{1}{4}$ in ramos deinde recurvos trifidus. *Capsula* late ovata, 3 mm. longa, 2·5 mm. lata, versus mediam valvulis 3 praedita.

Turkey. Prov. Antalya (Lycia) : Tahtali Dağ (above Kemer) in rocks on N. ridge at the upper limit of the *Cedrus libani* ssp. *stenocoma*—*Carpinus orientalis* zone, 1900–2000 m., 16 Aug., 1947, *Davis* 14163. Tahtali Dağ, in cliffs below Çukur yaylâ, about 1500 m., flowers lavender blue, leaves glaucescent, 17 Aug. 1947, *Davis* 14149 (type).

This beautiful dwarf species cannot be satisfactorily related to any other, though the median position of the capsular valves suggests a possible affinity with the perennial *A. psilostachys* (Boiss.) Bornm. or *A. amplexicaule* (Willd.) Handel-Mazzetti. Its dense cushion habit, however, and minute distinctively shaped leaves arranged in numerous rosettes, are unique. It holds an isolated position in its genus that parallels that of *Diosphaera asperuloides* (Orph. et Boiss.) Buser in its own, and there can be no doubt of its relict nature. *A. pulvinatum* P. H. Davis occurs in the hard limestone cliffs of Tahtali Dağ in Lycia—a hitherto unbotanised mountain that has produced several new species of remarkable distinctness. It grows in crevices of either vertical or sloping rock, and is locally the dominant chasmophyte, forming hard mounds up to 25 cm. across and flowering most freely in the sun. The forked stems composing the hummock are covered with the imbricated leaf-bases of previous years' rosettes. By counting these the age of a tightly grown plant 15 cm. in diameter is estimated at not less than 40 years. During 3–4 (5) years the stems grow 1 cm. in length. The simple racemose inflorescences (with very short pedicels) rise singly from the rosettes of the current year ; they are rarely more than 15 mm. tall, being generally much shorter and often reduced to a single nearly sessile flower of light lavender-blue. In cultivation it retains its pulvinate habit. A new combination is required for another species of this genus from Asia Minor.

Asyneuma floribundum (*Stapf*) *P. H. Davis* comb. nov. *Podanthum floribundum* Stapf in Bot. Mag. t. 8936 (1922).

P. H. D.

Micromeria L.

M. carica *P. H. Davis* sp. nov. (Sect. *Pseudomelissa* Benth.) a *M. taygetea* P. H. Davis habitu elatiore, indumento sparso, cymis laxis quam foliis floralibus longioribus, calyce graciliore dentibus subaequalibus acuminatis, nuculis subapiculatis valde discrepat.

Caules basi indurati, numerosi, ascendentes, simplices vel inferne subramosi, gracillimi, 15–30 cm. alti, vix 1 mm. lati, sparse et breviter pubescentes, internodiis ad 3 cm. longis. *Folia* late ovata, brevipetiolata, integra, subapiculata vel saepe acutiuscula, ad 1 cm. longa (vel paulo longiora) et 6 mm. lata, ± velutina, virescentia, textura tenui, nervis lateralibus haud prominentibus. *Folia floralia* inferiora caulinis simillima, superiore ovato-elliptica sensim diminuentia, tandem minuta. *Cymae* plerumque 3–5-florae (aliquando redactae) ± laxae, foliis floralibus longiores, racemum longum et valde interruptum formantes, inferiores pedunculo capillari 5 mm. longo munitae pedicellis aliquantum brevioribus, bracteis subulatis minutis. *Calyx* tubulosus, superne sensim dilatatus, 2·5–3 mm. longus, 13-nervius, sparse glandulosus et pubescens, fauce nudus, ad quadrantem vel ad quintam partem in dentes triangulares subaequales breviter acuminatos acutos fissus. *Corolla* 6–7 mm. longa, glabra vel ± hirtula, lilacina, tubo sensim dilatato paulo exserto ; labium inferius trilobum, lobulis omnibus rotundatis mediano sinuato quam lateralibus et labio superiore emarginato longiore. *Antherae* tubo vix exsertae. *Nuculae* ovatae, 1 mm. longae, 0·5 mm. latae, apice brevissime subapiculatae, sub lente dense papillosae.

Turkey. Prov. Denizli (Caria) ; Boz Dağ (near Acipayam) above Geyran yaylâ ; 1500–1800 m. ; on outcropping limestone rocks in the black pine forest, local ; flowers mauve ; 16 July 1947, *Davis* 13422 (type).

M. cilicica *Hausskn. ex P. H. Davis* sp. nov. (Sect. *Pseudomelissa* Benth.). Species valde distincta, a *M. congesta* Boiss. et Hausskn. foliis haud integris calycis dentibus gracilioribus acutis, corollae forma, nuculis tenuioribus haud apiculatis discrepat. A *M. taygetea* P. H. Davis habitu elatiore, foliis majoribus crenato-dentatis, dentibus calycis acutis, corollae forma, nuculis gracilioribus distinguitur.

Caules 13–30 cm. alti, ad 1·5 mm. lati, erecti, quadranguli, simplices, breviter velutini, internodiis inferioribus saepe 2 cm. longis. *Folia* ovata, subobtusa, adpresse breviterque velutina, cano-virescentia, petiolo 2 mm. longo, lamina saepe 1·5 cm. longa et 8–9 mm. lata plana remote et minute crenato-dentata, nervis lateralibus 4–5, subtus valde prominentibus. *Folia floralia* inferiora caulinis simillima, superiora elliptico-linearia sensim diminuentia. *Cymae* 3–6-florae, compactae, foliis floralibus inferioribus breviores, in racemum valde interruptum (3–15 cm. longum) dispositae, inferiores pedunculo 2–3 mm. longo munitae, superiores brevissime pedunculatae, bracteis subulatis minutis. *Calyx* breviter tubulosus, 2 mm. longus, ± 13-nervius, sparse glandulosus, pubescens, fauce nudus, circiter ad trientem in dentes anguste triangulares acutos ± aequales divisus. *Corolla* 6 mm. longa, tubo exserto ; labia aequilonga, posterius emarginatum, anterius parce trilobatum lobulo mediano breviter subtriangulari lateralibus ovatis vix breviore. *Nuculae* ovato-ellipticae, obtusiusculae, 1 mm. longae, latitudine 2½-plo longiores, sub lente minute puberscenti-papillosae.

TURKEY. Cicilia, 1895, *Siehe* 315 (type).

M. taygetea *P. H. Davis* sp. nov. (sect. *Pseudomelissa* Benth.) a *M. carica* P. H. Davis habitu humiliore, indumento densiore, cymis compactis, dentibus calycis latioribus, nuculis obtusis differt. A *M. congesta* Boiss. et Hausskn. facie humiliore graciliore, foliis minoribus, cymis perpaucifloris racemum minus congestum formantibus, nuculis latioribus obtusis (haud apiculatis) recedit.

Planta perennis, saxatilis. *Caules* e rhizomate crasso lignoso erecti, quadranguli, graciles, 4–10 cm. longi (in culti longiores), fere 1 mm. lati, breviter velutini, internodiis ad 1·5 cm. longis. *Folia* late ovata, obtusa, patentia, brevissime et adpresse velutina, canescentia, petiolo ad 3 mm. longo, lamina ad 1 mm. longa et 6 mm. lata, integra vel subintegra, nervis lateralibus subtus ± prominentibus. *Folia floralia* inferiora caulinis simillima, superiora elliptico-linearia, sensim atque valde diminuta. *Cymae* 1–5-florae, compactae, foliis floralibus inferioribus breviores, racemum valde interruptum formantes, inferiores pedunculo 2–3 mm. longo munitae pedicellis brevissimis, superiores brevissime pedunculatae, bracteis subulatis minutis. *Calyx* breviter tubulosus, 2–3 mm. longus, 13-nervius, glandulosus, pubescens, fauce nudus, ad quadrantem in dentes breviter triangulares aequales apice calloso-obtusiusculo brevissime apiculatos fissus. *Corolla* 6 mm. longa, violascens pubescens, tubo calycem ± aequante superne sensim dilatato ; labium superius breve, valde sinuatum, inferius paulo longius, trilobum, lobulis omnibus rotundatis sinuatis mediano lateralibus subduplo longiore. *Stigma et stamina* anteriora tubo exserta. *Nux* late ovata, vix 1 mm. longa, obtusa, latitudine 1½-plo longior, sub lente minutissime papillosa.

GREECE. Laconia ; in rupium calcareorum fissuris montis Taygeti supra pagum Trypi; c. 1500 m.; 2 Oct. 1938, *Davis*. E seminibus in monte Taygeto Laconiae lectis educata, *Barneby & Ripley* (type).

The new Micromerias described above are morphologically very well distinguished from other members of the *Pseudomelissa* section, and their precise affinities are not easily determined. The Peloponnesian *M. taygetea* is of particular interest geographically, being related to Asiatic species rather than to any from the Balkans. *M. cilicica* was labelled as a new species under that name by Haussknecht on the herbarium sheet in the Kew Herbarium, but as a description has not been published I have supplied a diagnosis here.

Work on this group of Micromerias, which contains many very rare saxatile species, is hampered by the small amount of material in herbaria. Mention should be made of *M. shephardi* Post, originally described from the Syrian desert, of which I have not seen any specimens. In his diagnosis Post compared this species with *M. mollis* Benth., but, so far as one can tell from the brief description and sketchy figure, it is nearly related to *M. congesta* Boiss. et Hausskn. (described from Cataonia) from which it seems to differ chiefly in its larger flowers. Valuable specific characters are found in the form of the corolla and nutlets, but these are seldom referred to in the early diagnoses of the *Pseudomelissa* species.

P. H. D.

Teucrium L.

T. cyprium *Boiss.* subsp. **kyreniae** *P. H. Davis* subsp. nov. a typo habitu laxiore virescente, foliis amplioribus, capitulis et floribus majoribus, laciniis calycis inferioribus manifeste acuminatis, corolla pallidissime citrina (haud pallide fusco-rosea) tubo graciliore divergit.

Suffrutex perennis, patule villosa, dense glanduloso-punctata, viscida, aromatica, ramis novellis aliquantum numerosis decumbentibus simplicibus vel sparse ramulosis, 5–15 cm. longis. *Folia* brevipetiolata, obovata, basi cuneata lanato-villosa, virescentia, 4–15 mm. longa, 2–8 mm. lata, praecipue in parte superiore crenulata, plana vel marginibus subrevoluta. *Capitula* rotunda, plerumque 20–30-flora, 2 cm. lata ; folia floralia elliptica, subintegra, calyce vix longiora. *Calyx* brevipedicellatus, tubuloso-campanulatus, extra villosus, intus sparse pubescens, 7 mm. longus, 3 mm. latus, dentibus 3 superioribus triangularibus acutis fere 2 mm. longis, 2 inferioribus triangulari-lanceolatis acuminatis 2·5 mm. longis. *Corolla* pallidissime citrina, 11–12 mm. longa, extra hirsuta, inferne glabra, tubo cylindrico 5 mm. longo, 1 mm. diametro ad faucem pubescente ; labii lobus medius $\pm$ rotundus, 3 mm. diametro, concavus ; lobi laterales anteriores oblongi, obtusi, fere 2 mm. longi, marginibus revolutis ; posteriores oblongo-lineares, obtusissimi, plani, 3·5 mm. longi, 1 mm. lati. *Filamenta* 3·5 mm. et 5 mm. longa, sparse pubescentes. *Antherae* rubro-fuscae. *Stylus* 0·9–1·2 mm. longus, glaber. *Nuculae* ovatae, reticulo-malleatae, 1·5–2 mm. longae. Floret praecipue probabiliter ad finem veris.

Cyprus. In the following localities of the Kyrenia range :—Yaila; 600 m. ; crevices of limestone rocks on N. side ; flowers creamy to lemon yellow, plant very aromatic ; 23 May 1941, *Davis* 3608. Buffavento ; 900 m. ; limestone mountain rock ; flower yellowish with dull pink ; 28 July 1938, *Kennedy* 1502. N. side of Yaïla near Halefka ; 600–750 m. ; saxatile in N. facing cliffs of Trypanian limestone ; woody at base, prostrate, corolla yellowish white, plant covered with yellowish viscid glands, very aromatic ; 4 Aug. 1940, *Davis* 1921 (type). Larnaca-tis-Lapithou ; 300–450 m. ; saxatile in sunny limestone rocks ; corolla pale creamy yellow, anthers reddish brown ; 3 Jan. 1941, *Davis* 2084. St. Hilarion ; 690 m. ; limestone rocks near the top of castle enclosure, scarce ; 24 Nov. 1940, *Davis* 2044. Seen also above Agirdha by Davis.

The new subspecies is separated both ecologically and geographically from the type, the latter being a plant of the igneous central range of Cyprus, while the subspecies is confined to the limestone rocks of the northern (Kyrenia) range. Similar instances are known of parallel endemics in these two island ranges, treated at specific and subspecific level, in *Arabis*, *Sedum* and *Pterocephalus*. Their occurrence is evidently related to the geological history of the island, the Messaria plain, which now joins the two mountain areas, being apparently under the sea during the latter part of the Pliocene (when the land connection with continent was also broken) and early Quaternary times.

In the central massif *T. cyprium* Boiss., as pointed out by A. K. Jackson (Hook. Ic. Pl. ser. 5. **4,** t. 3328) occurs in two forms (modifications ?) related to woodland and exposed sunny habitats respectively. Boissier's type belongs to the woodland form with wider, flatter leaves (fragments of *Pistacia* are lodged in the specimen at Kew) whereas the description of *T. cypricum* Post (later synonym for *T. cyprium* Boiss.) is apparently based on the condensed and woollier sun form having smaller leaves with revolute margins. The latter in cultivation at Kew simulates the shade form in Cyprus.

Specimens of *T. davaeanum* Cosson, endemic to Cyrenaica, have not been seen, but the illustration of this species in Durand & Baratte, Fl. Lib. Prodr. t. 15 (1910) does not convince me that the Cyrenaican plant, with its strongly bullate foliage, is conspecific with *T. cyprium* Boiss. as suggested by Jackson (l.c.). When material of *T. davaeanum* Cosson becomes available it will be necessary to reconsider its status and that of *T. cyprium* Boiss. ssp. *kyreniae* P. H. Davis, in relation to the type of *T. cyprium* Boiss. The Aegean *T. alpestre* S. & S. is less closely related.

N. Y. Sandwith (J. Bot., Lond. **79,** 34-35: 1941) has already drawn attention to the occurrence of *Galium recurvum* Req. ex DC. and *Euphorbia sintenisii* Boiss. & Freyn in Cyprus and Cyrenaica, and further stressed the vegetational affinities of Cyrenaica's *altipiano* with the Eastern Mediterranean. In the limestone cliffs of the Kyrenia range two other significant links, besides the *Teucrium*, are found with the Cyrenaican flora : these are the monotypic Ericaceous genus *Pentapera* Klotzsch (represented in Cyprus by *P. sicula* Klotzsch var. *libanotica* Barbey), and *Silene fruticosa* L. (represented in Cyrenaica by ssp. *cyrenaica* Bég. et Vacc.). Both these species have a very disjunct distribution, and though they occur in Sicily, it is noteworthy that neither is found in Crete—an island which shows interesting floral affinities with Cyrenaica, especially in its western part.

T. cyprium Boiss. subsp. *kyreniae* P. H. Davis differs from the type in its more lax habit, ampler green leaves, larger heads and flowers, markedly acuminate lower calyx teeth, and pale lemon-coloured (as distinct from very wan brownish-pink) corolla with a more slender tube. Some shade forms of the type recall the plant of the Kyrenia range in habit and leaf, but the floral characters remain constant, and under cultivation the characteristic flower colours of the two plants are maintained. The calyx teeth of *T. cyprium* Boiss. are rarely as blunt as those figured in Hooker's Icones Plantarum (l.c.) P. H. D.

GALANTHUS L.

G. cilicicus *Baker* in Gard. Chron. ser. 3, **21**, 214 (1897).

LEBANON. Dahr-ul-Baydar (pass between Beirut and Damascus); 17 March 1934, *W. A. West.* P. H. D. & F. C. STERN.

G. fosteri *Baker* in Gard. Chron. ser. 3, **5,** 458 (1889).

S. LEBANON. Above Jezzin ; 990 m. ; ledge of shady limestone rock with *Scilla cernua* in *Quercus calliprinos—Pistacia palaestina* macchie ; leaves flat, flaccid, green ; 14 Mar. 1943, *Davis* 5392.

This species has not hitherto been found south of the Amanus Mountains in Turkey, and constitutes the most southern specific record for the genus. Siehe, however, in a letter to Gottlieb-Tannerheim (Studien uber die Formen der Gattung Galanthus, in Abhandl. K. K. Zool-Bot. Gesellsch. Wien, **11,** (4), 72 : 1904) reports the presence of an unidentified *Galanthus* in the valley of Nahr el Ibrahim, north of Beirut. Dr. N. Feinbrun has kindly confirmed the determination of *G. fosteri* Bak.

P. H. D.

G. graecus *Orphan.* apud Boiss. Fl. Or. **5,** 145 (1882).

SAMOS. Mt. Kerkis ; 1200 m. ; collected spring 1940, cultivated in Sussex ; leaves glaucous, somewhat twisted ; *Davis*.

A new record from Samos, though Rechinger (Fl. Aegaea, 735 : 1943) reports *G. elwesi* Hook. from the same locality.

P. H. D.

ALLIUM L.

A. autumnale *P. H. Davis* sp. nov. (Sect. *Codonoprasum* (Reichb.) Endl.), ob spatham univalvam et flores valde serotinos *A. callimischon* Link affinis, sed bulbi tunicis senectute haud fibrosis, scapo altiore, spatha umbella ± breviore patente vel deflexa (haud erecta pedicellos amplectante) tepalis ellipticis fuscis, capsula latiore facile distinguenda.

Bulbus ovoideus, ad 2·5 cm. longus et 1·5 cm. latus, tunicis papyraceis albidis externis deinde vix laceratis haud fibrosis. *Scapus* plerumque 25–50 cm. altus, striatus, prope ad apicem vaginatus et foliatus. *Folia* plerumque duo (raro tria), anguste filiformia, ad 40 cm. longa, 2 mm. lata, fistulosa semi-teretia haud vel vix canaliculata, glaucescentia, evanescentia. *Spatha* univalva, lanceolata, in rostrum attenuata, 2–3 cm. longa, umbella plerumque paulo brevior, patens vel deflexa, ad basin pedicellos vix amplectans. *Umbella* 10–30-flora, capsulifera, laxa, pedicellis inaequalibus tenuibus, 1–3 cm. longis, juventute nutantibus, in fructu erectis subfastigiatis. *Perigonium* campanulatum tepalis subconformibus ellipticis obtusisissimis fuscis vel roseo-fuscis, plerumque 5–5·5 mm. longis, 2·5–3 mm. latis, dorso obscure lineatis, interioribus manifeste convexis. *Stamina* filamentis anguste lanceolato-subulatis integris perigonio ± aequilongis, antheris 1 mm. longis flavis. *Ovarium* anguste ovatum. *Stylus* tandem ad 3 mm. longus, exsertus. *Capsula* matura late obcordata, perigonio paulo brevior, 4·5 mm. longa, 5·5–6 mm. lata. *Semina* subovata, complanata, nigra, breviter rostrata, 3–4 mm. longa, 2 mm. lata. Floret Oct.–Nov.

CYPRUS. Kyrenia district :—Near Myrtou ; 300 m. ; among phrygana on steep marl slopes facing north ; flowering before the rains ; leaves hysteranthous ; tepals brown or pinkish brown with a darker fascia ; spathe 1-valved ; filaments simple ; flowers at first pendant, then held erect on lengthening pedicels ; bulb smelling of garlic; 14

Oct. 1940, *Davis* 1967 (type). Vasilia ; in garigue on limestone and marl hillside ; 3 Nov. 1940, *Davis* 2015. Akanthou ; 150–450 m. ; among garigue on north—facing hillsides of limestone and sandstone rock ; leaves coming after rain, somewhat glaucous ; 10 Nov. 1940, *Davis* 2023. Troödos range : Platres ; 1200 m. ; mountainside under pines ; igneous rock ; tepals dirty white suffused with dull pink, the veins reddish brown ; 2 Oct. 1938, *Kennedy* 1587. East of Platres ; banks of Mesopotamos road, in the hedge, among vineyards and pine trees ; 1200 m. ; 12 Dec. 1936, *Kennedy* 1588.

The autumn-flowering habit of this very distinct species has no doubt accounted for its being overlooked by earlier botanists. Occurring in very different types of soil, it may well prove fairly widepsread, though local, in the lower parts of Cyprus. It normally begins to flower before the autumn rains, the leaves appearing later. *A. autumnale* is so distinct taxonomically that its affinities are hard to determine. In its one-valved spathe and late-flowering habit it resembles *A. callimischon* Link from the south of Greece, the Cyclades and Crete, but differs markedly from that species in the characters cited in the diagnosis.

P. H. D.

Orchis L.

O. punctulata *Stev. ex Lindl.* Gen. & Sp. Orch. 273 (1835).

Cyprus. Kyrenia district :—Near Myrtou ; 50 m. ; on dry banks, 10 Feb. 1939, *Lady Loch* 67. Between Ayios Amvrosios and Akanthou ; in shrubby ground ; *Davis* 2172.

These discoveries confirm the solitary record of the species from Cyprus given by Soó (see reference below).

O. quadripunctata *Cyrillo* ex Ten. Prodr. Fl. Nap. p. LIII (1811).

Cyprus. Stavrovouni ; 600 m. ; 28 March 1934, *Syngrassides* 1930 : same locality, up to 900 m. ; in maquis on hillside ; 20 Mar. 1938, *Lady Loch* 43. Lefkara ; chalk hill above town, 660 m. ; 19 Mar. 1946, *Davis* 2769. Limassol district, Kaminarka ; on limestone ; 15 March 1941, *Kennedy* (*Davis* 2628).

The discovery of this delightful little species confirms the single record, *Kotschy* 417 from Mt. Buffamente (Buffavento), given by Soó (Rev. Orch. Sudosteur. & Sudwest-asiens ; Bot. Arkiv, **23,** 1928).

V. S. S.

Platanthera L. C. Rich.

P. holmboei *Lindb.* in Soc. Scient. Fenn. Årsbok, **20**, B, no. 7 (1942).

Cyprus. This species apparently occurs in a number of localities at higher altitudes (750–1800 m.) under pines or in garigue by streams, in the igneous Troödos massif.

The following specimens are in the Kew Herbarium :—*Kotschy* 755 ; *Feilden* ; *Kennedy* 271–277, 1511–13 ; *Syngrassides* 1593 ; *Davis* 3504.

Certainly quite distinct from *P. chlorantha* (Cust.) Reichb. with which it was formerly identified.

V. S. S.

SPIRANTHES L. C. RICH.

S. spiralis (*L.*) *Chevall.* Fl. Paris, **2**, 330 (1827).

CYPRUS. Kyrenia district, Vasilia ; 150 m. ; 11 Nov. 1940, *Davis* 1994.

This is the first record of this species from Cyprus. It is known from Greece, Crete, Asia Minor and Syria.

V. S. S.

A NEW SPECIES OF ISACHNE FROM INDIA.

N. L. BOR.

Isachne sikkimensis *Bor*, sp. nov. *I. dispari* Trin. similis, sed ab ea spiculis majoribus flosculis similibus haud disparibus, foliorum laminis pilosis recedit.

Gramen annuum. *Culmi* ad 10 cm. alti, basi decumbentes, radicantes, demum erecti, laeves glabrique, nonnihil purpurei, nodis barbati, striatuli, foliorum vaginis tecti. *Foliorum laminae* ad 7 cm. longae, 7 mm. latae, superiores multo longiores, lanceolato-lineari-acuminatae vel lineari-acuminatae, basi nonnihil rotundatae, utrinque brevissime pilosae, marginibus scabrae ; *foliorum vaginae* laxae, pilosae, inferne nonnullis longis pilis instructae ; *ligula* ad seriem pilorum longorum redacta.

Panicula brevis, 4 cm. longa, adscendentibus flexuosis minutissime scaberulis ramis ; spiculae longe-pedicellatae ; pedicelli sine glandulis. *Spiculae* 2·25 mm. longae, ambitu ovato-oblongo-acutae vel elliptico-acutae, 2-flores. *Gluma inferior* 2·25 mm. longa, explanata latissime elliptica, apiculata, 5–7-nervis, late marginibus hyalina, ceterum paene coriacea, glabra ; nervi dorso prominentes. *Gluma superior* 2 mm. longa inferior similis. *Anthoecium inferum* ♂ ; *lemma*, a dorso visum, oblongo-ellipticum, 1·5 mm. longum, textu membranaceo-coriaceum, 1-nerve, glabrum laeveque, marginibus anguste inflexum ; *palea* ovato-acuta, lemmati paullo brevior, textu similis ; antherae 3·6 mm. longae. *Anthoecium superum* hermaphroditum ; *lemma* a dorso visum ambitu elliptico-acutum, glabrum laeveque, marginibus angustissime inflexum, 1·5 mm. longum ; palea lemmati similis sed brevior ; *antherae* 3, 1 mm. longae ; *styli* 2 ; *stigmata* plumosa.

SIKKIM. Karponang, 2800 m., 5 Aug. 1945, *Dr. Bor's collector*. (typus in Herb. Kew.) ; Lachoong 3–3500 m., 29 Aug. 1849, *Hooker fil.*

Bulletin of the Bengal Botanical Society.* We are in receipt of the first two numbers of a newly published journal. Each number contains about eighty pages with nine original papers, in various branches of botany. It is gratifying to note some of the interesting and valuable papers on economic and decorative plants like rice, jute, mango, banana and *Bignoniaceae*. It is not possible to discuss the papers individually, and only a few general remarks are given below. It appears that both these numbers were produced somewhat in a hurry as there is a noticeable lack of care in the preparation of the manuscripts and also in their editing. The journal abounds in typographical, orthographical and even taxonomical errors, many of which could have been avoided by an energetic editorial board. It may be possible that some of the errors were due to the authors working in isolation, and in these days of specialisation, such a possibility could not be avoided without assistance from workers in other branches. This is specially noticeable in a paper dealing with the "Fungous flora of Calcutta and suburb." The author has taken considerable pains to cite the correct names and synonyms of the fungi on one hand, and equally neglected the names of the host plants on the other. As a result, he has at least in one instance conveyed an entirely erroneous idea. For example one of the host plants of *Fomes fastuosus* Lev. is given as *Terminalia tomentosa* Mart. ex Eich. [=*Buchenavia tomentosa* Eich.] This plant is a native of Brazil and has not been recorded from India. Evidently, the author has confused it with *Terminalia tomentosa* W. & A., which is an Indian tree.

In the often repeated names of *Tectona grandis* and *Shorea robusta* the names should have been credited to Linn. f. and Gaertn. f. respectively, instead of Linn. and Gaertn. The name *Aegle marmelos* has been wrongly credited to Hook. & Arn. instead of to Correa. Further, the following correct names of host plants should have been used. The correct name stands second.

Peltophorum ferrugineum Benth.=*Peltophorum inerme* (Roxb.) Naves.
Cocoloba nufera L.=*Coccolobis uvifera* (L.) Bailey.
Eugenia jambolana Lam.=*Syzygium cumini* (L.) Skeels.
Poinciana regia Boj. ex Hook.=*Delonix regia* Raf.
Pithecolobium saman Benth. = *Samanea saman* (Jacq.) Merrill.
Moringa pterygosperma Gaertn.=*Moringa oleifera* Lam.
Artocarpus integrifolia L.=*Artocarpus integra* (Thunb.) Merrill.
Pongamia glabra Vent.=*Pongamia pinnata* (L.) Merrill.

The same reasoning which guided the author to use the correct names of fungi holds good for the phanerogamic plants. The common Bengali name for *Pterospermum acerifolium* Willd. appears to be *Kanak champa* instead of *Muchukunda*—an unfamiliar name.

There are a large number of keen botanical workers in Bengal and for want of a journal, an organised school, although overdue, has not developed. It is hoped that this new journal will bring the workers closer to each other, and we shall look forward with much interest towards further improvements in the journal.

D. CHATTERJEE.

*Edited by Dr. P. N. Bhaduri ; 35, Ballyganj Circular Road, Calcutta, 19. Annual subsciption, Rupees ten or fifteen shillings.

ex Kew Bull. 1949 (2)

GLAUCOSCIADIUM: A NEW MEDITERRANEAN GENUS OF UMBELLIFERAE.

B. L. BURTT AND P. H. DAVIS.

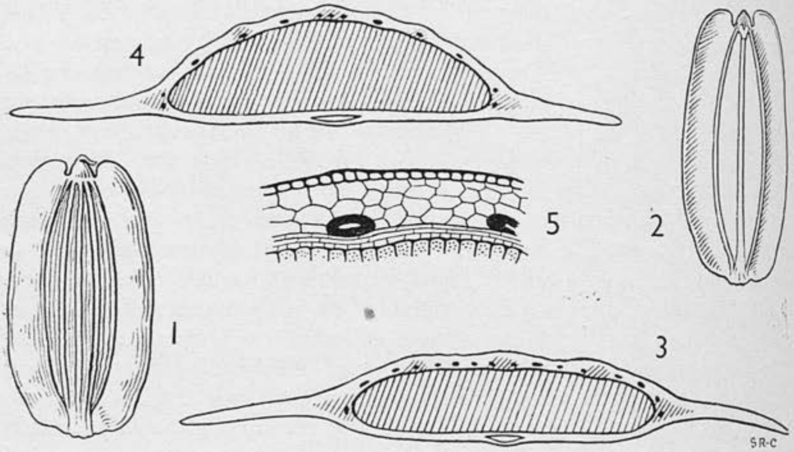
In 1888, in the Supplement to his Flora Orientalis, Boissier described the species *Siler* (?) *cordifolium* from material collected by himself on Mt. Cadmus in Caria and by Péronin near Ermenek in Cilicia Trachea. Fruits were not known at that time, and hence Boissier was doubtful as to the generic position of the plant. The next record for this species came when Post discovered it in Cyprus, probably in 1894. Post may have seen Boissier's material when identifying his specimen, but, as there are certain small discrepancies between the Cyprus plant and Boissier's original description, we have sent a more recent Cyprus specimen to Geneva and the identity has been kindly confirmed for us by Dr. Becherer. Fruits were still unknown to Post, to Holmboe in 1914 and to Thellung in 1925. Copious fruiting material was collected on Cyprus in 1937 by Mrs. E. W. Kennedy, and Jackson & Turrill (Kew Bull. 1938, 465) have already noted that the fruit-characters clearly exclude the species from *Siler*; they suggested that it should either be removed to *Ferula*, or made the type of a new genus. The more detailed investigation now carried out confirms that *Siler* (?) *cordifolium* Boiss. must be ranked as an independent genus, which we have named *Glaucosciadium*. Its closest affinity is with the large genus *Peucedanum* L.

The first step in this investigation was necessarily to establish the type-species of the genus *Siler*. A considerable tangle of nomenclature used to surround this name, but fortunately it was elucidated by Thellung (see Le Monde des Plantes, no. 38–153, 4 : 1925). It is sufficient to repeat here that *Laser* Borkh. is the correct name for the genus referred to as "*Siler* Scop." or "*Siler* Crantz" by many authors, and its type-species is *L. trilobum* (L.) Borkh. The first publication of the genus *Siler* was by Philip Miller in 1754 (Gardener's Dictionary, ed. 4); the type-species is *S. montanum* Crantz (*Laserpitium siler* L.). *Siler* Mill. is retained as a genus distinct from *Laserpitium* L. by Thellung (in Hegi, Illustrierte Flora von Mittel-Europa, **5**, pt. 2, 1467 : 1926).

The genus *Laser* is probably monotypic. The association of *L. divaricatum* (Turcz.) Thellung with *L. trilobum* is not warranted, for the narrow leaf segments and habit of the former are utterly dissimilar, and the absence of the characteristic secondary ribs is an important technical difference. Turczaninow originally placed this species in the genus *Stenocoelium* Ledeb., but its position needs reinvestigation: it may be possible to include it in *Peucedanum*, though the habit of using that genus as a general dumping ground is to be discouraged.

Thellung made the combination *Laser cordifolium* (Boiss.) Thellung without seeing any specimens. The material now available shows that this species has a much compressed, weakly ribbed fruit with well developed marginal wings which rise up round the conical style base; there is a variable number (9–16) of slender, irregularly placed vittae on the dorsal side, but commissural vittae are completely absent. In contrast to this, the fruit of *Laser trilobum* is only slightly compressed, strongly ribbed, wingless and provided with a broad dome-shaped stylopodium;

there are 4 dorsal vittae lying singly between the strongly developed primary ribs and immediately below the more weakly developed secondary ones ; commissural vittae are also 4 in number. These differences are sufficient to show that the two species cannot be considered congeneric.



Glaucosciadium cordifolium (Boiss.) Burtt et Davis. 1, mericarp, outer surface, × 3 ; 2, mericarp, inner surface, × 3 ; 3 & 4, transverse sections of 2 mericarps to show variation in number and arrangement of vittae, × 12 ; 5, transverse section through outer wall of mericarp to show details of position of vittae, *much enlarged*.

A wide search through the genera in this part of *Umbelliferae* failed to bring to light any precise affinity for our plant ; a few cases of superficial resemblance were found (see below), but the only general relationship which could be established was with *Peucedanum* L. and its close allies. In addition to the fruit characters mentioned above, some salient features of *Glaucosciadium* to which we have paid particular attention are the following :—the vertical root is branched above into rhizomes spreading laterally and bearing scale-leaves ; there is no crown of fibres formed from the decaying leaf-bases of the radical leaves ; the whole plant is strongly glaucous ; the leaflets are broadly ovate with thickened entire margins ; the stem is more or less smooth and possesses solid pith.

It is very difficult to generalise about the genus *Peucedanum*, of which *P. officinale* L. may be taken as the standard species (Green and Hitchcock in Proposals by British Botanists for International Botanical Congress, Cambridge 1930, 139 : 1929). Even when certain groups such as *Pastinaca* L. and the American *Lomatium* Rafin. are excluded, *Peucedanum* remains a vast assemblage of Old World species which shows a wide range of general facies and a considerable variation in the details of fruit-structure. In this group generic and subgeneric limits are greatly in need of re-definition.

We have examined all the material of *Peucedanum* in the Kew Herbarium and in every species we have found that commissural vittae are present. Only in *P. renardi* Regel & Schmalh. do they fail to reach to the base of the mericarp, a condition that is normal in *Pastinaca* L. and *Heracleum* L.

Whether this can be regarded as a step towards their complete disappearance is doubtful, as in these three examples the commissural vittae, though not running the full length of the mericarp, are very conspicuous. The genus *Steganotaenia* Hochst., which is also closely allied to *Peucedanum*, has fruits in which no vittae at all are developed. Its species are arborescent plants of tropical Africa, have simply pinnate leaves and are certainly less closely allied to *Glaucosciadium* than is *Peucedanum* itself.

We conclude from this survey that the presence of commissural vittae is a character of considerable generic constancy and therefore important and reliable taxonomically. By the absence of commissural vittae *Glaucosciadium* may be surely isolated from *Peucedanum* and the other genera closely allied to it. The further generic characters of *Glaucosciadium* are derived from the association of those salient features which have been mentioned above ; individually these characters appear occasionally in *Peucedanum*, but we have not found them associated together in any species of that genus ; they combine to give *Glaucosciadium* a most distinctive facies.

The genus *Ormosolenia* Tausch is now usually included in *Peucedanum*, and this treatment is probably unavoidable until the limits of the latter genus are thoroughly investigated ; then the claims of *Ormosolenia* to generic rank may perhaps be upheld. Certainly the two species concerned—*Peucedanum alpinum* (Sieber ex Schultes) Burtt & Davis* (from Crete) and *P. pisidicum* (Boiss. et Heldr.) Boiss. (from S.W. Anatolia)—are very distinct from the rest of the genus, and it is possible that they represent an affinity with *Glaucosciadium*. At first sight the difference in stature between these dwarf *Peucedana* and the robust erect plant from Cyprus is so marked as to make any close relationship seem highly improbable ; but there are other vegetative features which they share. It may be mentioned that we have had the advantage of studying some fine new material of the rare *P. pisidicum*, including ripe fruits.†

P. alpinum and *P. pisidicum* resemble *Glaucosciadium* in their branched rootstocks, more or less solid (though very slender) stems, radical leaves whose petioles do not split up into fibres as they decay, and glaucous leaflets. In the fruit, however, we find well developed commissural vittae as in other species of *Peucedanum*. It is particularly interesting to note that, although *P. alpinum* and *P. pisidicum* are very close in general characters, there is quite a range of variation in carpological details. Thus *P. alpinum* has one or two vittae between the dorsal ribs and 4–6 commissurally. *P. pisidicum* has (according to Boissier's description) 3

Peucedanum alpinum (*Sieber ex Schultes*) *Burtt et Davis*, comb. nov.

Sison alpinus Sieber ex Schultes in Roemer & Schultes, Syst. Veg. **6,** 414 (1820) ; Sieber, Reise nach Kreta, **1,** 472, **2,** 317, tab. 7 (1823).

Peucedanum creticum Sprengel, Neue Entdeck. **2,** 148 (1821), et in Syst. Veg. **1,** 911 (1825) ; Boiss., Fl. Or. **2,** 1021 (1872) ; Halacsy, Consp. Fl. Graec. **1,** 641 (1901) ; Hayek, Prod. Fl. Balc. **1,** 1036 (1927) ; K. H. Rechinger, Fl. Aegaea, 413 (1943).

Sison (?) *sieberianum* DC. Prod. **4,** 111 (1830).

Ormosolenia cretica (Sprengel) Tausch in Flora (oder Bot. Zeit.) 1834, 348 in nota.

†TURKEY. Prov. Antalya, distr. Kemer (Lycia) : Tahtali Dagh, 2100 m., loose scree facing north ; leaves thick glaucous, flowers pale yellowish-green, minute ; 16 Aug. 1947, *Davis* 14196.

It was at first thought likely that this material, due to apparent carpological differences and the invariably simple leaves, represented a new species distinct from *P. pisidicum* ; but Dr. Becherer has kindly compared a specimen with Boissier's original plants and reports that they are conspecific.

between the dorsal ridges and 6 commissurally, although in *Davis* 14196 the vittae between the ribs are solitary and there are only 2 on the commissure. In these species it appears that vegetative characters are less variable than are the details, though not the general form, of fruit-structure ; a similar fluctuation in the number of vittae is found in some species of *Ferula*. It may be mentioned that *P. alpinum* and *P. pisidicum* are placed by Boissier (Fl. Or. **2,** 1021 : 1872) in *Peucedanum* Sect. *Palimboidea* Boiss., the type-species of which appears to be *P. carvifolium* Vill. (*P. chabraei* Jacq.). The section is " characterised " by having 2–3 vittae lying in the valleys between the ridges, an extremely artificial classification that brings together species otherwise scarcely related and would, incidentally, exclude the new Turkish material of *P. pisidicum*.

The solid pith of *Glaucosciadium* is a somewhat unusual character in this group of genera. It is, however, also found in a few species of *Peucedanum* subgen. *Taeniopetalum* (Vis.) Thellung*, such as *P. arenarium* Waldst. & Kit., *P. neumayri* (Vis.) Reichb. fil. and their allies, which are otherwise widely separated from *Glaucosciadium* by their narrow leaf-segments and very fibrous leaf-bases.

A species in which the leaf-bases do not break up into fibres at the base, and in which the lowermost leaves are reduced to scales, is *Peucedanum ostruthium* (L.) Koch, the Masterwort. There is in this species, however, a little-branched creeping horizontal rhizome : the rootstock of *Glaucosciadium* is not creeping and is more or less vertical. *P. ostruthium*, in fact, only deserves mention as illustrating the occurrence of basal scale leaves in *Peucedanum*.

A plant which shows a much greater resemblance to *Glaucosciadium* is *Angelica strattoniana* Aitch. & Hemsl. from Afghanistan. Vegetatively, in fact, there is no significant difference to militate against their belonging to the same genus. Though the pith of the stem is not quite solid, the cavity is considerably smaller than the pith itself ; the most important discrepancy is that the leaflets are toothed. The fruits of *Angelica strattoniana* are, however, typical of its genus, the 3 dorsal ribs of each mericarp being developed into narrow wings ; commissural vittae are, of course, present.

There is a remarkable similarity in leaf-form between *Angelica strattoniana* and the Socotran *Peucedanum cordatum* Balf. fil., but in the latter the stem is quite hollow. Its fruits are more strongly ridged than is usual in *Peucedanum*, which may be interpreted as an approach to the winged ridges of *Angelica* and a character, together with the well-developed commissural vittae, dissociating it from *Glaucosciadium*. No rootstock is available for comparison.

Other species, which a superficial similarity in one or more characters has led us to compare more closely with *Glaucosciadium*, are *Peucedanum dhana* Buch.-Ham. (from India), and *Lomatium nudicaule* (Pursh) Coult. & Rose, *L. lucidum* (Nutt.) Jepson and allied species of this North American genus. The similarity of facies between these Californian *Lomatia*, the Afghan *Angelica strattoniana* and the Socotran *Peucedanum cordatum* is particularly striking. None of these trails, however, has led to any close

*In so far as they are applicable on a wider geographical basis we accept in this paper the generic limits given by Thellung in Hegi, Ill. Fl. Mitt. Eur. **5** (2), 1363 (1926).

affinity for *Glaucosciadium*, and these superficial resemblances in vegetative features may have been caused by parallel development. On the other hand, in a thorough study of this group of *Umbelliferae* the species just mentioned might possibly all be classed as relict types ; their community of vegetative features may really represent persistent characteristics of an old, and at one time more widespread, stock. Such speculation derives some support from the variation in carpological characters in *Peucedanum alpinum* and *P. pisidicum*, which are vegetatively very similar. Bentham & Hooker may have been struck by similar instances when they wrote (Gen. Pl. **1.** 861 : 1867) " genera Umbelliferarum ab auctoribus variis ad characteres futiles et quam maxime artificiales immoderate multiplicata, difficillime distinguuntur et ordinantur. Quae naturalia sunt saepe characteribus carent, et characteres e calyce petalis vittis et seminis facie sumpti species simillimas saepe longo tractu separant". We must hope that the characters of *Glaucosciadium* will not be termed futile by later workers !

Glaucosciadium *Burtt et Davis*, gen. nov. a *Peucedano* L. mericarpiis vittis commissuralibus carentibus, vittis dorsalibus tenuibus in pericarpio interiore irregulariter dispersis praesertim distinguendum. Etiam characteribus sequentibus conjunctis a *Peucedano* recedit : rhizomatibus ascendentibus ad apicem radicis crassi enatis ; caulibus solidis ; foliis infimis squamiformibus, vaginis petiolisque numquam in fibras dissolutis ; segmentis foliorum latissimis integris cartilagineo-marginatis coriaceis valde glaucis ; mericarpii alis tenuibus.

G. cordifolium (*Boiss.*) *Burtt et Davis*, comb. nov.

Siler (?) *cordifolium* Boiss. Fl. Or. Suppl. 263 (1888) ; Post in Mém. Herb. Boiss. no. 18, 94 (1900) ; Holmboe, Stud. Veg. Cyprus, 141, fig. 47 (1914) ; Jackson & Turrill in Kew Bull. 1938, 465.

Laser (?) *cordifolium* (Boiss.) Thellung in Le Monde des Plantes, no. 38–153, 4 (1925).

Perennial herb up to about 70 cm. high, strongly glaucous, with an acrid smell when bruised. *Root* vertical, dark brown, longitudinally fissured, deep-seated, supporting 1-few ascending rhizomes bearing semi-orbicular scale leaves. *Basal leaves* few (3–5), triangular-ovate in outline, up to 25 (–30) cm. long and 18 cm. broad, coriaceous, glabrous, very glaucous, sheaths ovate to oblong-lanceolate, ribbed and passing into the long striate petiole, old sheaths not breaking up into fibres, lamina pinnate with 1–3 pairs of lateral leaflets, the lowest often ternate ; leaflets ovate-orbicular, up to 7 (–8) cm. long and 5 cm. broad, unequally truncate and sometimes subcordate at the base, with radiating nerves and a pronounced webbing of reticulate venation ; shortly mucronate at the apex, margins entire cartilaginous whitish somewhat undulate. *Flowering stems* usually single from each crown, erect, laxly and sub-divaricately branched, 40–70 cm. tall, 3·5 mm. in diameter, glaucous, finely striate, the pith solid. *Lower stem-leaves* pinnate with 1–2 pairs of lateral leaflets, resembling the basal leaves but smaller. *Upper stem-leaves* reduced to ovate-oblong sheaths, the lower often drawn out into a short subulate petiole. *Umbels* compound, hermaphrodite, widely spreading, 6–13-rayed ; rays somewhat unequal, 1–3·5 cm. long, 0·5 mm. broad, rising from the knob-shaped apex of the common peduncle. *Involucre* poorly developed, consisting of a few triangular-subulate (often deciduous) scales. *Involucel* more or less obsolete. *Flowers* 15–25 in each umbellule, the outer 2–8 fertile on spreading pedicels 2–4 mm. long, the inner abortive, on very short pedicels. *Calyx* absent. *Corolla* regular, dirty white ; petals broadly ovate, acuminate, strongly incurved, webbed on the adaxial side, 1 mm. long. *Filaments* 1·25–1·5 mm. long ; anthers orbicular. *Ovary* 1 mm. long ; styles 0·5 mm. long, surmounting the large dome-shaped stylopodium. *Mericarps* elliptical, much flattened dorsiventrally, 10–12 mm. long, 5–6·5 mm. broad, 0·75 mm. thick, finally separating below from the carpophore ; dorsal ridges 3, slender, not prominent, about 0·75 mm. apart ; lateral ridges often slightly more distant from the dorsal ones, extending into a spreading wing ; wing 1–1·5 (–1·75) mm. wide, slightly tumid on the inner side but spreading into a thin flat margin, crossing the seed at the base and obscurely notched, at the apex rising sharply on either side of the persistent (0·75 mm. long) stylopodium, but scarcely overtopping it ; pericarp thin, especially on the commissure ; dorsal vittae 9–16, very slender, round or somewhat flattened, irregularly scattered on the inner side of the pericarp both beneath and between the ridges and often related to shallow depressions in the albumen, those running singly below the lateral ridges appearing faintly near the top of the commissural suture ; commissural vittae absent ; albumen slightly concave on the commissural side, light grey. *Embryo* small, straight, lying near the top of the albumen.

TURKEY. Lower regions of Mt. Cadmus, above Denisleh and Mesogis near Dervent (Caria) ; *Boissier* (sterile—not seen). In mountains near Ermenek (Cilicia Trachea), *Péronin* (fl.—not seen).

CYPRUS. Aphamis ; 900 m. ; limestone mountain, among garigue of *Genista sphacelata* and in vineyards; flower stalk has a bitter smell, herds crop only the young buds ; mericarp purple with white wings ; more plentiful than at 1050 m. ; 21 Aug. 1937, *Kennedy* 675. *Ibidem*, the vineyards had been cleared and the garigue about as far as might be ; the seed was dry and dropping, no rain had fallen and the ground was baked like a brick ; 2 Oct. 1937, *Kennedy* 675 A. Platres ; 1200 m. ; igneous rock ; a few plants on a shady slope towards a rain galley under pine trees and among bracken ; 29 Sept. 1937, *Kennedy* 676. Platres—Mesopotamos ; 1170 m. ; vineyard, among pine trees and garigue ; 17 Oct. 1938, *Kennedy* 1389. Aphamis ; 1080 m. ; limestone mountain ; vineyard ; young leaves dark green and red, with the look of young leaves of a garden rose; 21 April 1939, *Kennedy* 1390 A. Platres; 1200 m.; bank of a ravine among pine trees ; 17 Oct. 1938, *Kennedy* 1399. Perapedhi; vineyards in chalky marl; also on hillsides with *Scabiosa cypria* ; 12 July 1940, *Davis* 1835. Platres ; 1200 m. ; in vineyards, scarce ; leaves glaucous ; 12 July 1940, *Davis* 1848. Aphamis, above Perapedhi ; 1000 m. ; in vineyards on steep chalky hillsides ; glaucous perennial ; fls. creamy white ; 23 Oct. 1939, *Davis* 1978. These localities are all on the S. side or at the S. foot of the Troödos massif.

VEGETATIONAL SECTION

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 PRINTED IN GREAT BRITAIN

CLIFF VEGETATION IN THE EASTERN MEDITERRANEAN

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(*With Plates* 5–7 *and two Figures in the Text*)

CONTENTS

I. Introduction

The saxatile communities of the Mediterranean region have been very little investigated in regard to their ecology and phytosociology. The practical difficulties are very considerable, but, because of the occurrence of relict types in rock habitats, it seems desirable that these unique communities of vascular plants should be more extensively studied. Their analysis gives valuable clues to the history of the Mediterranean flora and climate.

This account, based on observations made during the last ten years, does not attempt a precise classification of rock communities; they are frequently fragmentary, and, due to the very restricted distribution of most exclusively saxatile species, they are exceedingly numerous. Eig (1938, p. 6; 1946, p. 223) has named a few saxatile associations in Palestine, but I am doubtful of the status of some of his units, and have in general preferred to indicate communities rather than to name them. The outstanding rock habitats of the Mediterranean are illustrated by reference to saxatile communities in Palestine where I have observed them more closely than elsewhere. However, my observations in the Aegean area (where, thanks to the rugged topography, crevice plants are particularly well developed), Lebanon, Turkey, Cyprus, Capri and Spain indicate that the rock habitats and associations of Palestine are fundamentally similar to those found elsewhere in the Mediterranean, and have a similar significance. Presentation of data is followed by a discussion of the problems presented by Mediterranean saxatile communities.

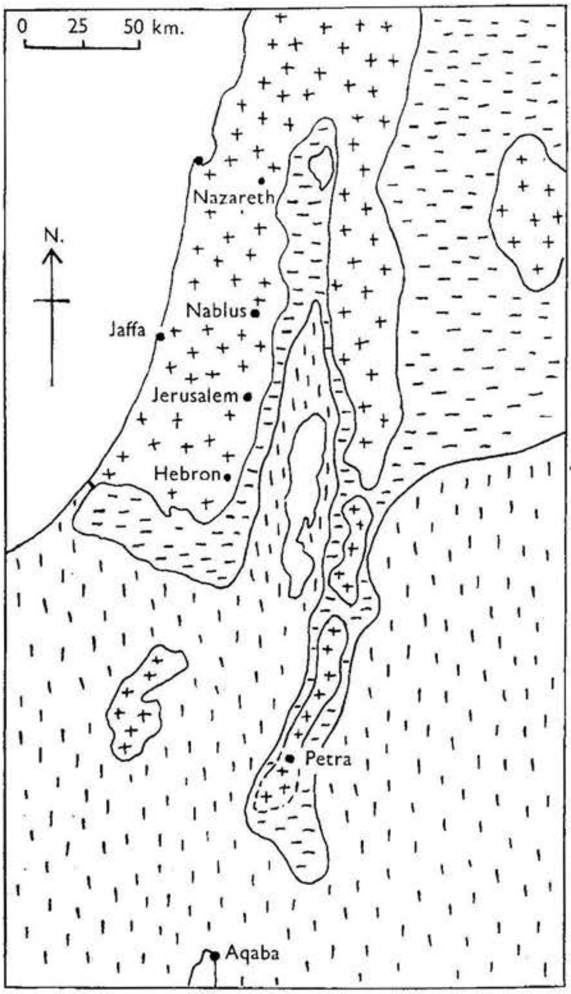


Fig. 1. The phytogeographical regions (Mediterranean, Irano-Turanian and Saharo-Sindian) of Palestine and Transjordan (after M. Zohary, 1942, in *Pal. J. Bot.* (Jerusalem Ser.), **2**, 207).
+ + + Mediterranean. - - - Irano-Turanian. ' ' ' Saharo-Sindian.

II. Palestine's phytogeography

Palestine, floristically and phytosociologically, is now the best-known country in the Eastern Mediterranean. Before describing its saxatile communities, the three phytogeographical regions that meet in Palestine and were first recognized there by Eig (1931, pp. 33–127) must be distinguished (Fig. 1).

(*a*) *Mediterranean territory*. This is the region richest in saxatile communities and with which we shall therefore be chiefly concerned. It extends from the Lebanon frontier along the coastal plain and the western slopes and summits of the Cis-Jordan range as far south as Hebron. The rainfall exceeds 35 cm. annually, falling, as in the rest of Palestine, almost entirely between October and early May. For the purpose of the study of rock vegetation we may recognize two divisions in this territory:

(i) Upper Galilee and Carmel, which receives the heaviest rainfall in Palestine (80–110 cm.). Its precipitation, coupled with lower temperatures, no doubt accounts for the area's relatively luxurious vegetation.

(ii) The rest of Mediterranean Cis-Jordan, from Nazareth to Hebron, where the vegetation is sparser, *Poterietum spinosi mediterraneum* Eig being the leading hillside community. The precipitation is between 35 and 80 cm., and the proximity of the steppe and desert has an unfavourable influence on the full development of Mediterranean communities.

(*b*) *Irano-Turanian territory* (*Mauritanian subregion*). Covering most of the Near Negeb, with Beersheba as its centre, this region extends in a narrow strip of steppe vegetation thence along the east flank of the Cis-Jordan range as far as the Lake of Galilee. The annual rainfall is between 20 and 35 cm., and the humidity is much less than in the Mediterranean territory. In my opinion, low humidity is generally the controlling factor separating the Irano-Turanian from the Mediterranean phytogeographical region.

(*c*) *Saharo-Sindian territory*. A desolate area, the Saharo-Sindian region is in some parts completely devoid of vascular vegetation; it occupies the Far Negeb and the Jordan Valley nearly as far north as Beisan. It therefore flanks the Jordan Valley's Irano-Turanian strip on the latter's eastern side. Precipitation is less than 25 cm. and is very irregular. Humidity, except along the shores of the Dead Sea, is exceedingly low, and temperatures are higher than in the other two regions.

III. Rock habitats and their plant communities in Palestine

(1) *Features of the habitat*

An account of Mediterranean saxatile communities is largely an account of the vegetation of compact limestone. In Palestine rocks of this type mainly belong to the Cretaceous Period (particularly the Cenomanian). They form the grand hill-side escarpments of Upper Galilee and the cliffs that flank the *wadis* (valleys) in much of the Cis-Jordan range, not only in the Mediterranean territories but also in the other two regions; they are the parent-rocks of *terra-rossa* in Palestine. Under the influence of selective erosion, the surface of the exposed rock weathers into narrow holes and crannies in which soil gradually accumulates; these are the habitat for *chasmophytes*, which may be defined as crevice plants independent of surface soil. In contrast to chasmophytes, *chomophytes* (which grow in layers of debris overlying lips and ledges of rock) are few and of local occurrence; the latter rarely grade, as they do in the moister climate of Britain (Tansley, 1939, p. 799) into chasmophytes.

The softer calcareous rocks of Palestine in general overlie the Cretaceous strata and are mainly of Eocene age. They consist largely of chalks and marls, and do not usually form cliffs. They weather to pale greyish soils more highly calcareous even than *terra-rossa*. In Samaria, however, more compact Eocene rocks form escarpments in the neighbourhood of Nablus. Maritime cliffs are very poorly developed.

For chemical details of the various soils of Palestine and their related plant communities, reference should be made to Zohary (1942, pp. 210–46). I have unfortunately not been able to distinguish dolomitic from non-dolomitic limestones, though Picard (1943, p. 35) states that Palestine, in contrast to Transjordan, is rich in dolomitic rocks.

The geographical limits of the saxatile communities are primarily determined by climate, and their local distribution by suitable exposures of rock. As the valleys on the east side of the Cis-Jordan range run from the Mediterranean watershed down to the Jordan Valley, they pass within a few miles through the three phytogeographical regions. This results in the penetration of certain species into climatic territories not originally their own. Because of the varied habitats a cliff provides, penetration has been in both directions.

In rock habitats—particularly those of cliffs—*aspect* is of great importance. Whether a cliff faces east or west seems to make little difference to the composition of rock communities; but whether the rock faces north or south is of considerable consequence. Even then, where many exclusive chasmophytes are concerned, the difference is often one of relative abundance of species, and is thus quantitative rather than qualitative. The effect of aspect is bound up with insolation (Boyko, 1947, p. 142) which depends mainly on aspect and the angle of slope (see below).

According to the aspect of the cliff, the *light supply* will be characterized by a reduction in intensity for longer or shorter periods as shadow falls over the face. The quality of the light is not changed, as it would be by diffusion through a leaf canopy. Any change from sun-light to shadow will necessarily be abrupt, thus putting a strain on the chasmophyte's ability to react physiologically.

The *differences in the minor habitats* of the rock face (unfortunately extremely difficult to investigate) are highly important in determining the differentiation of chasmophyte communities. Any large outcrop exhibits several such habitats, and each usually supports a distinctive crevice community. The habitats annotated below are of necessity classified according to their superficial differences, particularly their *angle of slope*. The distinctness of their plant communities, however, shows that external appearances reflect different conditions within the rock. For practical purposes, six habitats of consolidated rock are recognized here, and form a convenient basis for distinguishing different saxatile communities in the Mediterranean. They are designated as follows:

(*a*) Pavement (*d*) Overhanging rock
(*b*) Sloping rock (*e*) Step-crevice
(*c*) Vertical rock (*f*) Ledge

These are all chasmophyte habitats except for the ledge, which is a chomophyte one. Scree, being a less stable and unconsolidated habitat, is in a rather different category. Limestone cliffs in the Aegean area are shown in Pl. 5, phot. 1, this photograph being of a famous *locus classicus* in Crete where communities of vertical rock are wonderfully developed on a north exposure.

The angle of slope directly affects the amount of *rain* which falls on a rock face; the steeper the angle from the horizontal, the less rain is absorbed.

Underground water must be an important factor in maintaining chasmophyte communities on high limestone cliffs. Carrying with it dissolved salts, and even soil washed into weathered fissures at the top of the rock, it seeps along cracks, joints and bedding planes, and, especially on shady exposures where evaporation is lessened, provides a source of water more constant than that which falls erratically on a cliff face.

Wind, as testified by the many xeromorphic adaptations of chasmophytes, is an important factor, its force being usually proportional to the height of the cliff. Wilting is generally prevented by the supply of underground water referred to above. Mechanical damage by wind may determine the micro-distribution of some very brittle species of *Teucrium* (Sect. *Isotriodon*) and *Campanula*, etc. that grow only on the most sheltered exposures.

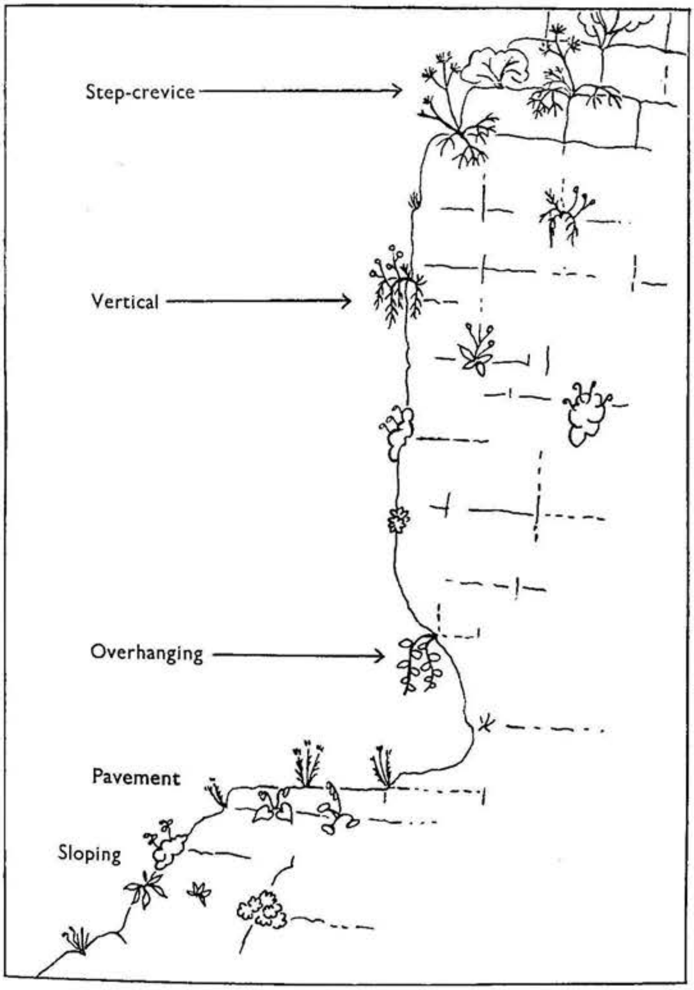


Fig. 2. Diagram of the main chasmophyte habitats in Palestine.

Insolation is partly determined by the ground's angle of slope, and has not been investigated with regard to cliff communities. On northerly cliffs, however, the *IE-factor* (I = insolation, E = exposure—Boyko, 1947, p. 142) can scarcely be very effective, for there the cliff is virtually in perpetual shadow, so that differences in the angle of slope mainly affect water absorption by the rock. As saxatile communities are clearly differentiated, even on cliffs in perpetual shadow, on various inclinations of rock, it would seem that different insolation values do not necessarily determine the micro-distribution of chasmophyte communities sharing the same aspect.

There are two other major factors (other than historical ones) in the development of cliff communities: *grazing* and *competition* with larger life-forms.

Regarding methods of investigating the rock communities to be described below, there was unfortunately rarely time to take more than direct notes. The use of belt transects would probably be, theoretically, the best way of charting cliff associations (with note of any change in the rock's angle of inclination), but the results would be rather unsatisfactory owing to large areas of bare rock signifying nothing beyond the absence of suitable crevices. Studying cliff communities in the Maritime Alps, Rioux & Quézel (1949, pp. 8–10) have recently charted stands of from 50 to 300 sq.m.—stands that one would expect to show more habitat-variation than those authors assign to them. Bisects would of course be a physical impossibility, but, however laborious, some attempt should certainly be made to investigate the root systems of different species, the capacity of the crevices and the nature of their soil content. The most valuable data lie hidden within the rock.

(2) *Mediterranean territory*

Each of the rock habitats and their communities, as found on compact limestone (but excluding maritime rocks) in the Mediterranean parts of Palestine below 900 m., will now be summarized.

(*a*) *Pavement*

The crevices of flat or very gently sloping pavements of limestone rock support only a limited number of species, of which *Varthemia iphionoides* (a September-flowering Composite) and *Micromeria serpyllifolia* var. *barbata* are frequently the dominants. This community is the *Varthemietum iphionoidis* subassociation *typicum* Eig. In Eig's subassociation *Stachydetosum palaestinae* the *Micromeria* is often replaced by *Stachys palaestina*. The *Varthemietum* develops on rocks recently denuded of *batha* communities, such as *Poterietum spinosi mediterraneum* Eig, by the washing away of surface soil. The saxatile *Varthemia*, *Stachys* and *Micromeria*, however, having many ascending willowy stems, tend to arrest soil and debris that are washed across the exposed rock by heavy rain, so that mounds of soil accumulate round the base of the plants. The process may continue until the bare surface of the rock becomes covered with a thin covering of soil, initiating a return to *batha* communities that may eventually be replaced by *garigue* and *maquis* associations of higher rank. The chasmophytes characteristic of flat and gently sloping rocks therefore play an important part in arresting erosion of the hillsides. The suffruticose Chamaephyte is the dominant life-form, but when a pavement becomes covered with a very thin layer of soil it may support colonies of the annual chomophyte *Telmissa microcarpa* (*Telmissetum microcarpae* Eig) independent of the presence of rock crevices. The low number of species found on pavements is apparently correlated with the full exposure of the plants to grazing animals and to the sun.

(*b*) *Sloping rock*

Exposed faces of rock sloping at an angle of 25–75° from the horizontal occur frequently at the foot of cliffs, or as outcrops on eroded hillsides. Like flat rocks, they are fully exposed to rain, but tend to be more broken and creviced; they may also provide shade, and are less readily grazed than flat exposures. Their flora is consequently much richer.

The communities are very fragmentary, and cover a rather wide range of species and life-forms. Chamaephytes (mainly suffruticose) are dominant; they are as numerous as the species of all other life-forms combined, of which about half (including ferns) are Hemicryptophytes; a few Geophytes and Therophytes occur. As in the case of pavements, the chasmophytes of sloping rock may, if the latter is not too steep for the accumulation of surface-soil, be replaced by communities of higher rank.

I have not been able to pick out any clear-cut associations, although Eig (1946, pp. 224–5) has given two—the *Crepidetum hierosolymitanae* and *Cheilanthes fragrans-Ceterach officinarum* associations—apparently belonging to this habitat; but the second of these is probably a mixture of two separate communities. *Rosularia lineata* (a succulent Cushion-Chamaephyte) is often the leading species on sloping, much-creviced rock from Upper Galilee to Samaria.

Micromeria nervosa, *M. juliana* and *M. graeca*, all suffruticose Chamaephytes, are very frequently found in this habitat, and are among the most widespread (and geographically variable) predominantly saxatile species of flowering plants found in the Mediterranean. The most widely distributed chasmophytes, however, occur among the ferns, of which most of the saxatile Mediterranean species grow on outcrops of steeply sloping rock. In Palestine these can be listed in the order of their apparent light-requirements: *Asplenium adiantum-nigrum* var. *virgilii* (in dense shade, and with plenty of humus due to overhanging shrubs); *Polypodium vulgare* and *Ceterach officinarum* (both in the 'open' shade of rocks, but the former perhaps a relict of woodland vegetation); *Cheilanthes fragrans* (on southern exposures, but getting slight shade due to irregularities of the rock surface); and *Notholaena vellea* (on the hottest exposures in full sun). In Greece the last species also grows on igneous rocks with the same exposure. They are all Hemicryptophytes.

Podonosma syriacum and *Ballota saxatilis*—two exclusively saxatile Chamaephytes characteristic of vertical rock—may also be found on sloping exposures, the latter species on those with a northerly aspect. (On the 1200 m. summit of Jebel Jermak, however, *Ballota saxatilis* grows on any exposure of rock, even southerly, presumably due to the comparatively cool and moist conditions found in that locality.) Neither of these plants is much eaten by goats, which is no doubt an important factor in permitting their occurrence on sloping rock.

Other exclusive chasmophytes occurring on sloping rock in Palestine are the following: *Onosma frutescens*, *Sedum laconicum*, *Stachys palaestina*, *Fibigia clypeata*, *Phagnalon rupestre*, *Campanula damascena* (Upper Galilee and rare on Carmel), *C. camptoclada* (annual) and *Caralluma europaea* var. *judaica*. The latter stem-succulent is found only in the hottest corners of rocks in Samaria and Judea; a similar habitat supports *C. aaronis* in Edom (Irano-Turanian) and *C. maris-mortui* by the Dead Sea (Saharo-Sindian). In the Levant the representatives of the genus are presumably of Sudano-Deccanian origin.

Characteristic species of sloping rock that are not exclusively (or normally) saxatile include *Crepis hierosolymitana*, *Stachys distans*, *Hypericum lanuginosum* (p. 82), *Andropogon hirtus*, *Heliotropium rotundifolium* (chiefly Irano-Turanian), *Scrophularia xanthoglossa* and *Campanula hierosolymitana* (annual).

In commodious holes in the rock that are several inches deep and hold a little soil only at the bottom (apparently insufficient for other plants), two Geophytes, *Cyclamen persicum* and *Cotyledon umbilicus-veneris*, are frequently found. As a rule Geophytes are rare in chasmophyte communities, being presumably unsuited to the restricted conformation of the crevice.

(c) *Vertical rock*

Owing to the large number of relict types associated with it, this habitat is of particular interest. It harbours a saxatile flora that is marvellously developed on the compact limestones of the Mediterranean territory; there the action of water in dissolving the calcium carbonate in the softer portions of the rock is more pronounced than in drier areas. Though vertical rock receives less direct rain than flat or sloping rock-exposures, cliffs no doubt possess a fairly constant supply of underground water slowly percolating through them. The flora is inaccessible to goats, and northerly cliffs are in complete shade throughout most of the day; under these evidently favourable conditions a rich and specialized flora has developed which finds no counterpart in the British Isles, and is rather poorly developed even in the Mediterranean climate of California.

There are usually several codominant species on vertical rock, but there is no information on the depth and capacity of narrow holes and crevices; it is possible that each species favours a certain type of crevice, so that codominance may be more apparent than real. Individuals are widely spaced, so that root competition must be negligible. A remarkable fact about vertical rock-communities is that the species concerned are not only almost entirely confined to saxatile habitats, but are also largely confined to *vertical* rock. It is, of course, impossible for surface soil to accumulate, so that these associations are not replaced by higher communities.

The dominant life form is the Chamaephyte (generally suffruticose) which is more than twice as numerous as the Hemicryptophytes that constitute the remainder. In this habitat, however, the suffruticose Chamaephyte grades into the Nano-Phanerophyte, the two being hard to delimit. Therophytes and Geophytes are entirely lacking.

Podonosma syriacum (the type of a probably dispecific genus related to *Onosma*) is the dominant species throughout the Mediterranean territory of Palestine, being absent only from the Safad area of Upper Galilee. This community is designated the *Podonosma syriacum-Ballota saxatilis* association (Davis), and two subassociations (in the sense of Braun-Blanquet 1932, p. 25) are recognized here: *typicum* and *judaicum*, both characteristic of more or less vertical rock in the Mediterranean territory of Palestine.

Subassociation *typicum* is confined in Palestine to the cliffs of Carmel and of Upper Galilee north of Tiberias, but extends northwards into the Lebanon. The following almost exclusively saxatile species are often codominant: *Podonosma syriacum*, *Dianthus pendulus*, *Centaurea speciosa*, *Ballota saxatilis* (in shade), *Rosularia lineata* and *Hyoscyamus aureus*; less common but exclusively chasmophytic are *Antirrhinum majus*, *Celsia horizontalis* and *Scrophularia xyllorhiza* var. Companion species include *Micromeria graeca*, *Stachys distans*, *Varthemia iphionoides*, *Phagnalon rupestre* and *Andropogon distachys*—the latter best considered an indifferent or even casual species. Coverage is generally less than 20 %.

Subassociation *judaicum* is characteristic of more or less vertical rock from Lower Galilee (Nazareth) to Hebron. With the exception of *Silene grisea* in Judea, this community is not marked by any exclusive species, and differs from subassociation *typicum* mainly in the absence of the latter's exclusive types (e.g. *Dianthus pendulus*, *Centaurea speciosa*, *Antirrhinum majus*), and the codominance with *Podonosma* of *Stachys palaestina*, especially in southerly exposures; the last species does not occur in the subassociation *typicum*, though it is found on pavement and sloping rock from Lower Galilee to Judea. Frequent companion species in subassociation *judaicum* include *Varthemia iphionoides*, *Ballota saxatilis* (in shade) and *Phagnalon rupestre*. The community is probably best regarded as an impoverished form of subassociation *typicum*; the latter is confined to a region of higher rainfall and lower temperature. The distribution of the component species in relation to dolomitic rocks deserves investigation.

Both subassociations are best developed on northerly exposures where *Ballota saxatilis* is frequently codominant with *Podonosma*. *Ballota* is usually absent from south-facing rocks, the abundance and luxuriance of most of the other species (especially the chasmophytes confined to subassociation *typicum*) being also much reduced.

Several of the leading species found in the *Podonosma syriacum-Ballota saxatilis* association, such as *Dianthus pendulus*, *Centaurea speciosa* and *Scrophularia xyllorhiza* var., are very attractive to goats, which may partly explain why these plants are confined to high cliffs; at the foot of vertical rock they are generally grazed back to the crown. *Podonosma*, *Varthemia*, *Ballota saxatilis* and *Stachys palaestina*, on the other hand, are seldom grazed, and this fact, coupled with a probably broader ecological amplitude, no doubt largely accounts for their wide distribution in Palestine; such plants are able to flourish on the vertical side of low rock-outcrops that are accessible to grazing animals. Consequently, subassociation *typicum* appears to have two 'accessibility' facies: one on inaccessible cliffs, and the other on the vertical sides of low outcrops; each of these exhibits different facies in sun and shade. Subassociation *judaicum* has developed only a sun and a shade facies, the prevalence of ungrazed species in the community enabling it to be floristically almost identical in accessible and inaccessible habitats.

On the other hand, because of the following features, it is quite possible that grazing is not the only—or even the prime—factor in differentiating the vertical communities of high and low rocks: precipices have a steadier underground water-supply than low outcrops, while, beside being windier, they are also cooler than lower exposures, due to the expansion of ascending air currents compressed against the foot of the cliff.

The chasmophytes of vertical and overhanging rock are usually exclusively saxatile; indeed, those of vertical and steeply sloping cliffs are seldom found in the other types of rock habitat. It would seem that an increase in the austerity of the conditions is accompanied by an increase in the chasmophyte's specialization. Such species, however, are rarely difficult to cultivate when competition is eliminated.

(d) *Overhanging rock*

Exposures of this type are frequen tat the lower part of cliffs (Pl. 5, phot. 1), the amount of overhead moisture obtained being proportional to the angle of the overhang. Seepage through cracks deep in the cliff is the main source of water for the circumscribed communities of this habitat. Even slight overhangs on compact limestone cliffs can be distinguished at a great distance by the reddish stains of iron oxides that colour the surface of the rock, in contrast to the grey colour of weathered vertical rocks more freely exposed to rain. If the bedding-planes do not slope downwards towards the overhang, the rock will be dry and poorly creviced. The flora is then very limited (often monospecific), the suffruticose Chamaephyte being the dominant life form. The leading species are generally *Podonosma syriacum*, *Hyoscyamus aureus* and *Varthemia iphionoides*—either separately or as codominants; *Phagnalon rupestre* and *Capparis spinosa* (sensu lato) are somewhat less common. None of these species appears to be much influenced by the aspect of the habitat, water supply being apparently the limiting factor. They are all plants that extend far into the more arid regions of Palestine, and are evidently able to endure drier conditions than most of the other chasmophytes found in the Mediterranean territory. It is not surprising, therefore, that they are (with the exception of *Varthemia*) the commonest plants found in the vertical crevices of free walls in Palestine.

No other species are commonly found on dry overhanging rocks, but of very local occurrence in this habitat are *Scrophularia xyllorhiza* var. (Upper Galilee), *Teucrium montbretii* var. (East Judea) and *Galium canum* (East Judea); these three plants are referred to more fully on p. 87.

Although in Palestine there are no species habitually confined to dry overhanging rock, other parts of the Mediterranean support species that are more or less peculiar to this habitat and which are obviously of a relict nature. These include *Euphorbia promecocarpa* (Antilebanon), *Lactuca acanthifolia* (Crete), *Primula allionii* (Maritime Alps), *Sarcocapnos crassifolia*,* *S. enneaphylla* and *Centaurea clementei*—the last three in Spain and North Africa. In the Isaurian Taurus of Southern Anatolia a remarkable endemic community has developed in the mouths of numerous limestone caverns that line certain ravines near Ermenek at 1400 m. The chief components are *Parietaria judaica* var. (luxurious where goats have sheltered), *Erodium pelargoniflorum*, *Campanula leucosiphon*, *Valeriana speluncaris* and new species of *Euphorbia* and *Teucrium*; all are Chamaephytes. Light is weak in such habitats, and temperature changes are less extreme than on the adjacent open cliff (Rioux & Quézel, 1949, pp. 9–10). The relative stillness of the air will not only prevent damage to brittle species, but will reduce transpiration.

Occasionally damp overhangs are found, due to the percolation of water attributable to forward-sloping bedding-planes. Hemicryptophytes usually predominate. Throughout the Mediterranean, overhangs of this type are frequently colonized by *Adiantum capillus-veneris*. In south-east Spain the evidently relict *Pinguicula vallesneriifolia* (Pl. 6, phot. 3) is confined to this habitat in Sierra de Cazorla, growing on an encrustation of tufa that covers the shady dripping rocks; the pendant midge-covered leaves of this butterwort may be as much as a foot in length. Like those of vertical cliffs, the communities of overhanging rock are not replaced by higher associations.

(e) *Step-crevice*

By this term I designate those rather large deep crevices between the big step-like blocks that are found in particular on the upper part of cliffs. The step-like formation is apparently pre-determined by the intersection of joint- and bedding-planes, and is accentuated by the weathering processes of rain and root action. The step-crevice supports a very different type of vegetation to that associated with the crevice habitats just described. Here we find that Nanophanerophytes and Microphanerophytes are the dominant life forms, being nearly as abundant as the Chamaephytes and Hemicryptophytes that together largely constitute the remainder of the species found. The dominance of the larger life form is evidently connected with the greater capacity of the step-crevice.

The habitat is marked by an association of *Ferula tingitana* and *Euphorbia thamnoides*,

* I have seen *Sarcocapnos crassifolia* on its native cliffs. The associations of this species described by Cuatrecasas (in *Cavanillesia*, **7**, pp. 136–7, 1936) as belonging to his *Saxifragion camposii* alliance appear to me unnatural units which each include more than one distinctive saxatile community.

these two species being generally codominant. Species found in Palestine exclusively in this step-crevice community are *Ferula tingitana*, *F. samariae* (endemic to one *wadi* in Samaria), *Artemisia arborescens* and *Chamaepeuce alpini* (the latter only known from Metulla in Galilee, but a rather common Composite shrub in the step-crevices of Lebanon, Cyprus and the Aegean area). Other characteristic species of the community include *Euphorbia thamnoides* (a shrub with a somewhat napiform root), *Michauxia campanuloides*, *Amygdalus communis** and *Pennisetum asperifolium*; the last occurs only on southern exposures (correlated with its thermophilic general distribution) where it may be co-dominant with *Ferula tingitana* and *Euphorbia thamnoides*, or may be the leading species.

Though the step-crevice community contains several exclusive species in Palestine, its chief interest is that it supports many characteristic *maquis* plants; many of these are familiar species in Eig's *Quercus coccifera* (*Q. calliprinos*)-*Pistacia palaestina* association. Among those most frequently occurring, especially in shady situations, are *Pistacia palaestina*, *Rhamus palaestina*, *Ceratonia siliqua* (local), *Rubia olivieri*, *Hypericum serpyllifolium* and the scramblers *Smilax aspera*, *Clematis cirrhosa*, *Lonicera etrusca* and *Ephedra campylopoda*. The *Hypericum* is found only in shade, and is normally a constituent of *Pinus halepensis* forest.

In many localities in Samaria and Judea all traces of woodland or *maquis* have been destroyed, though we have historical evidence that woodland existed in the past. An indication of the nature of those communities can often be obtained from the species inhabiting the step-crevices which have evidently acted as refugia. Indeed, the study of step-crevice vegetation might profitably be included in Mediterranean afforestation surveys. In Wadi Beidan near Nablus, which lies on the Irano-Turanian border of the Mediterranean territory in Palestine, the slopes support an almost Irano-Turanian vegetation at the present time. The occurrence of several *maquis* and woodland species on the cliff's step-crevices led me to expect a Mediterranean vegetation on the slopes at a recent date, and further search on the hillside did reveal a few goat-eaten bushes of *Quercus coccifera*. Although the latter seems unable to grow on cliffs (possibly due to inadequate means of dispersal) the occurrence in step-crevices of species normally associated with this oak infers the presence of a *Quercus* community in the past.

Most of the *maquis* or woodland species usually found in the step-crevice are plants with succulent fruits, and evidently owe their presence there to dispersal by fruit-eating birds which find the step a convenient perch. Where woodland still exists to-day (as on Carmel and in Upper Galilee), it is certainly those species of the immediate neighbourhood that are generally found on the step-crevice. Though some may have been carried a considerable distance, it seems probable that the main supply of these plants to step-crevices is derived from *maquis* and woodland communities that once flourished in the immediate vicinity of the cliffs. How long these species can hold their own on the step-crevice is not known, but the extreme rarity of bird-dispersed species in plant communities of vertical cliffs (a few habitually saxatile species of *Rhamnus* appear to form an exception) suggests that this method of dispersal is hardly efficacious on Mediterranean precipices if there is no seed-reserve on adjacent slopes. Certainly *maquis* species on cliffs are far more numerous

* Poljakoff (*Pal. J. Bot.* (Jerusalem Ser.), **3**, 138, 1945), working on the water balance of *Olea europaea*, *Ceratonia siliqua* and *Amygdalus communis*, has shown that the almond is a 'water spendthrift', and, in contrast to the other two trees, has a root system that penetrates deeply into the limestone rock; this no doubt partly accounts for the prevalence of this small tree in the step-crevices of Palestine.

in well-wooded country than in deforested areas. In recent years the last remnants of *Pistacia terebinthus* have disappeared from the rocks of Capri (Norman Douglas, *in verbis*).

The step-crevice is not always well developed, being sometimes replaced or supplemented by large vertical or steeply sloping fissures; these support shrub communities similar to those of the step-crevice.

(*f*) *Ledge*

Usually a ledge is due to exposed bedding-planes, and, when associated with a step-crevice, generally supports *Ferula tingitana* and *Euphorbia thamnoides* because of the presence of deep cracks. In its 'pure' form, however, there is no obvious crevice development, the chomophyte vegetation depending solely on the superficial layer of soil that has accumulated on the ledge. This does not allow the occurrence of such deep-rooting plants as the *Ferula* and *Euphorbia* just mentioned, or even of suffruticose Chamaephytes, but is excellently adapted to the development of the many Geophytes that constitute the characteristic life form of this superficial habitat, especially where a drift of humus has accumulated from *maquis* above the cliffs. There is evidence of seral development. The Geophyte communities vary greatly in composition, but on well-covered shady ledges the following may be found: *Lilium candidum* (undoubtedly wild on Carmel), *Asphodeline lutea*, *Asphodelus fistulosus*, *Fritillaria libanotica*, *Arum palaestinum*, *Allium triquetrum*, *Narcissus tazetta*, *Pancratium parviflorum*, *Muscari commutatum* (?), *Bellevalia trifoliata* and *Valeriana tuberosa*. These chomophytes (unlike most chasmophytes) die away completely during the dry summer months; *Pancratium* flowers in autumn, the rest in spring. Smaller ledges occur in many rock habitats, especially as lips on vertical rock, and these support very fragmentary communities that may include *Poa bulbosa*. Unlike the true chasmophytes (especially those of steep rock) most of the chomophytes are found also on hillsides.

Brief mention must now be made of the communities of limestone rock found in the other two phytogeographical territories of Palestine.

(3) *Irano-Turanian territory*

Vertical rocks in the steppe region of the Judean Desert are generally marked by the dominance of *Podonosma syriacum* (the most widespread, though not always fully developed, plant) and *Centaurea eryngioides*; *Ballota saxatilis* is lacking. The *Centaurea* is interesting: although it is essentially an Irano-Turanian plant in Palestine and Sinai, being absent from the Mediterranean territory of Palestine except in connecting *wadis*, it is characteristic of the Mediterranean region in the more rainy Lebanon. Different ecotypes are presumably involved.

Two other plants are sometimes leading species in vertical rocks of the Irano-Turanian territory—*Varthemia iphionoides* and *Sonchus suberosus*. The latter is a remarkable woody species recently discovered in the gorges of the Judean Desert and Moab, and is apparently related to saxatile types endemic to north-west Africa and the Canaries.

The step-crevice is still dominated by *Euphorbia thamnoides* and *Ferula tingitana*, with *Pennisetum asperifolium* frequent on southerly exposures. But typically Irano-Turanian species also occur in this habitat: *Retama duraei*, *Salvia graveolens*, *Ephedra alte* and *Ballota undulata*. *Ochradenus baccatus* and *Linaria aegyptiaca* subsp. *palaestina* are found here, having infiltrated from adjacent Saharo-Sindian country.

On pavements *Varthemia iphionoides* is the leading plant, though its place is taken in Edom (Transjordan) and Gebel Galâla (Egypt) by *V. montanum* which is characteristically an Irano-Turanian species. Ledges support a limited number of chomophytes, including the bulbs *Muscari commutatum* (?), *Bellevalia flexuosa* and *Hyacinthella nervosa*.

Penetration of species belonging to different phytogeographical territories takes place both ways in the Irano-Turanian and Saharo-Sindian regions, but infiltration is mainly from the latter into the Mediterranean; this occurs especially where the natural Mediterranean vegetation has been interfered with, and on enclaves of chalk.

(4) *Saharo-Sindian territory*

The true desert region is very poor in saxatile species. *Podonosma syriacum*—a species with evidently a wide range of climatic tolerance—is still the dominant plant on vertical rocks, but has penetrated into this region from adjacent moister territories and is poorly developed. It is sometimes accompanied by *Centaurea eryngioides* and *Sonchus suberosus* (both predominantly Irano-Turanian in Palestine); the latter occupies only the shadiest parts of Saharo-Sindian chasms. *Capparis spinosa* var. *aegyptiaca* is the chief truly Saharo-Sindian chasmophyte, and is usually the only species found in areas of the most arid variety of this climate which occur near the Dead Sea and in the Eastern Desert of Egypt. *Hyoscyamus aureus* and *Linaria aegyptiaca* subsp. *palaestina* may also grow on vertical rock, but of the plants mentioned none, with exception of the *Capparis* (often the sole constituent of *Capparidetum aegyptiacae* Zohary), reaches full development in this territory.

The step-crevice here supports a mixture of plants belonging to the Irano-Turanian and Saharo-Sindian elements, such as *Ephedra alte*, *Rhus tripartita*, *Ballota undulata*, *Linaria aegyptiaca* subsp. *palaestina*, *Pennisetum asperifolium*, *Reseda muricata* var. *undulata*, and *Blepharis edulis* (partly Sudano-Deccanian). Also occurring are the predominantly Mediterranean *Ferula communis* (Wadi Qelt) and *Abutilon muticum* which belongs to the Dead Sea Sudano-Deccanian enclave.

(5) *Screes*

Last among the communities of Palestine's limestone rocks are those of calcareous screes in Palestine—an unstable, unconsolidated habitat. In the comparative absence of frost-weathering these are poorly represented in the Mediterranean territory, but where talus does occur at the foot of rocks it is often invaded in Carmel and Galilee by a curious annual Crucifer, *Ricotia lunaria*, confined to this kind of habitat.

In the Saharo-Sindian and Irano-Turanian territories, however, well-developed screes occur below the wadi cliffs in the Judean Desert, presumably due to weathering brought about by sudden temperature changes. Screes in the former territory are often colonized by *Trichodesma africanum*, whereas *Ballota undulata* is the leading species in the Irano-Turanian region. In transitional areas (as in Wadi Khabis in Judea) they may occur as codominants.

(6) *Basalt rocks*

It now remains only to mention the vegetation found on basalt exposures. Rocks of this type are probably of Middle-lower Pleistocene age (Picard, 1943, p. 190); in Palestine and Transjordan I have seen them forming prominent outcrops only near the Lake of Galilee and in Moab—in both cases at the junction of Mediterranean and Irano-Turanian territories. Basalt is an unfavourable rock for chasmophytes: it cannot weather by selective erosion into suitable holes and crevices. Plants are chiefly confined to vertical cracks—often widely gaping—due to columnar jointing.

The leading species on basalt rocks near Tiberias is the succulent Cushion-Chamaephyte, *Rosularia lineata*, the only species which thrives better on basalt than on calcareous rock; it is generally dominant in shade, especially in places where the rock has begun to crumble. In vertical cracks *Hyoscyamus aureus* is common, and, incidentally, is the only flowering plant found in the free basalt walls of Tiberias. Sloping cracks may support *Aristida caerulescens* and *Ballota undulata*, while a few Geophytes are found on the ledges: *Asphodelus microcarpus*, *Allium stamineum*, *A. triquetrum* (shade), *Lactuca tuberosa* and *Iris hauranensis* (in Wadi Yarmuk). In step-crevices the leading species are *Retama duraei*, *Ferula communis* and *Euphorbia thamnoides*. But in Wadi Yarmuk *Pistacia atlantica* (one of the very few Irano-Turanian trees) and *Amygdalus communis* also occur in this habitat.

A striking feature of basalt rocks is the total absence of *Podonosma syriacum*, so widespread on the limestone rocks of Palestine, and growing also in the Nubian Sandstone gorge at Petra in Transjordan.

IV. Discussion

(1) *Life forms; increase in woodiness*

When outlining the different types of rock communities, attention has been drawn to the predominance of certain life forms (using the nomenclature of Raunkiaer) in the various rock habitats. Turrill (1929, p. 89) has compared the general life-form spectrum of Crete with that given by Raunkiaer (1934, p. 122) for Samos—both islands with a typical East Mediterranean climate. The two islands were each shown to possess 13 % Chamaephytes; Samos has 33 % Therophytes and Crete 38 %, while of Hemicryptophytes Samos has 32 % and Crete 27 %. The general spectra are indeed very similar, but they are in striking contrast to what we find in crevice communities of flat, sloping, vertical and relatively dry overhanging rocks. Here the Chamaephyte (predominantly suffruticose) is the dominant life form (passing imperceptibly, however, into the Nanophanerophyte, especially on vertical rock), its relative abundance being apparently directly proportional to the steepness of the rock. Chamaephytes make up, on sloping rock, about 50 % of the total number of species, but on vertical rock they consist (with Nanophanerophytes) of at least 60–70 % of the community, while on dry overhangs they are almost the sole representatives. This progressive increase in the proportion of Chamaephytes is accompanied by a corresponding decrease in the number of Therophytes. Though a few annuals (including several exclusively saxatile species of *Campanula* and *Arenaria*) occur in the crevices of sloping rock, I have seen none on vertical exposures or overhangs. (In Morocco, however, some annual species of *Rupicapnos* are said to favour vertical rock.) The Mediterranean region is marked by its high proportion of Therophytes (see spectra for Crete and Samos above), so that this difference is noteworthy, particularly when it is remembered that in 'pioneer' habitats (which rocks undoubtedly are) annuals are normally the dominant invaders among flowering plants. Raunkiaer (1934, p. 36) and Braun-Blanquet (1932, p. 294) have both drawn attention to the fact that the suffruticose Chamaephyte is, like the Therophyte, a life form particularly characteristic of a Mediterranean climate; but the importance of this form in cliff communities is far in excess of that found in general Mediterranean spectra.

It seems probable that the saxatile habit may result in increased lignification, both as a modification and as an inherited character. Plant growth in a crevice is necessarily slow; this will lead to delay in reaching the reproductive stage, and an increase in the formation of wood. Some saxatile species of *Campanula* (e.g. *C. saxatilis*, *C. calaminthifolia* and *C. heterophylla*), that in nature form long-lived woody individuals, in the easier conditions of cultivation may flower themselves to death in their second year. In this case the woody habit is directly influenced by environment. But in some monocarpic chasmophytes, such as the Umbellifer *Seseli crithmifolium*, flowering does not occur for several years, either in cultivation or in nature; the single rosette is raised each year on its lengthening woody caudex so that the species must definitely be classed as a Chamaephyte, not a Hemicryptophyte. Here the woody habit has probably been derived from the herbaceous habit (predominant in the genus), and is evidently an inherited character. The factors that normally prevent the rootstock of Hemicryptophytes from rising above the soil surface (Raunkiaer 1934, p. 40) cannot operate properly in a cliff-crevice.

Natural selection in a cliff habitat presumably acts in favour of lignification and longevity. In a cliff community most of the holes suitable for ecesis are already occupied, so that it is extremely difficult for the individual to produce progeny. Seed is the only method of reproduction; stolons and runners are not adapted to the habitat conditions, and plants possessing them are not found in Mediterranean crevice communities. The scarcity of seedlings shows that several years may go by, especially on vertical and overhanging rock, without an individual establishing progeny. This fact (which is true of other biologically closed communities) must be unfavourable for the persistence of annuals in these exacting habitats, but will certainly favour the selection of long-lived perennials. Long-lived monocarpic chasmophytes—and even biennials—will at least have an advantage over annuals in preventing the latter from becoming established. Monocarpic species mainly occur in Campanulaceae, where the immense output of wind-dispersed seed evidently compensates for the death of the parent plant; *Campanula tubulosa*, a rare species of steeply sloping rocks in Crete, is shown in Pl. 7, phot. 6. Such monocarpic chasmophytes are mostly of very limited distribution.

Under the exposed conditions of a Mediterranean cliff, a woody habit probably possesses mechanical advantages. There is also the possibility that high wind may cause the dying back of young shoots which would lead to an increase in the bushiness of the plant. On rocks at higher altitudes in the Mediterranean, where frost is severe, cushion Chamaephytes become abundant.

The woodiest species in many genera are often exclusively saxatile, and generally confined to vertical rock. The following chasmophytes may be cited as being probably the woodiest members of their genera within the Mediterranean area: *Ebenus cretica*, *Biscutella suffrutescens*, *Anthyllis aegaea* and *A. barba-jovis* (the latter is not constantly chasmophytic), *Iberis semperflorens*, *Silene fruticosa*, *Asperula tournefortii* and *A. majori*, *Helichrysum lamarckii*, *Fibigia triquetra* and *F. lunarioides*, *Odontites linkii* and *O. frutescens*, *Ptilotrichum pyrenaicum* and *P. reverchonii*, *Globularia davisiana*, *Cephalaria sieberi* and *S. balearica*, *Alyssum creticum*, *Linum arboreum*, *Sonchus suberosus*, *Scabiosa cretica* and allies, *Senecio gnaphalodes*, *S. bicolor* and *S. cineraria*, *Brassica rupicola*, *B. insularis* and *B. balearica*, *Celsia arcturus*, *Convolvulus cneorum*, *Dianthus arboreus* and *D. fruticosus*. In the genus *Staehelina* increasingly woody species occupy increasingly saxatile habitats (Davis in Burtt & Davis, 1949, p. 107).

The wood anatomy and cytology of such relicts, in comparison to that of related non-saxatile species, require investigation, as do their root growth and the longevity of their seeds. Though it seems probable that in chasmophytes the woodier forms have been most frequently derived from the less woody and herbaceous, this does not mean the species are necessarily young. The great taxonomic distinctness of many of them suggests that their woody habit was developed long ago, in many cases even in Tertiary times. The woody species, though structurally 'advanced', are often relatively old.

The view expressed above, that saxatile woody forms have very often evolved from herbaceous or less woody types, is contrary to the generalization of Raunkiaer (1934, p. 42): Hemicryptophytes, he maintains, have mostly arisen from Phanerophytes—and, in particular, Proto-Hemicryptophytes from suffruticose Chamaephytes. In cliff communities, due to the woodier forms being favoured by natural selection, I believe that development has been in the opposite direction. The protective advantages that will result from a plant keeping its perennating buds at or near ground-level are of less importance in cliff communities. It may be noted that Babcock (1947, p. 158) has come to the conclusion, from cytological and morphological evidence, that in *Crepis* the suffruticose species are relatively advanced.

(2) *The distribution of chasmophytes in different groups of vascular plants*

For the families listed below, the approximate percentage of genera containing some constantly chasmophytic species in the Eastern Mediterranean is given:

	%		%
Campanulaceae	80	Caryophyllaceae	30
Crassulaceae	60	Scrophulariaceae	30
Rubiaceae	33	Compositae	25
Labiatae	33	Cruciferae	19

The remainder of the larger families, including Leguminosae (the largest family after Compositae in the Mediterranean, and one rather better represented by saxatile species in Spain), Umbelliferae, Rosaceae, Cistaceae, Chenopodiaceae, Boraginaceae and Gramineae, contain a considerably smaller proportion. Monocotyledons are poorly represented by partially chasmophytic genera due, perhaps, to their poverty in the most suitable life form: the Chamaephyte. In the ferns, Polypodiaceae contains about 64 % partially saxatile genera; the majority of the crevice species belong to *Asplenium*. The Gymnosperms probably contain no constant chasmophytes, though species of *Ephedra* are frequently saxatile.

Because of the different size of the families and the uneven distribution of chasmophytes within them, the above list does not give an idea of the relative frequency of the various natural orders in Mediterranean chasmophyte communities. In the Eastern Mediterranean I estimate that Compositae, Campanulaceae and Labiatae together include at least 40 % of the constantly saxatile species of Angiosperms. Of the remaining families, Cruciferae is the best represented, followed by Caryophyllaceae. In the rock communities of the Iberian peninsula, however, Scrophulariaceae is a leading family (owing to the great saxatile development of *Linaria* and related genera, although the order in its total species-content is less well represented than in the Balkans), while saxatile Labiatae are less common than in the Nearer East where the family has its maximum species concentration. It will be seen from these data that certain gamopetalous families (considered advanced in all systems of classification) play the major role in Mediterranean crevice associations. This fact, though it does not prove that saxatilism is an advanced and specialized character (see p. 84), certainly says nothing against that hypothesis.

The distribution of saxatile species within their families is very uneven. Some large genera, such as *Astragalus*, *Trifolium*, *Acantholimon*, *Veronica*, *Salvia* and *Thymus*, produce scarcely any chasmophytes, whereas *Trachelium* (sensu lato), *Staehelina*, *Ramonda*, *Sarcocapnos*, *Rupicapnos* (which sows its seeds by reflexion of the pedicels), *Dionysia*, *Rosularia* and certain groups in *Draba*, *Hypericum*, *Dianthus*, *Brassica*, *Potentilla*, *Galium*, *Campanula*, *Centaurea*, *Micromeria*, *Stachys* and *Teucrium* are almost entirely saxatile. In these saxicolous groups we can assume crevice occupation to have been long established. The absence of chasmophytes in certain families and genera may in some cases be due to unsuitable life forms or to inadequate methods of seed dispersal, but it seems probable that many large non-saxatile aggregates lack the constitution necessary to adopt the crevice habitat as their own; this may possibly be due to an excess of calcium resulting in a reduction in the availability of other minerals. In the Dicotyledons, failure to adopt a saxatile habit is most frequent in the Archichlamydeae.

Below 900 m. the peak of the flowering season for communities of the vertical cliffs is in June—several weeks later than that of adjacent hillside associations. This may in part be due to the conditions of the habitat, but is also related to the comparatively late-flowering habit of the families that are most frequently represented in cliff communities.

(3) *Seed dispersal*

The difficulties of establishment have already been referred to. Without adequate means of dissemination, cliff species would be unable to survive: ecesis could not occur, even if the species were otherwise adapted to saxatile habitats.

A review of cliff communities shows that, except in the case of step-crevice shrubs, dispersal of seeds and fruits by *wind* is the prevalent method of dissemination. In many cases this is by the aid of structural modifications; and here we must include not only the familiar calycine modifications of the Compositae, the winged seeds of many Crucifers, etc., but also such mechanisms as we find in *Origanum* Sect. *Amaracus* where the large papery bracts remain attached to the pedicel when the fruit is ripe, so that the calyx, with the nutlets inside, sails away.

More frequently, however, the wind dispersal of chasmophytes depends only on the lightness of the seed. The prevalence of this type of short-range dissemination has already been noted among wall-plants by Ridley (1930, pp. 26–9) and Rishbeth (1948, p. 141). Such seeds are carried up the face of the cliffs by ascending air currents.* Wind dispersal of seed and fruit may to some extent supplement the gene-flow between partially isolated populations that is dependent on direct long-distance transference of pollen; indeed, it may even replace it, though such instances are probably rare. The majority of chasmophytes are apparently adapted to insect pollination, though on precipices suitable insects

* A type of dispersal postulated by Ridley (1930, p. 26), whereby a species climbs a wall by placing its seeds in the crevice above it solely by the aid of its ascending stems, probably plays little part on vertical cliffs; the suitable crevices are usually too widely separated for this 'ladder effect' to operate directly. Nevertheless, stem height must be of assistance in launching the seed well away from the parent crevice.

are not abundant. How many such 'entomophilous' flowers are casually pollinated by other means?

Some plants found in rock crevices possess an *Elaiosome* (oil-body), and it seems probable that ants play a part in their distribution (cf. Ridley, 1930, pp. 519–24). *Podonosma* (a member of Boraginaceae and one of the leading species of vertical rock in Palestine), *Capparis spinosa* (sensu lato), *Sarcocapnos* species of Spanish and North African overhangs, and species of *Parietaria* and *Euphorbia* are possibly among these. The phenomenon, which may be frequent in rock communities, needs further investigation in the field; but it is doubtful if it plays an important part on high cliffs. With regard to *Capparis*, Edwin Cerio tells me that on the walls of his garden in Capri ants carry away the seeds as soon as the fruit opens.

(4) *Geographical distribution; rarity*

The very limited distribution of many saxatile species and communities is a feature that must strike any botanist who has travelled in the Mediterranean. A species is often confined to a single gorge or range of cliffs, although the neighbouring precipices from which it is absent appear ecologically similar. This applies to species with or without modifications of fruit or seed for wind dispersal; indeed, many of the pappus-bearing Compositae (e.g. *Helichrysum amorginum*, *Scorzonera dependens*, *Staehelina arborescens* and *Centaurea tauromenitana*) are among the rarest chasmophytes. The extreme localness of many saxatile species is probably largely due to historical causes, especially to the climatic and topographical changes of the Pleistocene.

A vertical cliff-association is a *biologically closed* (though spatially open) community, for though the individuals are widely spaced, the area between them is generally unsuitable for ecesis. The chasmophyte fits into its crevice like a cork into a bottle. This will make it very difficult for a plant to extend its range, even though it be better adapted to a new locality than the saxatile species already in possession. Suitable holes for the establishment of seedlings are very few, and when such vacancies occur they will tend to be filled by the progeny of species already in possession of the rock. Spread of all but the most vigorous species will therefore be very gradual, and effective gene flow between partially isolated populations (and even within the same population) may be considerably inhibited through the frequent failure of seed to establish new individuals.

So far as I am aware, the only normally saxatile flowering plant that is distributed throughout the Mediterranean (though local in the East) is our native *Crithmum maritimum* (see the distributional map of Rikli, 1943, p. 343); however, this is confined to strictly maritime rocks (or occasionally shingle) and its mericarps can be distributed by sea (Ridley, 1930, p. 294). At the opposite extreme to the wide littoral distribution of *Crithmum* is the extreme rarity of *Kochia saxicola*; it is only recorded from maritime rocks in Capri (where it may be extinct), Ischia and Strombolicchio. In the Eastern Mediterranean, *Scrophularia heterophylla*, *Galium canum*, *Podonosma syriacum* and *Chamaepeuce alpini* are among the chasmophytes with the largest areas. The lack of omni-Mediterranean chasmophytes is in striking contrast to the omni-Mediterranean distribution of very many species in non-saxatile habitats. But although chasmophytes are usually restricted in distribution, geographical replacement by closely related species is common; it is found, for example, in *Campanula* (especially in the groups centring round *C. rupestris* and *C. mollis*), *Lactuca* (Rechinger, 1947, p. 192), *Brassica* Sect. *Brassicotypus*, *Dianthus*, *Diosphaera*, *Scrophularia*,

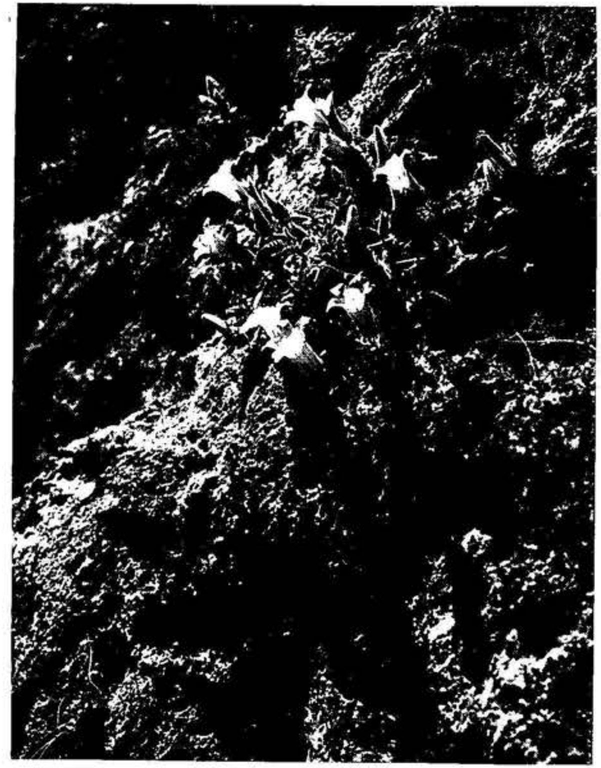
Phot. 1. Hag. Joannis in west Crete, showing communities of vertical and overhanging limestone cliffs with a north exposure. (*Edward Gathorne-Hardy.*)

Phot. 2. *Cupressus sempervirens* L. var. *horizontalis* (Mill.) Gord. on a limestone cliff in north Cyprus. The expanding roots have broken the rock away.

Phot. 3. *Pinguicula vallesneriifolia* Webb growing on the dripping tufa of north overhangs in the Sierra de Cazorla, south-east Spain. (*V. H. Heywood.*)

Phot. 4. *Viola cazorlensis* Gand. on sloping limestone rock in the Sierra de Cazorla, south-east Spain.

Phot. 5. *Arabis cypria* Holmb. confined to shady limestone rocks in north Cyprus.



Phot. 6. *Campanula tubulosa* Lam. on steeply-sloping limestone rock in Crete. (*Edward Gathorne-Hardy.*)

Sect. *Torniophyllum* Subsect. *Oppositifoliae*, *Inula* Sect. *Bubonium* Subsect. *Candidae*, and in *Linaria* and *Micromeria*. Strikingly disjunct and famous examples are found in *Ramonda* and *Viola* Sect. *Nominium* Subsect. *Delphinoideae*, where closely related species occur in the Balkan and Iberian peninsulas but are absent from Italy; in the case of *Ramonda*, *R. myconi* and *R. serbica* are known to be inter-sterile (Turrill, 1929, p. 297). A less familiar example occurs in *Cephalaria*, where the woody *C. balearica* of Majorca is closely related to *C. sieberi* of the South Aegean. In these examples, differentiation has presumably followed geographical isolation, and, in the case of vicariads in Spain and the Balkans, probably dates from Tertiary times. During the Miocene, Italy (with the exception of Sicily and Calabria) was still largely buried beneath the shrinking seas of the Tethys, while the Balkan and Iberian 'peninsulas' were land, and in the north were at least partially connected to one another (cf. Knoche, 1923, p. 219; Babcock, 1947, p. 92).

An intermediate stage in the development of 'good' taxonomic species is recognizable in many saxatile forms in which subspecies and geographical varieties have been recognized. *Alyssum saxatile*, *Inula aschersoniana*, *Campanula mollis*, *Scrophularia heterophylla* and *Symphyandra cretica* are examples of such *Rassenkreise* in which different periods of geographical isolation have tended to result in varying degrees of differentiation. Some species (e.g. *Micromeria graeca* in the Levant) even differ slightly from valley to valley, so that a species may be made up of a mosaic of topodemes which at present may or may not be completely isolated from one another. Isolation in gorges, however, may frequently be less complete than features of the habitat suggest; Emerson (1939, p. 537) and Wright (1939, p. 551) have shown that colonies of the rare New Mexican *Oenothera organensis*, though growing in deep canyons three miles apart, form part of an interbreeding population.

(5) *Pro-climax* nature of cliff-crevice communities*

Reference has been made to the biologically closed nature of vertical and overhanging rock communities. The cliff habitat is an ancient and relatively stable one; it is, in fact, a 'pioneer' habitat of permanent duration. The cliff tombs of Lycia, carved in limestone rock over 2000 years ago, show how slowly Mediterranean cliffs weather in regions where frost is rare. Cracks and holes may widen and deepen by the action of selective erosion, the expanding roots of plants may open up the crevices still further, but the general outline of the rock remains much the same. Cliff recession is a very slow process. Consequently, the communities cannot be expected, while the climate remains more or less static, to change appreciably. A chasmophyte association of vertical or overhanging rock is generally a physiographic and/or edaphic climax in the Mediterranean; it is not replaced by other associations as are communities of flat or gently sloping exposures.

The pro-climax communities of Mediterranean cliffs, such as those already described for Palestine, develop directly from the crustose-lichen stage, or may even be independent of it. Except on wet rocks there is usually little formation of moss, and the Chamaephytes that dominate the rock communities take possession of the crevices when sufficient soil has accumulated from wind-blown dust or rain-wash; there is no obvious seral development. This direct occupation by advanced life forms has already been noted by Rishbeth (1948, p. 146) for the vegetation of Cambridge walls.

* Because the word *sub-climax* has been used in two senses, the term *pro-climax* was proposed by Clements (*J. Ecol.* **22**, 45, 1934) for vegetation that appears instead of the climatic climax. It was considered by Tansley (*Ecol.* **16**, 293, 1935) an 'unobjectionable term'.

The composition of the community probably depends to a large extent on the suitable species that are immediately available for the colonization of any new rock exposure that may appear. When once a plant is in occupation of a narrow crevice, it is not likely to have its place usurped: late comers will have a poor chance of establishing themselves.

In the Eastern Mediterranean the only tree that plays an important part on cliffs (apart from step-crevice types) is *Cupressus sempervirens* var. *horizontalis**; in the limestones of Crete, Lycia, Cyprus and Lebanon this wind-disseminated tree may locally be a conspicuous feature of very steeply sloping or vertical cliffs. It occupies large vertical fissures initially delimited by jointing, and further widened by acidulated water and the expanding roots of the tree (Pl. 5, phot. 2). Similar root action has recently been described by Jackson & Sheldon (1949, p. 45) for *Taxus baccata* on limestone rocks in Derbyshire. The roots may eventually cause part of the rock to break away, so adding to the talus below the cliffs. In the Mediterranean the wild cypress does not appear unduly to interfere with, or to replace, the characteristic species of the chasmophyte communities; the latter exhibit a similar composition whether the tree is present or not.

(6) *The local saxatile habit of normally non-saxatile species*

This phenomenon is not uncommon, particularly at the edge of a species' range. It is obviously related to the protection which the rock habitat affords under unfavourable regional conditions—climatic or biological. *Hypericum lanuginosum*, which in the relatively damp climate of Lebanon grows on shady banks, in the drier environment of the Mediterranean region of Palestine occurs as a saxatile plant, usually on the steeply sloping or vertical rock of minor outcrops. On the over-grazed island of Amorgos in the Cyclades, *Erica verticillata* (normally a constituent of hillside scrub communities) has become virtually confined to cliffs. A shift to a saxatile habitat may be brought about by too rigorous competition with life forms dominating the slopes, or by grazing. In the case of a species (e.g. *Hypericum lanuginosum*) centred in a more humid area, the moist root-run afforded by rock crevices with, in certain exposures, the provision of shade, may compensate, at least in part, for the lack of optimal living conditions provided by the normal habitat of the species at the periphery of its range (see Mayr, 1947, p. 266). Once the saxatile habit has been locally adopted (evidently an impossibility in many genera), the development of a saxatile ecotype seems likely to follow. As Mayr has pointed out, in peripheral regions differentiation will be accentuated by one-directional gene-flow.

Artemisia arborescens is not usually a cliff plant in the Mediterranean, but in Palestine (its most easterly extension as a wild plant) it is confined to the step-crevice. Even some species of very limited distribution, such as *Dionysia curviflora* in Persia and *Viola cazorlensis* in Spain (Pl. 6, phot. 4), which flourish on screes, rocks and stony slopes at the centre of their area, are confined to rock crevices at the edge of their range (especially at their lower altitudinal limits) where their ecological amplitude is narrowed. *Symphyandra cretica*, which has developed three isolated subspecies on Aegean islands (Samothraki, Giura and Crete), is generally saxatile on each island, being confined to shady cliffs; but in Crete I have also found the plant on shady banks in forests of *Castanea sativa*. In appearance the *Symphyandra* is a typical mesophyte, and it seems possible that the species has adopted

* *Cupressus* is by no means a habitual chasmophyte in the Mediterranean, and can form, as in parts of the Kyrenia range of Cyprus, extensive woods on northerly slopes. It is often found on rocks after the last traces of it have been eliminated from the slopes.

its saxatile habit as a result of drier conditions that developed in Inter-Pluvial or Post-Pluvial times. A similar history may lie behind *Digitalis dubia*, endemic to the shady rocks of Majorca; it is the only calcicole member of the *D. purpurea* group. The latter is believed to have had its origin in Tertiary forests (Goday, 1946).

Genera that are not saxatile in their main distributional area may be represented by exclusively saxatile species towards the edge of their generic or sectional range. An excellent example is found in *Origanum* Sect. *Amaracus*: the species in Southern Anatolia—where the section is most fully developed—grow mainly on stony slopes or in woods; but most of the outlying species of the Aegean islands, Cyprus and Cyrenaica are exclusively saxatile. Similarly, the trichophyte *Sideritis cypria*, confined to sunny vertical rocks in Cyprus, is related to non-saxatile species in the Taurus mountains. Such species have probably evolved from the local saxatile ecotypes postulated above.

(7) *The occurrence on chalky slopes of species that are otherwise strictly chasmophytic*

The existence on loose chalky slopes of species that are normally found only in cliff crevices of compact limestone is uncommon. But the reason for it has a bearing on the understanding of chasmophyte problems. Two notable examples in Palestine are *Hyoscyamus aureus* and *Scrophularia xanthoglossa*. *Ebenus cretica* behaves similarly in Crete, and *Chamaepeuce alpini* (cited by Rechinger, 1947, p. 210, as a relict strictly confined to rock crevices) in Cyprus. This is probably because Mediterranean vegetation is less well developed on pale chalk soils than on *terra-rossa* formed from compact limestone; the former has a lower water capacity than the latter. Competition is therefore greatly reduced, and, as the species mentioned are not particularly attractive to goats, they are able to occur in a habitat that would otherwise be impossible for them. *Capparis spinosa* (sensu lato), so common on arid cliffs that are otherwise practically barren, also grows in many hillside communities where competition is weak, especially on chalk.

(8) *Relicts; increase in saxatilism*

We can scarcely hope to find chasmophytes in the fossil record. Nevertheless, species of a relict nature (in the phylogenetic sense) may generally be recognized by their taxonomic distinctness, or disrupted distribution, or both. On taxonomic grounds we have no difficulty in recognizing as relicts (epibiotics) *Jankaea* (*Ramonda*) *heldreichii*,* *Centaurea crassifolia*, *Staehelina arborescens*, *Hypericum balearicum*, *Campanula laciniata*, *Feeria angustifolia*, *Petromarula pinnata*, *Lyrolepis diae*, *Scabiosa limonifolia*, *Pentapera sicula* and *Hemicrambe fruticulosa*. They are either monotypic genera or have no close relatives. Special mention should be made of *Pelargonium endlicherianum*, the only representative of the genus occurring outside Africa; it is endemic to sloping non-calcareous rocks in southern Asia Minor.

Extreme geographical disjunction within a species is very rare among Mediterranean cliff plants; usually the separated populations have been isolated sufficiently long to have differentiated into separate species. Nevertheless, there are several examples of species

* The European Gesneraceae are mesophytic chomophytes rather than chasmophytes, and do not occur in true Mediterranean territory. Their root system is superficial.

disjunction of considerable magnitude—*Pentapera sicula** (a monotypic Ericaceous genus confined to limestone precipices) in Sicily, Cyrenaica, Cyprus, Lycia and Lebanon; *Scabiosa cretica* in the Balearics, Sicily, Calabria, Capri and Crete; *Silene fruticosa* in Malta, Cyrenaica, Sicily, Province of Naples, Laconia, the Dodecanese and Cyprus. In some localities differentiation has reached varietal or subspecific level.

The occurrence of numerous phylogenetic relicts that are strictly chasmophytic emphasizes the stability of the cliff habitat. Many closely related species, though often widely separated geographically, are found in the same type of saxatile situation. In such cases the chasmophytic habit must often have characterized an ancestral stock. This applies particularly to species confined to vertical or overhanging rocks—the most extreme types of habitat and ones rarely invaded (unlike sloping rock or step-crevice) by usually non-saxatile species. In other chasmophytes the saxatile way of life has evidently been acquired recently, and may indeed be seen in the process of development where normally non-saxatile species are growing under unfavourable conditions.

During Pluvial and late Tertiary times desiccation and grazing were probably less important factors in the development of the saxatile habit than they have been during historic times. Due to the well-wooded nature of the country, however, competition was doubtless very intense on the hillsides; this would have tended to drive certain species into the sanctuary of rock outcrops that may have been less numerous than now. It therefore seems likely that chasmophyte communities have always been a feature of the Mediterranean flora, though in Tertiary times they may not have been so well developed or so sharply delimited as they are to-day.

When once a species 'in difficulties' has developed a saxatile habit (even if only locally), it is probable that natural selection of suitable biotypes will tend to increase the degree of saxatilism. Though the species has no longer to compete with the plants of the slopes, it must with those of the rocks, and, under selection pressure, will tend to develop forms better adapted to the most extreme types of rock habitat (vertical and overhanging rock) where competition, grazing and, in suitable aspects, exposure to sun are greatly reduced. If that is the case, species confined to vertical and overhanging rock will tend to be older—at least as saxatile plants—than those of sloping rock and pavement. The large number of morphologically very distinct and woody rare species confined to the most extreme types of rock habitats supports this view. But the price paid for such specialization is high.

(9) *Cliffs as refugia; Quaternary climatic changes*

I believe there can be little doubt that cliffs have served as refugia in the Mediterranean. They offer certain plants a refuge from:

(*a*) unfavourable climatic conditions; (*b*) competition with hillside communities; (*c*) grazing. Although inter-related, these will, for convenience, be discussed separately.

* The genus *Pentapera* (considered by Drude a subgenus of *Erica*) has pentamerous flowers in contrast to the tetramerous one of *Erica*. Pentamery is evidently a primitive feature in this group of genera, and therefore has a bearing on the origin of the large genus *Erica* believed by Chevallier (*Bull. Bot. Soc. Fr.* **70**, 867–9, 1923) to be a relict of the Tertiary xeromorphic flora of tropical Africa. It is perhaps significant that the distribution of *Pentapera* corresponds rather closely to the Mediterranean range of the relict *Cupressus sempervirens* var. *horizontalis* (occurring elsewhere in North Persia and the Himalayan region), and is indeed often associated with it. When it is remembered that the most widespread member of the genus *Erica*, *E. arborea*, is common in the Mediterranean *maquis* as well as in the mountains of tropical Africa, one wonders if the origin of the genus may not be bound up with the Tertiary history of the Tethys. Leaf impressions referred to *Erica* have been described from Miocene deposits in Germany.

(a) *Unfavourable climatic conditions*

It is fairly generally accepted that the climate of the Mediterranean is now considerably drier than it was during the so-called Pluvial phases of the Pleistocene. The work of Garrod & Bate (1937, p. 149) on the Pleistocene fauna of the Carmel caves shows a marked faunal break at the beginning of a Pluvial phase correlated by Zeuner (1945, p. 199) with the beginning of the Last Glaciation in Europe. The more primitive fauna was wiped out and modern forms took its place. According to Picard (1943, p. 122) there were apparently three Pluvial periods in the Pleistocene of Palestine; the last, as Garrod & Bate have shown, was divided into two Sub-pluvials correlated by Zeuner with the first and second phases of the Last Glaciation. Garrod & Bate's arguments—based largely on mammalian remains—for a damp tropical climate during the Pluvial of the Middle Pleistocene (according to Zeuner contemporary with the Penultimate Glaciation) have been convincingly refuted by Picard (1943, p. 121) on the more reliable evidence of snail fauna and total absence of tropical soils. The faunal break, he claims, marks a limit in Western Palestine not between tropical and Mediterranean climates, but between 'extreme Mediterranean (e.g. Dalmatian) and general Mediterranean'. The modern flora of Palestine certainly suggests that during the Pleistocene there occurred no more than an oscillation of the climatic belts found in the Levant to-day.

Much controversy has centred round the question of the climatic changes that may have occurred in the Mediterranean since the close of the Pleistocene. Turrill (1929, p. 74) has shown how difficult it is, when dealing with this problem, to disentangle cause from effect. Brooks (1949, p. 286), however, has recently pointed out that nearly all the 'anti-variation literature' is directed against *progressive* desiccation, not against climatic *fluctuation*. He has correlated much varied evidence to give a convincing picture of climatic oscillations since the end of the Pleistocene. So far as the Eastern Mediterranean is concerned, Brooks (1949, pp. 299–325) finds strong evidence for relatively dry periods around 2200 B.C. and A.D. 700, and relatively wet ones from 4000–5000 B.C. and around 500 B.C. and A.D. 1300. But he does not refer to the valuable work of Garrod & Bate (1937) which would certainly have strengthened his arguments for climatic oscillations. The distribution and ecological requirements of cliff communities certainly suggest that the climate of the Mediterranean, whether or not due to deforestation and erosion, is now drier than it has been during recent times.

The temperature of Pluvial periods in periglacial regions is as controversial a subject as their precipitation. A large number of Sudano-Deccanian species are found in the Dead Sea oases, and are separated by great distances of unsuitable territory from the main area to the south; being typically monsoon plants, they are believed to have reached Palestine under Pluvial conditions (cf. Eig, 1939, p. 304) that were far from cold. It is generally considered that during Pluvial periods the rainfall in the Mediterranean was more generally distributed throughout the year than at the present time. But Pluvial phases are also expected to explain the southern extension of many northern forms, and for this migration the temperature would have been lower than that which enabled the Sudano-Deccanian element to move northwards. It would seem that two types of damp climatic phases occurred, one cooler than the other, for a single type could hardly account for the present distribution of both these northern and southern elements in Palestine. The low percentage of endemics in the Sudano-Deccanian element, however, suggests that a northerly penetration of this flora may have been effected, in part, as recently as the warm damp period postulated by Brooks for 4000–5000 B.C.

The majority of chasmophytes develop fully only on shady exposures. Indeed, many species are never found in full sun and exceedingly few are confined to it. This is marked not only in the Mediterranean proper, but also in Irano-Turanian Persia where species of the beautiful saxatile genus *Dionysia* are confined almost exclusively to shady crevices. Some *Primulae* in Sect. *Floribundae* (probably the nearest affinity to *Dionysia*) are an extreme example, for there the 'demand' for shade is coupled with the necessity for a copious water supply. *Primula aucheri* in Oman, and *P. verticillata* (*typica*) in Yemen, with its subsp. *boveana* on Mt. Sinai and subsp. *simensis* in Abyssinia, are apparently all confined to a few damp and shady rocks near springs; they are separated from one another by vast stretches of desert where the genus could not possibly survive under present conditions. It seems impossible to explain their distribution except by migration under Pluvial conditions from the north-west Himalayas, through Afghanistan and Persia, where the other members of the group are found. The climate must certainly have been wetter than at the present time.

In Edom (Transjordan) we find quite a concentration of Mediterranean species in the shady Nubian Sandstone gorges of Petra, often separated by many miles of unsuitably arid country from their main distributional area farther north. They could only have reached their present position at Petra during a period (or periods) of heavier rainfall than now. As a few of these species (e.g. *Galium petrae* and *Daphne linearifolia*), though closely related to more northerly Mediterranean types, are endemic, such migration may date, at least in part, far back in the Pleistocene; indeed the waves of migration presumably corresponded to the number of cool damp phases the area experienced. This northern element does not stop at Petra; some species get as far south as the granite peaks of southern Sinai and the limestone plateaux in the eastern desert of Egypt.

Cliffs—and those of a gorge in particular—offer a refuge to plants during unfavourable climatic change, whether it be towards wetter or drier conditions (provided, that is, the species is able to grow in a crevice at all). Every exposure, in sun or shade, is represented. Because ecological tolerance differs with the species, it is to be expected that the range of various species in possession of a cliff will either extend, contract, or remain unaffected as the climate alters; a floristic change in the communities will result. A shifting of climatic belts, such as apparently occurred several times during the Quaternary, would bring about not only a migration of saxatile species from one area to another, but also a change in crevice habitats, within a particular area of rock—e.g. the movement of a species from a sunny crevice to a shady one or vice versa. A rare chasmophyte, *Centaurea speciosa*, grows in Northern Lebanon on south-facing cliffs; but in Upper Galilee (its farthest extension into the drier country to the south) it is virtually confined to cliffs with a shady exposure. In this connexion it may be noted that *Antirrhinum majus*, which in Galilee is confined to vertical shady rocks, favours sunny walls in the alien locality of Cambridge (Rishbeth, 1948, p. 145). Such changes in the choice of aspect might be termed 'compensation effects', and are evidently related to IE-amplitude (I = insolation, E = exposure) as worked out in Palestine by Boyko (1947, p. 151) for *Ononis natrix* and *Limonium thouini*. Climatic and topographical changes have no doubt accounted for the fragmentary nature of many cliff communities, but different types of crevices (particularly with regard to slope and aspect) must often have allowed species to survive that would otherwise have become extinct. Numerous phylogenetic relicts bear witness to it.

When an unfavourable climatic change takes place more quickly than a chasmophytic species can change its crevice in its original locality, or can migrate to a more favourable area, then disruption of its range is bound to occur. Cliffs are local, and migration for most saxatile species is necessarily a slow and hazardous process. It is therefore not surprising that climatic oscillations have resulted in the distributional disjunction of so many saxatile species. Judging by the richness of the Mediterranean flora, Pleistocene climatic changes have not been sufficiently devastating to bring about a large-scale extinction of the flora.

(*b*) *Competition with hillside communities*

Competition with plants of the hillsides—and particularly with those of larger life form—appears to have been an important factor in the development of saxatile plants. This can be appreciated at the edge of a species' range where the saxatile habit is adopted or accentuated in response to a less favourable environment that often takes effect through a decrease in the species' ability to compete with the more vigorous plants of the slopes. Cliffs, in fact, offer a refuge to certain plants from too rigorous competition in hillside communities. The shift in the balance of competition may be initiated by climatic change, grazing, deforestation or other means.

The curious distribution of certain rare saxatile species in Palestine is apparently related to the intensity of competition. *Teucrium montbretii* var., *Scrophularia xyllorhiza* var., *Silene grisea*, *Galium canum*, *Allium davisianum* and *Ferula samariae* all occur on rocks in Palestine at the junction of the Mediterranean and Irano-Turanian territories. The first four chasmophytes have their main distributional area in typical Mediterranean territory to the north of Palestine, but are apparently absent in Upper Galilee and Southern Lebanon; the *Allium* and *Ferula* are 'point' endemics closely related to non-saxatile species of Mediterranean *maquis* associations, and belong to the step-crevice and ledge communities. Why, in the drier and hotter climate of Palestine, do these six plants grow only on the dry hot margin of the Mediterranean territory, instead of within it? I think the explanation can only be that, in their present Palestine habitats, they avoid, by being in a 'no man's land' between Mediterranean and Irano-Turanian conditions, the vigorous competition (whether saxatile or not) offered by typical Mediterranean vegetation. The first four species compensate for living under such difficult climatic conditions by growing always in complete shade, even, in the case of *Scrophularia*, *Galium* and *Teucrium*, where the rock overhangs and competition with other species is reduced to a minimum. *Teucrium montbretii* var. has gone to extraordinary lengths to survive, growing upside down on the roofs of shallow caverns; many of the individuals are dead or dying, though in the main part of its range the species flourishes on vertical and steeply sloping rock. I have also noticed this cavernicolous state in *Dionysia strausii* and *D. boydii* in Persia; *Primuletum allionii* Quézel & Rioux grows under similar conditions in the Maritime Alps. A relict cavern community in Isauria is confined to a transitional montane area between Mediterranean and Irano-Turanian regions. It is difficult to see such cringing associations and still believe that the climate is not drier than it has been during historic times.

(*c*) *Grazing*

Grazing, especially by goats, has been referred to earlier. It is often very important in determining the micro-distribution of chasmophytes, and can be the controlling factor preventing their spread. Grazing may increase the development of the chasmophytic habit by eliminating non-saxatile biotypes.

(10) *The evolution of chasmophytes*

Plants found on rocks may be divided into two main groups, of which the second is largely derived from the first.

(*a*) *Species saxatile only casually or under adverse circumstances.* The majority of species of the ledge and step-crevice belong here, but also many of those found on sloping rock and pavement.

(*b*) *Exclusive chasmophytes.* Plants of vertical and over-hanging rock nearly all belong to this group, and also most of the leading species of steeply sloping exposures. When related species are all (as is often the case) exclusive chasmophytes, it is likely that the saxatile habit was already a feature of the ancestral stock. Many exclusive chasmophytes, however, were probably derived originally from non-saxatile ancestors, although the crevice-occupying habit may already have been acquired in Tertiary times. Evidence in support of this view is found in the fact that many normally non-saxatile species become chasmophytic under adverse circumstances; they may be considered incipient chasmophytes, and would become exclusively saxatile if they were to be exterminated in their non-saxatile habitats—an event that would effectively isolate the cliff population and facilitate its differentiation. All stages can be found between habitually non-saxatile species and those that are exclusively chasmophytic.

One of the most striking features of chasmophyte communities is the restricted distribution of their constituents; endemism is the rule. By taxonomic criteria these consist of both young and old types, so that neither the concept of 'Age and Area' (Willis, 1922, p. 63), nor 'senescence' resulting directly from the age of a species (Fernald, 1925, pp. 336, 342), nor 'competition' (Griggs, 1940, p. 592) can offer a satisfactory explanation for their rarity. Every gradation is found between the slightly differentiated geographical race and the well-marked taxonomic species. The view held by Goldschmidt (1940, pp. 149–54) that species have a different origin from subspecies and are on a completely different level of organization certainly finds no support from the taxonomy of Mediterranean chasmophytes.

Stebbins (1942, pp. 250–2), in his stimulating study of the genetic approach to problems of rare species, has distinguished between 'depleted' continental species and 'insular' species, giving a wide meaning to the latter so as to include not only species of islands but also those of 'many types of habitats that are radically different from their surroundings'. But where are we to draw the line between 'insular' and 'depleted' species? Stebbins (1942, p. 255) has indicated some morphological criteria whereby these two types may be distinguished, but I have found them hard to apply. The degree of morphological differentiation attained in isolated populations depends not on whether the latter are 'insular' or 'depleted', but on how long they have been isolated. If a cliff can be considered an 'isolated ecological habitat' (Stebbins, 1942, p. 257), then rare chasmophytes that have apparently evolved in such habitats from widespread non-saxatile species are to be considered 'insular'; such, perhaps, is *Ajuga chasmophila* which may have evolved from the polymorphic *A. chia* by a shift in habitat initiated at the edge of the latter's range. But the majority appear to be 'depleted' species or their derivatives; the latter applies particularly to those allopatric groups of closely related species that are all saxatile. Because of climatic and topographical changes, the splitting-up of their range results in differentiation that in time reaches the species level. In central Crete a rather unusual case is found in *Linum dorfleri*: it actually divides the range of *L. arboreum* which we may assume to be its ancestor. Both species are confined to vertical cliffs, and *L. dorfleri* would thus appear to be a geographical derivative of a 'depleted' saxatile species that is itself probably descended from a once more widespread stock. The complexities of the subject are formidable, time and topographical changes tending increasingly to obscure the distinctions between 'insular' and 'depleted' continental species. Nevertheless, there seems little doubt that many of the rarest chasmophytes found to-day—such as *Centaurea crassifolia* on the sea-cliffs of Malta, *Scabiosa limonifolia* in West Sicily, and *Lyrolepis diae* recently discovered by Rechinger on an islet off the Cretan coast—must be numbered among the Tertiary types of the Mediterranean region. The survival of so many relicts on islands and promontories has been explained by Griggs (1940, p. 589) and Stebbins (1942, p. 254) as due to less rigorous competition resulting from retarded succession. I suggest that it may also be owing to the more temperate conditions found in such localities, which would have been particularly advantageous during the climatic oscillations of the Quaternary.

A feature of rare chasmophytes is the morphological uniformity of the populations involved, especially those of vertical and overhanging cliffs where natural selection is most rigorous. This applies particularly to species which are taxonomically very distinct and are therefore presumed to be old types (epibiotics), but is common even in many vicariads that have evidently arisen more recently by disjunction of an ancestral stock (as in groups of *Dianthus*, *Scrophularia*, *Brassica* and *Dionysia*). There is, in fact, only one hypothesis that satisfactorily explains the rarity of most cliff endemics—the concept of genetic homogeneity (Stebbins, 1942, p. 248). Whether the species (or geographical race) is old or young, 'insular' or 'depleted', this concept offers the best explanation of the facts. Poverty in biotypes is assumed to be the fundamental reason for rarity; it accounts for that *maladie imaginaire*, 'senescence', and the failure of rare species to compete with common ones.

An attempt can now be made to outline the general evolutionary history of Mediterranean chasmophytes. Besides topographical changes, the climatic vicissitudes of the Quaternary in the Mediterranean, though probably not sufficiently drastic to bring about wholesale extinction of plant species, evidently caused numerous discontinuities; in this respect the Inter-pluvials must have played an important part. As a result, the areas of many cliff species were greatly reduced, and, under the force of rigorous selection necessitated by life in a very restricted and specialized habitat, woodiness and the degree of saxatilism increased; but populations became depleted of many of their biotypes. When more congenial conditions returned, they were often unable to spread, for their ecological amplitude had been narrowed still further.

In the Mediterranean during the Quaternary period cliffs must have played a refugial part comparable to that of nunataks in glaciated areas (cf. Hultén, 1937, p. 140). During hot arid periods (such as characterized the Interpluvials) shady cliffs at low elevations provide a refuge not dissimilar to that afforded by mountain peaks. The two habitats sometimes produce 'parallel' endemics. Here we are faced with the difficulty of evaluating the roles of geographical and ecological isolation in speciation (Mayr, 1947, p. 285). An example may be taken from the genus *Sedum* in Cyprus: *S. lampusae* is endemic to the shady limestone cliffs of the Kyrenia range; in the igneous Troödos *massif* it is 'replaced' below 1500 m. by the closely related *S. cyprium*, and above that altitude by *S. microstachyum* on serpentine rock. Another example is provided by *Arabis cypria* (Pl. 7, phot. 5) and *A. troodi*, the first of which has nearly the same distribution and habitat as *Sedum lampusae*, and the second as *S. cyprium* and *S. microstachyum* combined. Because the related species are geographically as well as ecologically separated, it is hard to evaluate the part played by ecological isolation in their differentiation. But spatial separation, if of sufficient magnitude, will give populations absolute isolation, instead of the partial isolation that ecologically different, but adjacent, habitats will normally provide. However, the fact that species on cliffs often flower later than those on slopes may facilitate the differentiation of saxatile ecotypes by at least partially isolating the cliff population from that of adjacent open declivities. Complete geographical isolation will allow differences in the habitat (well marked in the examples cited above) to operate through natural selection with the maximum effect. As Darwin (1897, p. 334) pointed out, even if different areas are physically identical, the species within them will be exposed to dissimilar competition because of the different organisms with which they must compete. In Mediterranean chasmophytes there can be little doubt that in the majority of cases geographical isolation has been a prerequisite of speciation, providing the medium in which other factors operate; its effects have been accumulative.

In isolated colonies there is a tendency, as Wright (1931, p. 157) and Dobzhansky (1941, p. 332) have shown, for genetic drift to occur, entailing the fortuitous fixation of non-adaptive characters through recessive genes (including deleterious ones) becoming homozygous; other genes are accidentally eliminated. Pitted against genetic drift is the pressure of natural selection, the character of the colony depending on which of these factors has the upper hand. Natural selection will of course tend to speed up the process of differentiation. A feature that will militate against rapid speciation, however, is the infrequency with which a chasmophyte can reproduce itself, because of the biologically closed nature of cliff communities. In the event of genetic drift being dominant over selection pressure, the colony may sometimes be doomed to extinction by the fixation of unfavourable genes. Even if selection is the dominant factor, an isolated colony can have little chance of extending its range, because of over-specialization and biotype-depletion. Too extreme selection destroys the field of variability, and therefore the basis for advance (Wright, 1932, p. 365). Rare cliff species live in a very precarious state of equilibrium. Many, due to high specialization, are no doubt successfully adapted to their circumscribed habitat, and are therefore able to survive in small numbers for a considerable period. But when conditions change, extinction must often be hard to avoid.

Although differentiation can occur, theoretically, purely as a result of restriction in population size, environment differs locally, so that selection pressure—which must always be present in some degree—will not be uniform throughout the range of a species. Genetic differentiation, by whichever factor it is primarily controlled, will be modified by the infiltration of genes from neighbouring colonies (Wright, 1932, p. 363; Dobzhansky, 1941, p. 336). Such partial isolation of many small colonies within a species' range is considered by Wright (1948, p. 291) to be the most favourable condition for evolution. But the differentiation of small *completely* isolated colonies, even though they may soon reach specific level, can hardly be considered progressive evolution. Such species are born old, and, even if they are not running down like an overwound clock, can do little more than maintain themselves. Only in the event of isolated populations being brought into contact with one another— provided no genetic barriers have arisen during prolonged isolation—does progressive evolution seem likely to occur. Chasmophytes are, both literally and figuratively, on the rocks.

V. SUMMARY

1. A preliminary account has been given of the major types of rock habitats found in the Mediterranean region, for convenience distinguishing pavement, sloping, vertical and overhanging rock, the ledge and the step-crevice. The main factors of saxatile habitats have been annotated.

2. The plant communities that occupy these habitats in Palestine have been outlined. Each habitat is found to be characterized by distinct communities, often of a relict nature. Whereas vertical and overhanging rock support species that are almost exclusively chasmophytic, the step-crevice is occupied by many species derived from neighbouring *maquis* communities.

3. The following aspects of Mediterranean cliff communities have been discussed:

(*a*) Life forms and their distribution in different communities. The predominance of the Chamaephyte (especially suffruticose) has been stressed, and reasons given for believing the woody habit so characteristic of chasmophytes to be most frequently a derived character. Longevity will be favoured by natural selection.

(*b*) The distribution of chasmophytes in different groups of flowering plants. Saxatilism is considered an advanced and specialized character favoured by natural selection.

(*c*) Seed dispersal. With the exception of many step-crevice plants disseminated by birds, wind-dispersal—often depending only on the lightness of the seed—was found to be predominant.

(*d*) Discontinuous distribution caused by climatic and topographical changes.

(*e*) Cliff communities as biologically closed communities, generally representing physiographic and/or edaphic climaxes.

(*f*) The development of a saxatile habit in species not normally saxatile. This was found to occur at the edge of a species' range and/or under adverse conditions. Species of vertical and overhanging rock are believed to have the longest saxatile history; they show little morphological variation in any one locality.

(*g*) Relicts; their recognition and significance.

(*h*) Cliffs as refugia. They offer a refuge from unfavourable climatic change, competition with hillside communities, and grazing.

In connexion with (*d*) and (*h*), Quaternary climatic changes in Palestine have been discussed. Rock communities suggest that the Mediterranean climate is drier than it has been during recent times.

4. An attempt has been made to outline the general evolution of Mediterranean chasmophytes. Geographical isolation, often resulting from the climatic and topographical changes of the Quaternary, has in most cases been a prerequisite of speciation. Ecological isolation

has probably played a subsidiary role. The rarity of endemic chasmophytes, including both young and old types, is explained by the concept of genetic homogeneity; their ecological amplitude is exceedingly narrow. Unfavourable conditions during a chasmophyte's development have resulted in a reduction in the biotype supply. Following biotype-depletion, genetic drift has played a considerable part in speciation, particularly in the later stages of differentiation when the population is much reduced in size.

Chasmophytes are in general a blind alley in the scheme of evolution: though they may differentiate *in situ*, they can rarely give rise to successful new forms. Due to high specialization, chasmophytes can often maintain themselves for a considerable period. But for many extinction seems inevitable.

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THE VEGETATION OF THE DESERTS NEAR CAIRO.

CONTENTS.

I. INTRODUCTION.

No account appears to have been published of the phyto-sociology of the Egyptian Desert (excluding Sinai) at the latitude of Cairo (30° N.). These notes are the result of frequent visits made between 1943 and 1945 to many parts of that area which belongs to the Saharo-Sindian Botanical Region. My purpose is to give a general account of the main plant communities in relation to their habitats, and in particular with reference to the geology of the district. In this arid region, the fidelity of a plant community to a particular type of rock is often remarkably striking.

The two main areas treated in this paper — the Western and the Eastern Deserts — correspond to the Libyan Desert subregion (D.l.) and the Northern Arabic Desert subregion (D.a.sept.) of Muschler (1912). Although my observations are largely based on an area within a 30 km. radius of Cairo, pertinent references to Gebel 'Ataqa and Gebel Galâla (both near the Gulf of Suez) have been included. A map is provided at the end of this paper.

II. CLIMATE.

The scarcity of meteorological stations in the Egyptian Desert makes it impossible to give a detailed account of the climate. Normal values for Helwan and Suez are given in the accompanying table (using figures obtained from the Physical Department in Cairo), followed by some general remarks.

TABLE.

		Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
TEMPERATURE (°C)														
HELWAN (1904-41)														
Maximum		18.6	20.3	24.0	28.6	32.6	34.8	35.5	34.8	32.3	30.0	25.3	20.2	28.1
Minimum		8.1	8.9	11.1	14.2	17.5	19.9	21.1	21.4	19.9	18.2	14.6	9.9	15.4
SUEZ (1921-38)														
Maximum		19.6	20.6	24.0	28.1	32.1	34.7	36.0	36.0	33.3	30.7	26.3	21.5	28.6
Minimum		9.6	10.1	12.2	15.0	18.6	21.1	22.9	23.3	21.6	19.3	15.7	11.0	16.7
RELATIVE HUMIDITY (%)														
HELWAN	(1904-41)	62	56	52	45	41	44	51	54	58	59	62	62	54
SUEZ	(1921-41)	68	66	64	61	59	62	63	65	67	69	69	67	65
RAIN FALL (mm.)														
HELWAN	(1904-42)	7	4	5	3	1	0	0	0	0	1	3	4	28
SUEZ	(1921-42)	2	2	4	1	1	0	0	0	0	2	6	2	20
NUMBER OF RAIN DAYS														
HELWAN	(1904-42)	1.5	1.3	0.8	0.4	0.2	0	0	0	0	0.3	0.8	0.1	5.4
SUEZ	(1921-42)	1.0	0.6	0.6	0.2	0.2	0.1	0	0	0	0.4	0.6	0.6	4.3

TABLE OF NORMAL VALUES

The whole area experiences an extreme type of Saharo-Sindian climate with a very low and irregular rainfall. Rain, which may occur any time between October and May, is often heavy when it comes. Ten millimetres is sufficient to cause flooding in the narrow valleys (wadis), due to the poor development of soil; but such floods are exceptional, and several years may go by without their occurrence. The Eastern Desert, thanks to its greater relief, certainly has a heavier rainfall than the Western Desert; even on the Galala plateaux, however, it is doubtful if the mean annual rainfall exceeds 30 mm. The average rainfall for Helwan — 28 mm. a year — is probably a fair estimate of precipitation in the northern part of the Eastern Desert. Rain is brought by the eastward passage of Atlantic cyclones across the Mediterranean.

Only in a narrow strip down the Gulf of Suez is relative humidity highest in summer (Hurst). Over the rest of the desert it is higher in winter than summer. Due to Helwan's proximity to the Nile Valley, the relative humidity is presumably somewhat higher there than in the interior of the desert. The low humidity figures for May are explained by the prevalence of scorching <u>Khamsin</u> winds at that period. Humidity decreases with increase in altitude, but the effect of this on vegetation is compensated for by a decrease in temperature. Great temperature differences are experienced between deep valleys and windswept plateaux. Slight frost has been reported during the winter months at Helwan, and snow has been known to lie on Gebel Ataqa and the Galala Plateaux.

Records of dew-fall are not published in the Egyptian weather reports, but, judging by records kept by Prof. E.J. Lewes (<u>in</u> /

(*in litt.*) on the Cairo-Suez road, and from information obtained from bedouin, heavy dews occur from time to time throughout the year.

III. PHYTOSOCIOLOGY.

A. THE WESTERN DESERT.

The area known as the Western Desert of Egypt stretches from the Nile to the Libyan frontier. Topographical relief is poor, and the landscape consists largely of barren gravel plains. Superimposed on these gravels (and beyond the area I visited) are the sand-dunes. In two places near Cairo (Giza and Abu Roash) hard limestone rocks of Eocene and Cretaceous Age support a flora different from that of the gravel wastes. These compact rocks will be dealt with first.

1. Cretaceous Rocks.

Occurring only in the vicinity of Abu Roash, Cretaceous strata are represented by compact limestones containing such characteristic marine fossils as *Exogyra* and *Ananchytes* (Beadnell, 1902). The exposed limestone, sloping from 5° - 40° in a dome, is full of vertical cracks at right angles to the bedding planes. The crevices are filled with blown sand and support a plant-community which I have not seen elsewhere: an association of *Salsola pachoi* and *Anabasis articulata* (photo. 1). These two members of *Chenopodiaceae* are both autumn-flowering nanophanerophytes. They may be co-dominant, or one or other may dominate locally. Accompanying them are two other autumnal Chenopods of similar habit — *Agathophora alopecuroides* and *Traganum nudatum* — and the geophytes *Dipcadi* /

Dipcadi erythraeum and Scorzonera alexandrina, both of which flower in spring. I have not found the rare Salsola pachoi elsewhere; Scorzonera alexandrina is very local in the Cairo deserts, though it is a characteristic species of the Mediterranean coast west of Alexandria (known as the Mariut) where it is confined to hills of oölitic limestone with a much heavier rainfall and higher humidity than one finds at the latitude of Cairo.

The composition of the Salsola pachoi - Anabasis articulata community, which covers practically the whole area of Cretaceous limestone, is as follows:-

Characteristic spp:

Exclusive :	Salsola pachoi, A 1 - 2, Soc. 1 ø	) dominant
Constant :	Anabasis articulata, A 1 - 2, Soc. 1	)
"	Agathophora alopecuroides, A +, Soc. 1.	
"	Traganum nudatum, A +, Soc. 1.	
"	Dipcadi erythraeum, A +, Soc. 1 (vernal aspect)	
"	Scorzonera alexandrina, A +, Soc. 1 (vernal aspect)	
Indifferent spp:	Pituranthos tortuosus, A +, Soc. 1.	
	Farsetia aegyptia, A +, Soc. 1.	
	Gymnocarpum fruticosum, A +, Soc. 1.	
	Fagonia arabica, A +, Soc. 1.	
	Cotula cinerea, A +, Soc. 1 (vernal aspect)	
lc. /	Danthonia Forskahlei, A +, Soc. 1.	
	Plantago ovata, A +, Soc. 1 (vernal aspect)	

The /

ø The symbols are those used by Braun-Blanquet (1932, p. 32 - 36): A = Combined estimate of Abundance + Cover (using a 6-part scale); Soc. = Sociability (using a 5-part scale).

The association is best developed on S.W. exposures, and is apparently an edaphic climax community modified by grazing. Sand-drift enables areas in the desert to support vegetation that would otherwise be quite bare, the sand acting as a mulch and preventing drying-out of the substratum. At Abu Roash the exposed bed-rock acts as a water-catch, the rain being absorbed in the vertical sand-filled fissures. It is only in such areas overblown with sand, or on ground which is by nature sandy, that vegetation can occur on open slopes in the deserts near Cairo. Elsewhere phanerogams are confined to valleys or depressions.

On rock slopes at Abu Roash blown over with deep sand, Zygophyllum album dominates (A 1 - 2, Soc. 1), but with Heliotropium digynum as a local dominant accompanied by scattered plants of Convolvulus lanatus, Anabasis articulata and Pituranthos tortuosus; where the sand-cover thins out, Zygophyllum decreases and is replaced by Anabasis as a dominant.

Sand accumulates mainly on the easterly side of rock outcrops of the Abu Roash dome; the S. and W. faces are blown clear (except for sand-filled crevices) and therefore support the Salsola pachoi - Anabasis articulata community which occurs only where some bed-rock is exposed.

2. Eocene Rocks.

Rocks of Eocene Age are found at the pyramids of Giza, and are similar in appearance to the Cretaceous area just described, but the gently sloping outcrops are characterised by fossils of Nummúlites gizehensis. As at Abu Roash the vertical crevices of the /

the exposed bed-rock are filled with blown sand.

Anabasis articulata (A 1 - 2, Soc. 1) is the dominant species of these sand-filled cracks, accompanied by scattered individuals of *Haloxylon salicornicum*, *Agathophora*, *Pituranthos tortuosus*, *Dipcadi erythraeum*, *Farsetia aegyptia*, *Launea nudicaulis* and *Plantago ovata*; the latter characterises the vernal aspect in this locality, and in favourable years is very abundant. Of rarer occurrence are *Heliotropium bacciferum*, (*H. undulatum sensu lato*), *Danthonia Forskahlei*, *Erodium triangulare*, *Rumex roseus*, *Gymnocarpum fruticosum*, *Atractylis flava*, *Malva parviflora*, *Gymnarrhena micrantha*, *Fagonia cahirina* and *Aristida* sp.

lc. /

Slopes of limestone talus mixed with sand support no *Anabasis*, but in spring are covered by an open therophyte community dominated by *Erucaria crassifolia* (in Egypt confined to the Western Desert) accompanied by *Erodium triangulare*, *Malva parviflora* and other annuals, and by the bulb *Dipcadi erythraeum*. In rainless years such communities of desert annuals fail to develop.

Besides the sloping expanses of exposed rock with sand-filled crevices, there are also shallow run-off channels filled with sand and limestone rubble. In these *Scorzonera alexandrina* is dominant (though active only in the winter and spring aspects), accompanied by *Dipcadi* and rare individuals of *Pituranthos*, *Fagonia glutinosa*, *Farsetia aegyptia*, *Echinops spinosissimus*, *Launea nudicaulis*, *Erodium triangulare* and *Anabasis articulata*.

Floristically this area of Eocene limestone can be most closely compared with that of the Cretaceous rocks of Abu Roash, but *Salsola pachoi* is absent.

In /

In shallow sandy valleys on Eocene limestone the leading plants are Echinops spinosissimus, Heliotropium digynum and Pituranthos tortuosus; Panicum turgidum is infrequent, probably because the sand is not deep enough to suit it well.

3. Gravel Plateaux.

Where the valleys just referred to widen out on to the plateau above, their beds become filled with a mixture of sand and flinty gravel dominated by Pituranthos tortuosus (A 1 - 2, Soc. 1) — a suffrutescent summer-flowering Umbellifer. Less frequent is Polycarpaea repens, usually growing in more sandy beds, and scattered individuals of Farsetia aegyptia. Heliotropium digynum and Cornulaca monacantha occur. The Pituranthos community is also found in shallow sandy depressions on the plateau, but in those filled with almost pure sand it is poorly developed; in such habitats Cornulaca becomes more abundant but still fails to dominate numerically.

Between the Pyramids and Gebel Khasab (the Western Petrified Forest) a dreary expanse of gravel plateau, mostly Oligocene, is bare of plants except in the shallow wadis filled with a mixture of sand and gravel, where soil moisture is sufficient to support sparse vegetation. Pituranthos tortuosus is generally the leading species, with Lithospermum callosum and Farsetia aegyptia accompanying it.

As the foot of Gebel Khasab is approached, the big sandy Pituranthos wadis are replaced by small channels and grooves filled with fine gravel and sand. There is no Pituranthos, but a varied dominance of Polycarpaea repens, Aristida sp., and Cotula cinerea, with occasional plants of Dipcadi, Erodium bryoniifolium, Anchusa hispida, /

hispida, Monsonia nivea, Malcolmia aegyptiaca, Silene villosa, Senecio coronopifolius and Neurada procumbens. (The last behaves as an annual in the Egyptian Desert, but is perennial on the more humid coastal dunes of Palestine.)

Gebel Khasab itself is surfaced with large flinty gravels, mainly of Pliocene or Plio-Pleistocene age, embedded in a sandy matrix. On northerly slopes Anabasis articulata (A 1 - 2, Soc. 1) is the dominant species, accompanied by less common Traganum nudatum and an annual Aristida. In spring Dipcadi, Scorzonera alexandrina and Senecio coronopifolius are also in evidence. On slopes that show a higher proportion of sand to gravel, Traganum (A 1 - 2, Soc. 1) dominates over Anabasis; with it grow scattered bushes of Calligonum comosum (a member of Polygonaceae closely resembling an Ephedra in habit). Notes on the autecology of Calligonum and some other plants of the Eastern Desert have been given by H. Hamshaw Thomas (1922).

On the sides of steep gravel channels near the summit of the Khasab hills Anabasis and Traganum are varyingly dominant, the latter apparently preferring the sandier sites. Companion species include Erodium bryoniifolium, Mesembryanthemum forskahlei, Senecio coronopifolius, Gymnarrhena micrantha, Savignya parviflora, Reseda sp., Dipcadi, Cleome arabica, Fagonia arabica, Cotula cinerea and Rumex roseus; sometimes only the annual (vernal) aspect of the community develops, especially on southerly slopes which on Gebel Khasab are less favourable for the woody Chenopods than those with a northerly aspect.

The gravel plains (Oligocene and Plio-Pleistocene) between

Abu /

Abu Roash and Wadi Natrun are not marked by valleys but only by shallow depressions filled with fine gravelly sand. These were examined to the east of Bir Hooker (Wadi Natrun) and were found to be dominated by *Pituranthos tortuosus* and bushes of *Convolvulus lanatus* (both A 1 - 2, Soc. 1); the former, however, was usually dominant. Growing with these was *Artemisia monosperma* (A 1, Soc. 1), a psammophyte which 25 km. further north (towards Alexandria) becomes co-dominant with *Thymelea hirsuta* forming an association that is not characteristically Saharo-Sindian in its composition. Less abundant species in the *Pituranthos tortuosus* - *Convolvulus lanatus* community are *Zilla spinosa* (only in the centre of depressions where sand is deep and water conditions less difficult), *Lithospermum callosum* and *Polycarpaea repens*. The vernal aspect includes such therophytes as *Trigonella stellata*, *Arnebia* sp., *Neurada procumbens*, *Erodium bryoniifolium* and *Cotula cinerea*; *Trigonella stellata* and the bulb *Dipcadi erythraeum* often occur outside the zone dominated by *Pituranthos*, where the sand-cover becomes very shallow.

Convolvulus lanatus, *Artemisia monosperma* and several of the annuals were not seen in the Western Desert near the pyramids, so that the *Pituranthos* - *Artemisia monosperma* community might be considered an association distinct from that of the *Pituranthos* community widespread between Giza and Gebel Khasab. If so, the two types might be united in a *Pituranthos* alliance characteristic of the sandy gravel plateaux of the Western Desert.

It must be stressed that the whole flora of the Western Desert as seen by me is more or less psammophytic, due to the fact that even on limestone rocks the soil consists very largely of sand blown /

blown across the desert by predominating N.W. winds. Although several of the species common in the Western Desert (e.g. Anabasis articulata, Pituranthos tortuosus) occur also in the Eastern Desert quite unconnected with sandy soils, the majority of species listed are preferentially psammophytic; indeed many (e.g. Convolvulus lanatus, Artemisia monosperma, Fagonia arabica, Heliotropium digynum, Lithospermum callosum, Dipcadi erythraeum and many of the annuals) are entirely confined to sandy soils. Except for one large area of gravel hills, such habitats are only of local occurrence in the Eastern Desert.

It is the geological, edaphic and topographical differences between the two deserts, coupled with the barrier to E.-W. migration formed by the Nile Valley and Delta, which it would seem are primarily responsible for the marked difference in their floras.

According to Ball (1939), the Nile has been in existence since the Miocene. During the Pliocene subsidence, much of the valley became a marine gulf of the Mediterranean. This must have been made E.-W. migration more difficult than it is at the present time. For information on the vexed question of climatic changes during the Quaternary in Egypt and adjacent territories, reference should be made to Hume (1910), Beadnell (1933), Sandford (1934), Garrod and Bate (1937), Sandford and Arkell (1939) and Picard (1943). My own observations on the great gravel terraces in Gebel Galâla and Gebel 'Ataqa suggest that even in 'Pluvial' times the wadis were scoured by sudden floods rather than by gentle perennial streams. However, there can be little doubt that during much of the Pleistocene, thanks to a heavier rainfall, plant migration was considerably /

considerably easier than it is today.

B. THE EASTERN DESERT.

This area differs strikingly from the Western Desert in its geology, relief and vegetation. It offers a much more varied landscape and has – indeed has apparently always had – a heavier rainfall than the Western Desert due to large areas of high ground. The flora is therefore relatively rich.

1. The Limestone Plateaux.

From the Mokkatam Hills that rise precipitously E. of Cairo, the nummulitic Eocene limestones stretch eastwards to Gebel 'Ataqa and southwards to the Galalâ Plateaux and far beyond. Blown sand plays only a very local part in this limestone region of the Eastern Desert. (See v. below).

i. Open Plateau. This is everywhere surfaced with angular limestone gravel covering a loosely packed loamy soil. It is the type of country known as hammada, and its edaphic characters are largely due to deflation. Bed-rock is rarely exposed, and there are no plant communities (apart from stone-clinging lichens on which the desert snail, Helix desertórum, largely subsists) on the open plateau below 700 m.

Between 700 m. and 800 m. a community dominated by Salsola tetrandra (A + - 2, Soc. 1) occurs on Gebel 'Ataqa near Suez, the leading species increasing in abundance with altitude. Of frequent occurrence in this community are Erodium hirtum and Fagonia /

Fagonia cahirina which on N. slopes (where the community is always better developed) are accompanied by Telephium sphaerospermum, Diplotaxis harra, Gymnocarpum fruticosum, Gagea reticulata var. fibrosa, Gymnarrhena micrantha, and the annuals Lappula spinocarpus, Senecio coronopifolius, Crepis senecioides and Bromus sp. The composition of this community differs greatly from that of Salsoletum tetrandrae Eig, described from the Lisan marls of the Lower Jordan

n.p. / Valley and placed in the alliance Salsolion tetrandrae Eig. / An account of the geology of the Gebel 'Ataqa region is given by Sadek (1926).

On the S. Galalâ plateau * vegetation does not appear on the open slopes below 1300 m., but at that altitude Anabasis setifera dominates the S. exposures. Dwarf Chenopodiaceous shrubs are in fact the dominant feature of the high limestone uplands, Anabasis articulata and Salsola longifolia being among the commonest; in November their winged hyaline fruits give a very attractive aspect to this region. Haloxylon salicornicum, however, so characteristic of much of the Eastern Desert, does not ascend to altitudes sufficiently high to enable it to grow on the open Galalâ plateaux.

While dealing with the S. Galalâ plateau mention should be made of the Irano-Turanian communities found above 1300 m. in special habitats. On sloping limestone rocks with a N. exposure Varthemia montana, Noaea mucronata and Artemisia herba-alba are the leading species /

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* In the spring of 1944, Mr. J.R. Shabetai and the writer accompanied Dr. N. Feinbrun on a camel journey through the N. and S. Galâlâ. I understand that Dr. Feinbrun intends to publish a phytogeographical account of this expedition. In the late autumn of 1944 I returned to the S. Galâla to collect the Chenopodiaceae in fruit.

species in the crevices, accompanied by Pyrethrum santolinoides, Atraphaxis billardieri, Ballota kaiseri (?), Centaurea eryngioides, Ephedra alte, Dianthus guessfeldtianus (endemic) and Rhamnus disperma. Several of these species (or parallel species) are found in the Phlomis aurea - Pyrethrum santolinoides association (Zohary, 1944) from 1700-2000 m. on the granite slopes of Mt. Sinai. A community dominated by Artemisia herba-alba (one of the leading components of Irano-Turanian vegetation in Transjordan and Syria) inhabits the shallow wadis of the high S. Galâla plateau, and includes the endemic Colchicum guessfeldtianum among its characteristic species; the community, however, is not predominately Irano-Turanian in its floristic composition. Both these Galâla associations are confined to specially favourable habitats within the dominion of Saharo-Sindian communities (dominated by woody autumn-flowering members of Chenopodiaceae), so that even the high Galâla plateaux must be included in the Saharo-Sindian phytogeographical region. In this the district differs from the upper region of Mt. Sinai, which above 1630 m. should be considered Irano-Turanian territory (Zohary, 1944).

ii. Shallow Run-off Channels. Wherever water drains off from the plateaux, however small the grooves, vegetation is able to develop, even at very low elevations. The communities of these shallow channels, however, though fragmentary and variable, generally constitute an edaphic climax. Every transition is found between the vegetation of shallow grooves and that of deep wadis, probably depending on the depth of the soil and water-table, and to wind-exposure.

In /

In very shallow grooves only annuals are found - and they, of course, only in a favourable spring. Such communities must, nevertheless, be considered an edaphic climax. The leading species E. of Helwan are usually Anastatica hierochuntica and Trigonella stellata. Other annuals include Zygophyllum simplex, Plantago ovata and Odontospermum pygmaeum. The last two, like Anastatica, exhibit hygroscopic movements connected with seed-dispersal. Anastatica and Plantago ovata are locally co-dominant. Seedlings of Erodium glaucophyllum found in these annual pioneer communities often mark the transition to perennial associations in deeper channels dominated by Odontospermum graveolens, Erodium arborescens (photo. 3), E. glaucophyllum (the last two with tuberous root-stocks), Fagonia cahirina and (less commonly) Iphiona mucronata.

Above Wadi Tih, where the Upper Eocene limestones are soft and marly, Anabasis setifera (an autumn-flowering annual that develops throughout the summer) is generally dominant in small shallow grooves on the plateau (consisting of clay and chips from gypsaceous rocks) with frequent small clumps of Allium desertorum (in spring), Salsola inermis and S. longifolia. On the N. side of the watershed, between Wadi Tih and Bir Digla, the annual Moricandia clavata dominates the marly channels (rivalling in floral display Mathiola humilis of the Mariut), while Diplotaxis harra is the dominant annual in similar habitats on the S. side of the watershed; D. acris (photo. 4) is characteristic of the grooves near the crest, and occasionally crosses with D. harra to give a sterile hybrid.

iii. Less Shallow Wadis. The small run-off channels of the limestone plateau deepen below into less shallow wadis which exhibit /

exhibit plant communities more or less intermediate between those of the plateau-grooves and the deep wadis.

One of the first plants to appear as you trace the deeper channels downwards is Zygophyllum coccineum, a succulent shrubby species; this may accompany Erodium arborescens and Iphiona mucronata (both species of the deeper run-off channels) and even be co-dominant with them. Frequent associates are Helianthemum cahirinum, Odontospermum graveolens, Farsetia aegyptia, Reaumeria hirtella, Gymnocarpum fruticosum, Diplotaxis acris and D. harra (the latter behaving either as an annual or a short-lived perennial).

As the wadis deepen conditions become more sheltered and favourable: Zygophyllum coccineum becomes increasingly abundant and luxurious. Its increase in abundance is correlated with an increase in Zilla spinosa, and a decrease — indeed a rapid disappearance — of such plateau-channel species as Erodium arborescens, E. glaucophyllum (in the deeper wadis the genus is always remarkable for its absence), Fagonia cahirina and Anastatica. Fagonia mollis appears — a species characteristic of the deeper wadis. The second terrace, which is a feature of the deep valleys, is not developed in the shallow upper wadis, and even the first terrace (referred to more fully below) is poorly and irregularly distinguished from the bed.

The wide rather shallow wadis of the Tih plateau (consisting of soft marly Eocene limestones) are dominated by Anabasis setifera with abundant Zilla spinosa and less common Pituranthos tortuosus and Gymnocarpum fruticosum. Nitraria retusa and Lycium arabicum are two shrubs which colonise the clay banks that often develop by the stream bed.

iv. /

iv. Deep Limestone Wadis. In contrast to the Western Desert, the limestone areas of the Eastern Desert, thanks to their higher altitude and heavier rainfall, are dissected by a series of deep sheltered wadis running into the Nile Valley.

Those visited, from N. to S., were Wadi Tih, Hof, Abu Silly, Rished and Gerrawi. Species were found in each of these which were not seen in the others, but as the communities are nevertheless very similar I shall deal with the wadis collectively and only indicate certain differences. Except in Wadi Gerrawi, blown sand does not play an important part in these valleys; consequently the vegetation is generally confined to the bottom of the wadis. As Schweinfurth (1901) noted, in the valleys much of the ubiquitous Sodium Chloride — probably a constant feature of the Eocene strata — gets washed out.

The vegetation of the deep valleys is relatively rich in species, and a greater density of individuals is found than elsewhere in the deserts dealt with here. The soil of the valley-bottom consists of calcareous silts and clays mixed with limestone boulders and gravels. A definite zoning of the vegetation can be distinguished referable to several distinct habitats. The area has evidently been uplifted in recent times.

a. Wadi bed proper. As indicated earlier in this paper, as little as 1 cm. of rain is sufficient to cause severe flooding in deep valleys, due to the rapid run-off from the bare rocky sides of the valleys which have scarcely any soil cover. The actual beds of the wadis are therefore frequently (though not annually)/

annually) scoured by floods and support a very limited and fragmentary vegetation. In the Helwan district this is derived from the first terrace and consists of such suffrutescent Chamaephytes as Stachys aegyptiaca ~~affinis~~ and Achillea fragrantissima, and the annuals Diplotaxis harra, D. acris and Zygophyllum simplex. In Wadi Tih, where the bed is very wide and contains an admixture of sand with the clay and silt due to the valley's passage through the edge of Oligocene sandstones above, Diplotaxis harra and Moricandia clavata dominate a considerable area in a favourable spring. On the other hand, the gravelly valley beds of Gebel 'Ataqa and Gebel Galâla support a community dominated by the dwarf bushy Cleome droserifolia – a species almost confined to this habitat (photo. 6).

After the devastating floods of Dec. 30 and 31, 1944, I visited Wadi Hof near Helwan. Not only the bed, but also much of the first terrace, had been swept absolutely bare of plants, debris of Zilla spinosa and Zygophyllum coccineum being piled up 1.7 m. high at the bends of the valley. Floods occurred again in May of the following year, Wadi Tih being flooded twice in three days. Such phenomena are of local and very intermittent occurrence; several years may go by without a wadi being flooded at all – or indeed without its containing any running water. Nevertheless, floods play a vital part in determining the plant communities of the wadis; their destructive power is immense.

b. First terrace. This is swept by only the heaviest floods, so that it is able to support a rich vegetation. The dominant plants are Zilla spinosa (A 2 (-3), Soc. 1 - 2), and Zygophyllum coccineum (A 2 (-3), Soc. 1 - 2), both shrubby spring-flowering /

flowering species that are little grazed by camels and therefore widespread. In this community the following rather woody species are fairly common, though less abundant and of lower sociability: Lavandula coronopifolia, L. pubescens, Iphiona mucronata, Stachys aegyptiaca, Achillea fragrantissima, together with the large tufted grass Pennisetum dichotomum and the annual Anabasis setifera. Less common associates are Echinops spinosissimus, Pituranthos tortuosus, (P. triradiatus occurs only in Wadi Digla), Heliotropium arbainense, Reaumeria hirtella ø, Atriplex Halimus var. schweinfurthii, A. leucocladum, Trichodesma africanum, Daemia tomentosa, Odontospermum graveolens, Fagonia mollis, Cistanche tubulosa, Diplotaxis harra and Zygophyllum simplex. On Gebel 'Ataqa Zilla, Zygophyllum coccineum and Z. decumbens are co-dominant on the first terrace of Wadi el Obar (photo. 7), often accompanied by Retam raetam (photo. 8).

At many of the bends in the deep wadis near Helwan, flood currents have resulted in partial or complete suppression of the first terrace and its replacement by a steep bank. This habitat is generally dominated by Pennisetum dichotomum (A 3, Soc. 2 - 3; photo. 5), with the frequent occurrence of Zygophyllum coccineum, Echinops spinosissimus and Pituranthos tortuosus, and, less abundantly, Zilla /

ø Reaumeria hirtella combines succulence with salt-secretion. According to Shmueli (1948) the covering of salt on the leaves sets up an external osmotic system, sucking water out of the plants, so that the transpiration-rate is high. Transpiration is lower if the salt is artificially removed.

Zilla and _Iphiona_. The density of the vegetation is greater here than elsewhere, and forms an almost closed community lining the outer bends of the wadis in a band 1 - 2 m. wide. No species are found here which do not occur also on the fully developed first terrace.

The soil in Wadi Hof has been analysed by Monastir (1938). It is clear from the plants he cites that the analysis refers to the first terrace. Some of his figures, however, are difficult to interpret.

It is most probable that the microphanerophyte _Retama raetam_ would be common on the first terrace in the Helwan wadis, had it not been totally eliminated by man or his herds in this area. The _Zilla spinosa_ - _Zygophyllum coccineum_ community must therefore, in the absence of _Retama_, be considered a biotic climax.

A variety of the _Zygophyllum coccineum_ - _Zilla spinosa_ community of the first terrace is found in Wadi Gerrawi, where much sand is mixed with the clays and silts of the gravel terrace. _Zilla_ and _Zygophyllum coccineum_ are still the leading species, accompanied by _Achillea fragrantissima_ and _Pennisetum dichotomum_; but _Zygophyllum decumbens_ is found here occasionally (so far as I know, not previously reported from the deserts near Cairo), and several habitual psammophytes are able to grow together with the species characteristic of the silt. The psammophytes include _Zygophyllum album_ (which dominates locally if the proportion of sand is high), _Convolvulus lanatus_ and _Heliotropium digynum_.

c. /

c. Second terrace. Only very rarely is the second terrace swept by flood water. This advantage over the first terrace, however, is offset by its greater aridity and higher salt-content, so that vegetation is sparse and very poor in species; it consists mainly of a few deep-rooted perennials and the autumn-flowering annual Anabasis setifera. In the wadis near Helwan Zygophyllum coccineum is the leading species (A 1, Soc. 1), accompanied by Anabasis setifera; they are co-dominant in Wadi Rished. Zilla spinosa, a characteristic dominant of the first terrace, is absent. On Gebel 'Ataqa Haloxylon salicornicum is the dominant species, generally unaccompanied by any other perennial; grazing camels leave it alone. Due to water difficulties, the communities of the second terrace are always more open than those of the first.

In the upper reaches of wadis, and at their mouths, terraces seldom develop.

d. Exposed rock of wadi bed. The vertical crevices of exposed limestone rock (in place of the more usual gravel bed) are filled with silt and support limited perennial communities. Although swept by floods, the plants growing in these crevices are able to "hold on" as they would be unable to do on a shingle bed. Stachys aegyptiaca (A 1, Soc. 1) and Iphiona mucronata are the leading species. Zygophyllum coccineum may be co-dominant with either or both of the latter, but is very poorly developed in this habitat. On Gebel 'Ataqa the exposed rock-bed of Wadi el Obar is dominated by Varthemia montana: a September-flowering suffruticose chamaephyte in Compositae, which probably belongs to the Irano-Turanian element.

e. "Dry waterfalls". Where winter torrents have cut through /

through a bed of compact limestone down to a softer stratum, a "sidd" or "dry waterfall" develops. In the crevices of these vertical limestone rocks Capparis spinosa var. aegyptiaca is the dominant species, though the trailing Ephedra alte and Cocculus leaeba also occur.

f. Sides of the wadis. These support practically no perennial vegetation (except when blown over with sand — see below) and only a few annuals in favourable seasons. Limonium pruinosum, however, occurs locally near the foot of the rocky sides; it can probably stand a higher salt concentration and/or a lower water-content of the soil than other wadi species. Vernal annuals include Zygophyllum simplex, Pteranthus dichotomus and Diplotaxis acris.

The absence of trees in the wadis near Helwan is apparently due to interference by man. Acacia tortilis (a member of the Sudano-Deccanian element) is abundant in similar wadis in Gebel Galâla, and a few relict specimens occur in wadis S. of the Cairo-Suez road; indeed, Schweinfurth (1901) even refers to a small tree of this Acacia in Wadi Gerrawi S. of Helwan. A young tree of Zizyphus spina-christi (also a Sudano-Deccanian type) stands in Wadi Hof, and has probably appeared since Schweinfurth's time.

v. Sand-Drift. In this paper, drifts of sand have already been referred to in the Western Desert, but such areas occur locally on the limestones in the Eastern Desert both in Wadi Gerrawi and S. of the Cairo-Suez road. The Nile has evidently checked its drifting in from the West. Vegetation varies according to the depth and steepness of the sand, but everywhere the accumulation /

accumulation of the latter enables open psammophytic communities to develop on slopes which would otherwise be bare of flowering plants. The communities — fragmentary and very variable in composition — consist of a few leading perennials and many spring annuals.

Zygophyllum album is the dominant perennial on the sand-drifts in Wadi Gerrawi, but on a slope of 30° - 40°, facing N., Heliotropium digynum is co-dominant on the lower part of the slopes, replaced in the upper part by the annual Mathiola livida which in the spring is co-dominant with Zygophyllum album. Convolvulus lanatus and Monsonia nivea occur occasionally, and the many annual psammophytes include Linaria haelava (the most abundant), Polycarpaea repens, Silene villosa, Arnebia linearifolia, Astragalus gizehensis, Reseda sp., Plantago ovata and Cotula cinerea. The annuals also occur in the absence of perennial species, and perhaps precede the latter. On another slope in Wadi Gerrawi (at an angle of 10° - 20°) Convolvulus lanatus was abundant with Zygophyllum album; Heliotropium digynum, Lithospermum callosum and Fagonia glutinosa also occurred. When the sand-cover is very thin, Anabasis articulata appears; its roots penetrate deeply into the limestone crevices below.

The sand-drifts in Wadi Anqabya south of the Cairo-Suez road support a different psammophytic community. The dominant perennials are Aristida brachypoda and Haloxylon salicornicum, in varying proportions, with Lasiurus hirsutus locally common or even co-dominant with the other two species. Less common in this community are Launaea cassiana, Gypsophila rokejeka, Farsetia aegyptia, Pancratium sickenbergeri, Paronychia lenticulata, Fagonia glutinosa, Linaria haelava, Mesembryanthemum forskahlei (locally a vernal /

vernal co-dominant), Cotula cinerea, Anthemis deserti, Polycarpon arabicum, Centaurea aegyptiaca, C. pallescens, Diplotaxis harra, Mathiola livida and Silene villosa. Aristida brachypoda tends to dominate above Haloxylon salicornicum which is found mainly on the lower part of the drifts where the sand is deeper and water conditions easier.

The neighbouring Gebel Anqabya is overblown with sand on its N. escarpment. On the gently sloping lower part of the drifts (mixed with fallen limestone chips from rocks above) Lasiurus hirsutus is co-dominant with Anabasis articulata; on the higher parts of the drifts Aristida brachypoda is co-dominant with Anabasis articulata. (The latter species is absent from Wadi Anqabya, perhaps because the sheltered nature of the wadi encourages the growth of Haloxylon salicornicum.) Besides most of the annuals listed for Wadi Anqabya, the remarkable yellow-flowered Campanula sulphurea occurs, and a blue annual Arnebia. On the limestone plateau above the sand-drifts, Anabasis articulata grows in vertical sand-filled crevices, just as it does on the Eocene limestone near the Giza pyramids.

By comparing the species listed from the sandy habitats in the Eastern Desert with those from the Western Desert, it will be seen that there are many species in common. Indeed, the floral relationship with the Western Desert is much closer in the sand-drift (and probably sand-dune) communities than in any other habitat community in the Eastern Desert. Such communities can be considered an edaphic climax, though it is difficult to know how much they are modified by grazing.

2. Sand-Dunes.

The /

The Khanka dunes N.E. of Cairo form a magnificent sand-range that blocks like a dam the small shallow wadis that come up against them from the South; the channels crossing the gravel plain are deflected by the dunes.

An almost pure community of Haloxylon salicornicum (A 1, Soc. 1), which is by no means an obligate psammophyte, dominates the gently sloping and stable lower region of the dunes. Of local occurrence in this community are Cistanche tubulosa (here parasitic on Haloxylon), Lithospermum callosum and the annual Malcolmia aegyptiaca.

Above the Haloxylon community the less stable slopes are colonised by Aristeda scoparia, ascending at least 30 m. up the sides of the dunes. Malcolmia aegyptiaca occurs locally here, with rare bushes of Cornulaca monacantha. Round the Sheikh's Dune (65 m. above the plain, and the highest "peak" in the range) either Cornulaca or Aristida scoparia may dominate. The latter has extraordinarily long roots than can be seen to extend horizontally for many metres after the sand has been blown away. On the highest slopes these two species were the only ones seen; but lower down they were accompanied by isolated plants of Polycarpaea repens, Malcolmia aegyptiaca and Calligonum comosum.

In depressions among the dunes, surfaced with coarse yellow grains that have evidently rolled down the adjacent sand slopes, a psammophyte community dominated by Polycarpaea repens is found, characterised by the presence of Lithospermum comosum, Malcolmia aegyptiaca, Calligonum comosum and Convolvulus lanatus.

The dune communities listed, except for that of Haloxylon salicornicum, are noticeably better developed on the N. side of the /

the dunes (from which the prevailing winds come) due to the greater stability of the sand there. The slip face on the S. side is bare. Along the top of the crest, the winged fruits of Haloxylon were seen blowing about incessantly.

The communities of the dunes are very different in their composition to those of sand-drifts, and contain a much smaller number of species.

3. Flinty Gravel Hills.

Hills surfaced by gravel of a flinty nature, often mixed with large fragments of petrified wood (Nicolia aegyptiaca), cover a considerable area between the Eocene plateau and the Cairo-Suez road. The geology of the region is described by Barron (1907). The flints are embedded in a sandy matrix that is basic in reaction due to the presence of wind-blown calcareous dust. These estuarine deposits are either Oligocene — being associated with the sandstone of that period — or are of late Miocene or Pliocene age; in the latter case they form a layer, from 0.3 m. to at least 2 m. in thickness, overlying hills of soft Miocene marls and chalks that would be worn away were it not for the protection afforded by the flinty covering.

These flint hills, recognisable from afar by their dark purplish-brown colour, support many species not seen elsewhere in the Egyptian deserts. Their flora, though rich in rare species, has not been well investigated, perhaps because the area from a distance looks very unfavourable for plants. The sandy matrix, however, with the flinty gravel embedded in it, forms a medium that retains moisture well, so that vegetation is found on the slopes just as it is on sand-drifts and dunes. The hills may be divided into two areas /

areas on the basis of plant communities — a division that cuts across any attempt to classify the flint hills by their geological age.

a. Dominion of Haloxylon salicornicum. This shrub covers the whole of the Great Petrified Forest E. of Cairo, and the low rolling gravel hills S. of the Cairo-Suez road. The latter area is richer in species than the former, but the two will here be taken together and the main differences indicated.

Haloxylon salicornicum is generally the dominant perennial (A 1, Soc. 1) on the open slopes, both on the Oligocene gravels of the Great Petrified Forest and on the gravel-covered marly hills of the Cairo-Suez road. Often equally abundant in the latter area are Ephedra alata (especially on N. slopes) and Lasiurus hirsutus (especially on S. slopes), either of which may be co-dominant with Haloxylon; in the Great Petrified Forest, however, Haloxylon is always the leading plant. Local co-dominants on the Cairo-Suez road are Farsetia aegyptia, Agathophora alopecuroides and Fagonia latifolia. The latter — the only annual in a predominantly Saharo-Sindian genus that has outliers in S. Africa, Chile and California — is apparently endemic to the flint hills; it completely failed to appear in the dry spring of 1944, but was abundant the following year. Species characteristic of this type of Haloxylon community — which is best developed on the north-facing slopes of the steep drainage channels — are listed here:

NANOPHANEROPHYTES: Haloxylon salicornicum, Ephedra alata, Agathophora alopecuroides, Gymnocarpum fruticosum, Zilla spinosa (poorly developed).

CHAMAEPHYTES: /

CHAMAEPHYTES: Linaria aegyptiaca, Reaumuria hirtella, Lasiurus hirsutus, Aristida ciliata, Centaurea aegyptiaca, Panicum turgidum, Paronychia lenticulata.

HEMICRYPTOPHYTES: Centaurea pallescens, Launea cassiana, Aristida brachypoda.

GEOPHYTES: Erodium hirtum, Scorzonera alexandrina, Urginea undulata (Cairo-Suez road – photo. 9), Gagea sp., Dipcadi erythraeum (photo. 11), Allium crameri (Petrified Forest – photo. 10), A. desertorum and Pancratium sickenbergeri. The last has a noteworthy life-history: the strikingly circinate leaves (see photo. 14), present during winter and spring, die away for the summer; they are succeeded by the flowers in September, when no rain has fallen for several months (photo. 13).

THEROPHYTES: Erodium deserti, E. triangulare, Anastatica hierochuntica, Roemeria dodecandra, Trigonella stellata, Calendula aegyptiaca, Zygophyllum simplex, Mesembryanthemum crystallinum (abundant in the vernal aspect of the Petrified Forest), Pteranthus dichotomus, Centaurea lippii, Moricandia clavata, Reichardia tingitana, Bromus sp., Polycarpon arabicum, Arnebia hispidissima, A. linearifolia, Matthiola livida, Silene villosa, Plantago ovata, Rumex roseus, Gymnarrhena micrantha and Senecio coronopifolius.

The species listed above are characteristic of the slopes, but in the bed of the grooves and deep channels that drain the flinty hills a rather different vegetation develops due to the layer of sand that overlies the gravel. This habitat is marked in the Petrified Forest by the relative abundance of Zilla spinosa, which is here nearly /

nearly as common as *Haloxylon*. On the Cairo-Suez road *Panicum turgidum* and *Lasiurus hirsutus* are, with *Haloxylon*, the three dominant species of the sandy grooves. *Haloxylon* tends to dominate beds where the sand-covering is shallow and the proportion of gravel fairly high, whereas *Panicum* leads in the wider channels with a deeper sand-bed; it is common to see *Haloxylon* dominating the edge of the bed (and adjacent slopes), whereas *Lasiurus* and/or *Panicum* occupy the centre (photo. 2). Other species characteristic of these drainage channels include, as would be expected, several psammophytes that are usually absent from the gravel slopes of the Cairo-Suez road region. They are: *Fagonia glutinosa*, *Convolvulus lanatus*, *Heliotropium digynum*, *Artemisia monosperma*, *Lithospermum callosum* and *Atractylis flava*. In the Petrified Forest, however, where the proportion of sandy matrix is locally very high (probably due to the underlying Oligocene sandstone), most of these species occur also on the slopes.

The floral composition of the *Haloxylon* communities of the flinty hills is very different from that of communities dominated by the same leading species on other geological formations in Egypt. Attention should be drawn to the difficulty this species has in establishing itself. During 1944 – a very dry year – countless dead seedlings of *Haloxylon* about 20 cm. tall were seen in the Eastern Desert; the young generation appeared to have been completely wiped out before the seedlings could get their roots sufficiently deep to withstand the intense summer drought. But in the following year (1945) a new crop of seedlings, thanks to early and late spring rains, fully established themselves. In the seedling stage *Haloxylon salicornicum* produces comparatively long,

juvenile /

juvenile leaves; the adult foliage (developed in the second year) is represented only by short scales, photosynthesis being mainly performed by the equisetoid stems.

As Schweinfurth (1901) pointed out, winter rains are useless for the development of the majority of Egyptian desert annuals; they depend upon spring rains (late February and March) for their success, since only then are temperatures high enough for germination and active growth.

b. Dominion of *Anabasis articulata*. *Haloxylon* is totally absent from the communities dominated by *Anabasis articulata* on the flinty hills. The *Anabasis* region is that of the high flint-covered ridges between the Petrified Forest and Bir Gindali; it comprises Gebel Yammum el Abraq, G. Yammum el Asfar and G. Yammum el Asmar. Though these hills may be in part of Oligocene age, Gebel Yammum el Asmar must certainly be referred to the Miocene, having a substratum of marl overlaid by a protective skin of flints. No superficial habitat difference could be seen between this *Anabasis* area and the hills dominated by *Haloxylon*. In this respect it is worth noting that Zohary (1944) was unable to discover any factor controlling the distribution of these species on the *hammadas* of the Sinai Peninsula. The vegetative morphology of the two plants is so similar that they are readily mistaken for one another.

In its composition the *Anabasis* communities of the flint hills do not differ very greatly from the *Haloxylon* communities. Several of the constant species of the former, however, were not found on the *Haloxylon* hills, whereas several species characteristic of the latter were absent from the *Anabasis* region.

On the slopes *Anabasis* is usually the dominant species (A 1, Soc. 1), /

(A 1, Soc. 1), though not infrequently it is co-dominant with Zilla which never fully develops in this habitat. On southern exposures Anabasis may be poorly represented, dying, or even absent, in which case more fragmentary communities develop with Diplotaxis harra, Fagonia glutinosa and Mesembryanthemum crystallinum as the leading constituents.

Among the plants found in the Anabasis communities that were not noted from the Haloxylon hills of the Cairo-Suez road are Lotus villosus, Bellevalia sp. nov. ? (photo. 12), Asparagus stipularis (rare), Spergularia sp., and Euphorbia chamaepeplus var. sinaica. The latter is confined to slopes composed of very large spherical flints at the foot of N.E. declivities, and is one of the most "particular" of the rare desert annuals. Fagonia mollis, a characteristic species of deep limestone wadis, was found here co-dominant with Anabasis articulata on the flint slopes of one deep groove - an unexpected association.

The sand-covered channel-beds support a psammophyte community similar to that found within the dominion of Haloxylon. Anabasis is still the most frequent dominant, but Zilla may be locally co-dominant, with an abundance of Panicum in deeper sand. Lasiurus hirsutus does not play an important part here. If the channels are shallow and gravelly, the larger life-forms are not present; instead one finds the annuals Plantago ovata, Mesembryanthemum crystallinum, Trigonella stellata, Asteriscus pygmaeus, etc.

In some of the major valleys on the flint hills the beautiful white Broom, Retama raetam, is common, though Anabasis is still numerically /

numerically more abundant. Retama is the largest member of the Saharo-Sindian element found in the Egyptian Desert, forming a shrub in sheltered situations up to 3 m. tall.

IV. SUMMARY.

A preliminary account is given of the main plant-communities of the Eastern and Western Deserts of Egypt, chiefly in the neighbourhood of Cairo.

As a rule the communities are closely related to the particular geological formations and topography of the area. The presence or absence of blown sand is very important in determining the type of community that develops. Only in areas where sand occurs (either as dunes, drift, or the sandy matrix of flinty gravel hills) is vegetation able to develop on the slopes below 700 m.; elsewhere it is confined to grooves, valleys or depressions where soil moisture is sufficient to support vegetation.

The Eastern Desert has a much richer flora than the Western Desert, due to its greater relief, heavier rainfall, and the larger variety of suitable habitats. The richest communities are those of the first terrace in deep limestone valleys, and those of hills covered with flinty gravel imbedded in a sandy matrix.

Most of the desert associations must be classed as edaphic or biotic climax communities.

The floristic relationship between the two deserts is much closer in the psammophyte communities – especially of superficial sand-drifts – than in any other type of plant community. The Nile Valley has proved a moderately effective barrier to the E.-W. dispersal /

dispersal of desert plants.

APPENDIX.

THE WADI NATRUN DEPRESSION.

The depression of Wadi Natrun has been formed by wind erosion during Quaternary times. Its flora can hardly be described as that of a desert, owing to the lakes it contains; these are fed by seepage from the Nile.

In contrast to the Fayum depression, large areas of which are dominated by Salicornia fruticosa and other salt-marsh Chenopods, the saline marshes of Wadi Natrun are (so far as I saw them) lacking in Chenopodiaceae. Soils in Wadi Natrun have been analysed by Monastir (1938), but I am unable to decide from his data the reasons for this dearth of Chenopod genera. The area is, however, exceptionally rich in free alkali salts. The most striking vegetational feature of Wadi Natrun is the Typha latifolia swamp; this species does not occur elsewhere in Egypt.

The main communities may be summarised as follows:-

1) Typha latifolia reedswamp (Typha A 5, Soc. 5) surrounds many of the salt lakes, and is apparently a biotic climax community. Occasional stands of Phragmites communis are found here; Sonchus maritimus, Heliosciadium nodiflorum and Samolus valerandi are characteristic species. The Typha is frequently destroyed by cutting and burning, and the rhizome is eaten by the inhabitants; where the wetter parts of the swamp have been interfered with, Typha is often accompanied by Cyperus laevigatus. The Wadi Natrun Warbler, endemic to /

to the depression, is almost confined to the Typha swamp, so that the increasing destruction of the Reed Mace may lead to the bird's extinction.

2) Cyperus laevigatus community (Cyperus A 5, Soc. 5) forms closed spongy lawns grazed by cows and buffaloes, and seems to form where the wetter facies of Typha swamp have been destroyed by burning, etc. Juncus acutus is frequent, but no other species were seen. Lake Um Ruzania is entirely surrounded by this community.

3) Typha latifolia - Eragrostis bipinnata community occurs towards the dry edge of Typha swamps and extends onto the encroaching dunes that choke Lake Hamra.

4) Eragrostis bipinnata community extends along the dry marly N.E. side of the lakes, evidently replacing the Typha - Eragrostis community where Typha has been destroyed. Eragrostis makes suitable cattle-pasture, so that the inhabitants of Wadi Natrun encourage its growth by destroying the accompanying Reed Mace.

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ILLUSTRATIONS .

1. Salsola pachoi community at Abu Roash.
2. Lasiurus hirsutus edging a sand-filled wadi on flint hills; Haloxylon salicornicum on Rt. Cairo-Suez road.
3. Erodium arborescens in shallow wadi near Helwan.
4. Diplotaxis acris and seedlings of Zygophyllum simplex in drying silt near Helwan.
5. Pennisetum dichotomum edging wadi near Helwan.
6. Cleome droserifolium in bed of wadi in Gebel Galâla.
7. Zygophyllum coccineum, Z. decumbens, Zilla spinosa on first terrace in wadi el Obar (Gebel Ataqa).
7. The same, with flowering bushes of Retama raetam.
9. Urginea undulata on flint hills.
10. Allium Crameri in Great Petrified Forest.
11. Dipcadi erythraeum and Trigonella stellata on flint hills.

Fig. 12. Bellevalia sp. nov.? on flint hills.

Fig. 13. Pancratium sickenbergeri , flowering on flint hills in September.

Fig. 14. The same , in February . Note Helix desertorum.


30°
31°
32°
Alexandria
31°
Wadi
Natrun
km. 24
Abu Roash
Cairo
Suez
30°
Gt Pyramid
Gt. Petrified Forest
Bir Gindali
G. Ataqa
Helwan
Fayum
Gulf of Suez
N. Galala
29°
S. Galala
WESTERN DESERT
EASTERN DESERT
0
25
50
miles
(green stippling = cultivation)

Map.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

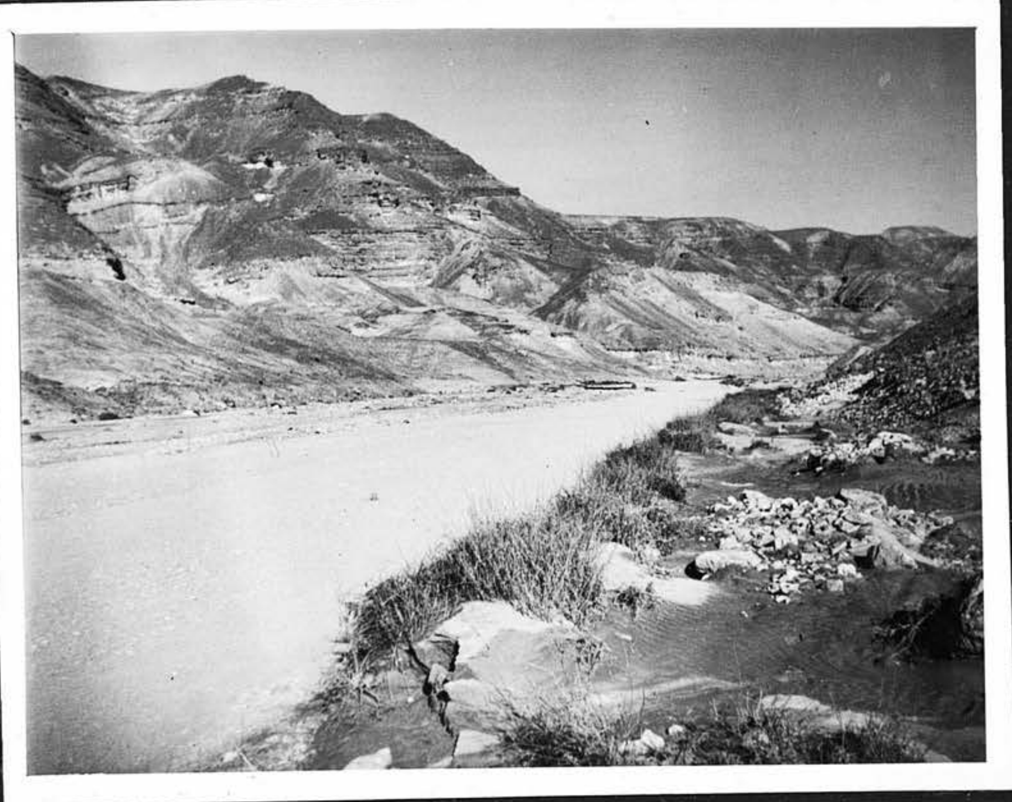

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

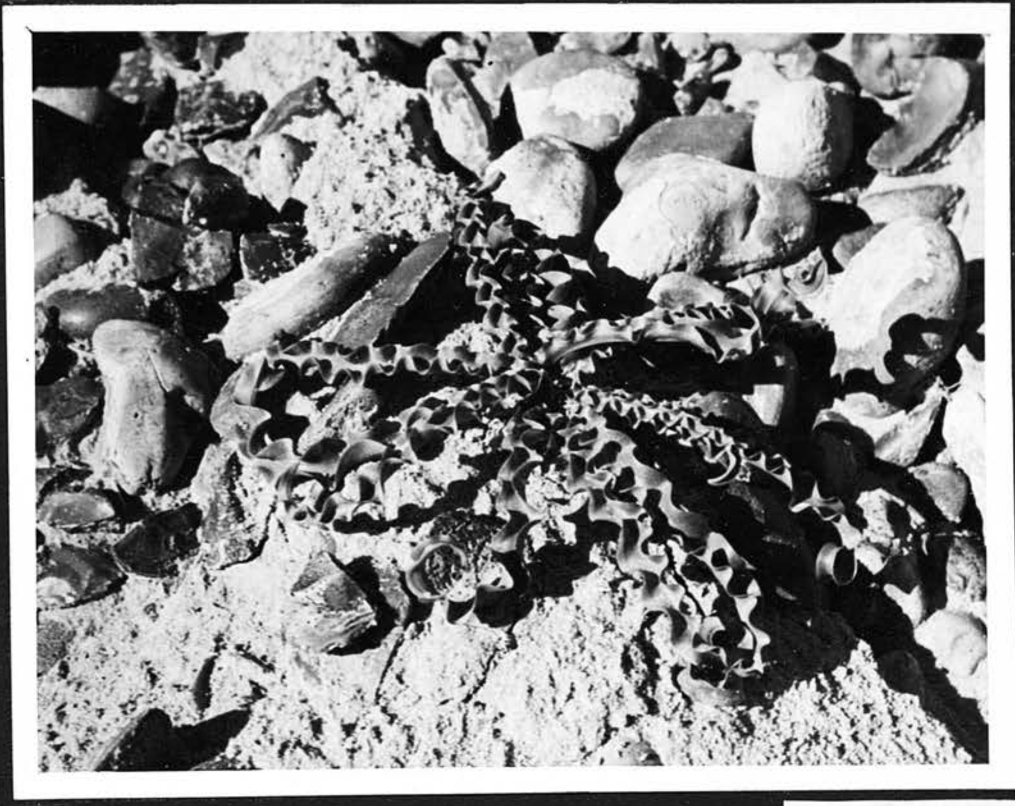

Fig. 9.

Fig. 10.

Fig. 11.

Fig. 12.

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A JOURNEY IN SOUTH-WEST ANATOLIA

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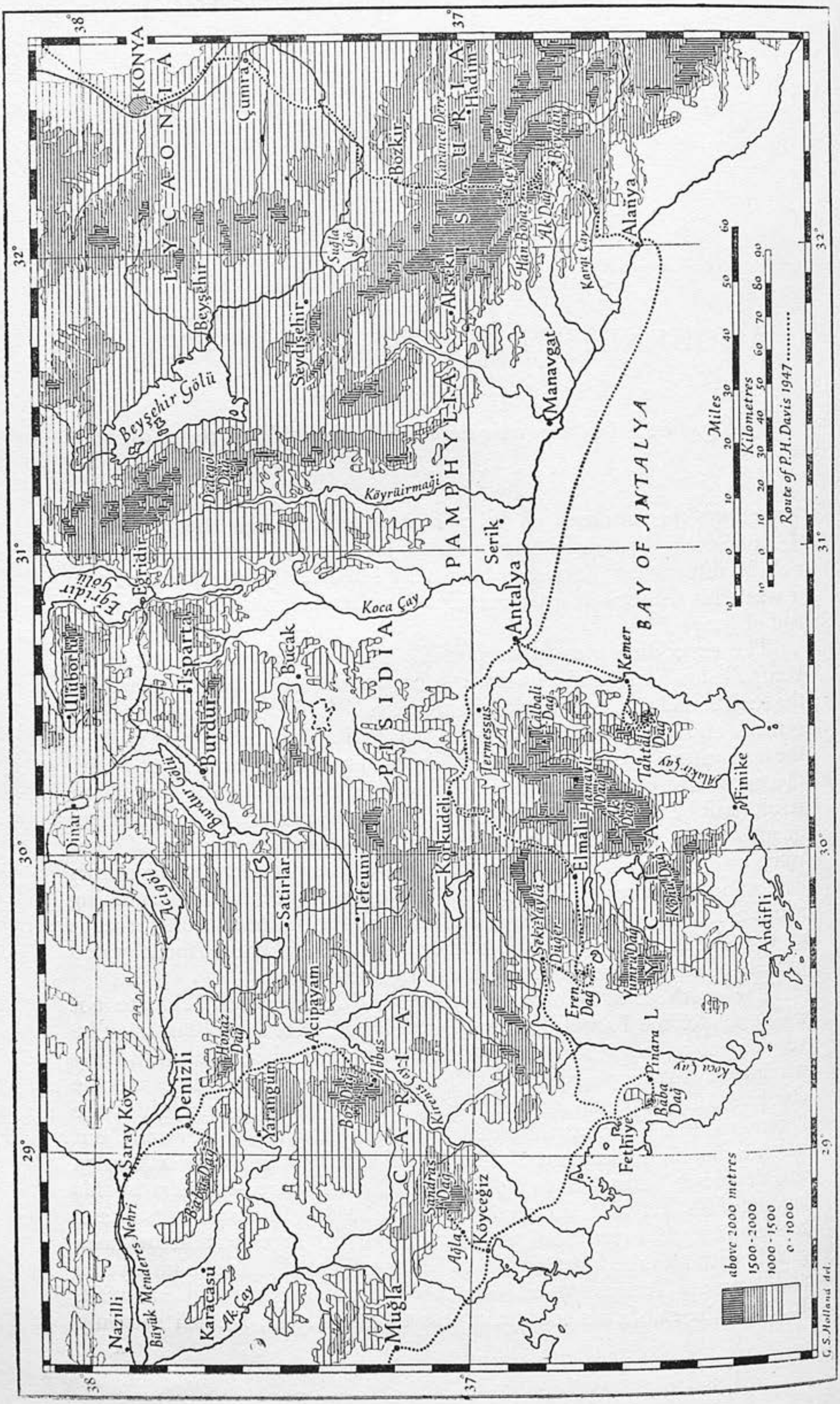
(*Based on a Lecture given to the Society on March* 16, 1948)

PART I

DURING the summer of 1947 I travelled through the mountains of South-West Asia Minor. This area, which has an exceedingly rich Mediterranean flora, has been very imperfectly botanized, so that it was with feelings of great anticipation that I flew to Istanbul at the end of June.

The expedition was made possible by means of a grant from the Percy Sladen Memorial Fund and subscriptions from Botanic Gardens, the R.H.S. and numerous private gardeners. This account is essentially general and preliminary. It is in no sense taxonomic, the bulk of the herbarium gatherings being still in the process of being named with the assistance of a grant from The Royal Society. The systematic results will be published elsewhere. The nomenclature is therefore frequently tentative, but I have endeavoured to make the account of more value by quoting my herbarium numbers with unnamed (or uncertainly determined) species. The first set of pressed specimens, numbering about 2,000, is being deposited in the Kew Herbarium, and another is at the Y.Z.E. (*Yüksek Ziraat Enstitüsü*) in Ankara. About 3,000 packets of seeds were distributed among subscribers.

The south coast of Anatolia enjoys a Mediterranean climate not unlike that of the French Riviera. Frost is rare at sea-level but must be very severe in the mountains. The summers are hot, the mean daily maxima at Antalya being 85°–95° F. from June to September, and the absolute daily maxima 100°–110° F. from May to October; July is the hottest month. Summer humidity averages less than 65 per cent. but is somewhat higher in winter. The annual rainfall is 42 inches at Antalya and decreases eastwards to 24 inches at Adana; three-quarters of this amount falls between November and February, the summers being rainless except for rare mountain thunderstorms. Precipitation increases greatly with altitude, over 80 inches being estimated for the high Lycian and Isaurian Taurus which have a correspondingly heavy snowfall. In Caria the rainfall is somewhat less than in Lycia; Denizli has only



South-West Anatolia

17 inches a year, but this is probably due to local topographical features which greatly modify precipitation.

The Anatolian plateau experiences a steppe climate with a much lower humidity, considerable snowfall and severe frosts. Precipitation is only 10–17 inches, falling mainly in heavy showers during May and November, but cloudy weather can occur at any time of the year.

Owing to the failure of " advance " luggage to arrive, the journey was unfortunately delayed for a fortnight. The delay had some advantages, however, enabling collections to be made of the rich steppe flora in the vicinity of Ankara. The Y.Z.E. very kindly provided me with a botanical assistant, KÂMIL BILGER, to act as companion and interpreter throughout the journey. To anyone unacquainted with the language and customs of the country such an assistant is invaluable.

On July 11, our pockets filled with letters to the *Valis* through whose territories we intended to pass, we set off by rail south-westwards to Denizli. There we were joined by the entomologist DR. MALCOLM BURR. It had been my original plan to climb Carian Baba Dağ (ancient Cadmus), where I had seen the fine rock plants, *Linum aretioides* and *Silene Echinus*, in 1938; but, being already two weeks late in our itinerary, something had to be left out. It is always difficult to chose between the mountain which is *known* to be rich, and the unknown peak which you hope will prove so. The latter alternative won the day.

At Denizli we boarded a lorry for Acipayam, with Boz Dağ* (Grey Mountain) in Caria as our objective. Crossing a low pass of conglomerate rocks, flashes of the most intense magenta-carmine caused the driver to pull up with a dangerous lurch. It was *Pelargonium Endlicherianum*, the sole representative in the northern hemisphere of an otherwise South African genus. With it grew *Cistus laurifolius* and, in the conglomerate boulders, the wide woolly-white leaves of *Inula heterolepis* (13280). On the pass horizontal icy rain—quite exceptional for the season, which had been a comparatively dry one—lashed down upon us in the back of the lorry.

We put up at one of the most deplorable inns it has been my misfortune to endeavour to sleep in, and we were very thankful to be off to our mountain next day. The charming and very efficient forest officer of the district decided to accompany us to Boz Dağ, and drove us over the most atrocious road—the previous day's rain having caused havoc in this area—in a convenient shooting brake. The fallow chalky fields near the village were filled with the incredibly white leaves of *Verbascum pycnostachyum* † and the tawny *Phlomis Nissolii*. Further on, the grassy-green *Pinus brutia* (closely related to *P. halepensis*) was the dominant tree, as it is over much of South-West Anatolia below 3,000 feet, and was frequently accompanied by *Cotinus coggyria* (*Rhus Cotinus*). The rare

* Not to be confused with Boz Dağ (ancient Tmolus) in Lydia. The Turks have proved singularly unresourceful in naming their mountains, the same name serving for several peaks. This is particularly the case with "Ak Dağ." In spelling these place names I have endeavoured to follow modern Turkish orthography, with the exception of the undotted *i*; all mine are conscientiously dotted.

† I am indebted to DR. HURBER-MORATH of Basel for the naming of the numerous *Verbasca* collected on the expedition, and to PROF. O. SCHWARZ for determining the Oaks. When referring to 'new' plants I have used the adjective in the sense of new to science.

Phlomis carica flourished on open flat ground, and, on bare steep slopes of gravel, grew a densely caespitose, silver-leaved *Convolvulus* (13467) out of flower, with an *Alyssum* (13461) forming tiny white-leaved hummocks like those of *Veronica bombycina* ; five seeds of the *Alyssum* were collected and are making promising plants.

Horses were obtained at the hamlet of Abbas at the south foot of Boz Dağ, and at dawn next day (July 16) we made the ascent. Due to a misunderstanding, we had set ourselves an unnecessarily hard task for one day. Boz Dağ was an exhausting scamper with too little time to do justice to a mountain virtually unknown botanically. The lower Pine forest was as monotonous as it usually is, but above 3,000 feet gave place to forests of Black Pine, *P. nigra* subsp. *Pallasiana*. On open north slopes two species of *Acantholimon* (13316 and 13317) occurred at 5,000 feet, one with grey and the other with green spiny leaves, and both with the fine pink flowers characteristic of this genus. We soon reached Geyran Yaylâ, a fascinating little plain of watermeadows cradled in a hollow of the forested hills at 4,700 feet. These *yaylâs* are a most convenient feature of Turkish mountains, and are used as summer resorts by the people of the lowland plains; they pasture their flocks there in summer and are always ready to supply the traveller with dairy produce or meat. Here we left our horses and continued on foot the steep ascent of the peak. A marvellous gorge opened to the South which would well repay thorough investigation as the valley at the head of it was exceedingly rich. Silver-Washed Fritillaries sunned themselves on the big thistle-heads of a grey-leaved *Onopordon* (13327).

A large *Asyneuma* (13339) produced its long tails of starry flowers on rocky banks, and a much dwarfer species (13338) filled the crevices. We scrambled up a steep tributary ravine, hauling each other over the polished limestone boulders, my vasculum banging loudly against the rocks. Here we found a few small trees of *Populus tremula* and of Yew (*Taxus baccata*)—the latter far from the Turkish stations recorded by KRAUSE.*

I was pleased to find a broad-leaved Peony in the *mascula* group (*Paeonia* 13359) growing under the Black Pines. It is apparently an undescribed species; the carpels are glabrous and the guide swore that the flowers were red. Unfortunately our efforts to have seed collected later were not successful. The twinkling panicles of *Verbascum cheiranthifolium* var. *asperulum* occurred on the wooded slopes, and a frail new *Micromeria* (13422), with Balkan affinities, grew on the outcropping limestone rocks. Low cliffs held an intriguing saxatile *Galium* (13428) with whorls of very wide hairy leaves; glaucous wads of the powder-blue *Omphalodes Luciliae*, the seed of which had already been shed, filled the crevices.

Stopping for lunch in the ravine, we found the wet and slimy limestone by the stream covered with very fine plants of *Pinguicula hirtiflora* (fig. 36), just as it grows by the Styx in Greece; the flowers were a cool pale lavender. A diminutive Hartstongue, *Phyllitis Hemionitis*, grew near by. Then on up the steep mountain-side. A new *Origanum* (13401) in the *Amaracus* section, related to the graceful

* KRAUSE, *Türkiyenin Gymnospermleri*, Ankara, 1936.

O. sipyleum which we had seen near Denizli, hung out its rosy hop-like heads. Soon the Pines thinned out; a *Linum* (13400) appeared, slender and white-flowered, and a dwarf red *Allium* (13398). The most exciting plants were, as usual, in the rocks; there was so much to collect that flower photography was almost impossible. Wedged in the crevices were two apparently undescribed chasmophytes of exceptional charm: a very dwarf *Micromeria* (13403) with large carmine flowers, and the smallest perennial *Hypericum* (13365) I have ever seen, the prostrate stems, clad in minute round leaves, being only an inch long. Some of the rocks were filled with *Globularia dumulosa*. This very beautiful species was discovered by PROFESSOR OTTO SCHWARZ on Maşda Dağ during his still largely unpublished journey of 1938. The plant is related to *G. stygia*, endemic to Mt. Chelmos in the Peloponnesus, but the mounds of tiny bright-green rosettes are harder and tighter and altogether more to be desired. The almost stemless blue capitula were nearly over and seed still unripe; but of the chunks sent home by air one fragment is forging ahead so that I hope the plant may eventually become established in our gardens.

As is frequent in the Mediterranean, the highest screes were not so rich as the zone of rocks at 6,000 feet to which I have just referred. But *Pterocephalus Pinardi* was there; this is the Anatolian counterpart of the Greek *P. perennis* subsp. *Parnassi*, but the Scabious heads are of a clearer pink and hover over mats of distinctly lacerated foliage. A procumbent *Helichrysum* (13369), with oblong ashy leaves and golden heads, rambled through the screes. *Euphorbia Kotschyana* formed drifts at 7,000 feet—a handsome, foot-tall plant having yellow floral leaves and leathery foliage glaucescent below and darkly lacquered above. It was often accompanied by the lavender flowers of *Salvia Bourgaeana* (related to the Persian *S. sahendica*) and a new *Marrubium* (13402). A densely caespitose *Galium* (13382), resembling the minute *G. aretioides*, covered a windswept ridge, and in the rocks two rosulate species of *Umbilicus* (*Rosularia*) were in bloom, one with large creamy flowers (13418) and the other with pink petals (13379).

Near the summit we met a camel. These supercilious but determined creatures get almost everywhere in the mountains (especially in the Lycian Taurus), and have a devastating effect on the flora, brutally grazing the vegetation in all but the steepest places. The afternoon was well advanced before we began the descent, tumbling down 2,000 feet of shockingly steep scree to the Pine woods below us. Stopping to pluck a form of *Calamintha origanifolia*—"Boz Dağ Tea"—from the gravel of a dry river bed, we plodded on to the *yaylâ*. Shepherds brought us wide bowls of *ayran*, in my opinion a wonderfully refreshing drink; it is made of *yoghourt* beaten up in water. We retrieved our horses and reached Abbas at 10 P.M., almost too tired to sleep.

Returning to Denizli, we took the train to Aydin and then banged along in a bus, cooped up like foetuses, through a bleak granitic landscape, and, on the following day, continued by lorry to Köyceğiz. The village lies beside a lake nearly at sea level, and the alluvial plain on its north side is in parts covered by dense forests of *Liquidambar orientalis* which is confined to this corner of Turkey. A member of the

Hamamelidaceae, the genus is represented only by two other species: one in North America and the other in Formosa and South China. The Turkish tree is of local economic importance, resin being extracted from the wood and used as a cure for scabies; the fragrant by-product of crushed shavings is sold for incense.

Liquidambar orientalis is often considered a Tertiary species, and I had hoped to find a considerable relict flora associated with it; but I was disappointed owing to the almost total absence of ground vegetation. There is no doubt that this is due to winter flooding; *Juncus maritimus*, forming large clumps, was almost the sole representative of a herbaceous layer. *Ficus carica* was frequent, however, and two relict Lianas festooned the trees: *Smilax excelsa* (a predominantly Pontic plant related to species in the Atlantic islands) and *Vitis sylvestris*, giving an almost tropical aspect to the humid gloom of the forest. The wild Vine referred to is dioecious (in the cultivated Vine—*V. vinifera*—the flowers are hermaphrodite), and the sexes can apparently be distinguished by the shape of their leaves—a most unusual feature, and probably a secondary sexual character. The grapes are small, black, and not unpalatable.

From Köyceğiz we made a leisurely five-day ascent of Sandras Dağ (7500 feet), a wide dome of serpentine rocks botanized for the first time by SCHWARZ ten years ago. *Styrax officinalis*—a vigorous relict with Californian relationships—was unusually abundant in open *Pinus brutia* forest; this beautiful white-flowered shrub is so characteristic of calcareous rocks in the Mediterranean that its super-abundance on a serpentine formation is noteworthy. A new shrubby *Phlomis* (13586), related to *P. viscosa*, was also found in this zone, and an undescribed *Sideritis* (13583). Spending the first night at Ağla, a tiny hamlet at 2,000 feet, we found the steep ravines round about filled with the most magnificent trees of *Platanus orientalis*—a genus which in part parallels the distribution of *Liquidambar* and is certainly a relict type. Fossils have been recorded from the early Cretaceous rocks of Greenland, and the genus was common in the Northern Hemisphere during Tertiary times. It is extraordinary that *Platanus orientalis* and the American *P. occidentalis*, which have apparently been isolated for millions of years, have been genetically so little modified that they have been able to produce a fertile hybrid—the London Plane. It would be interesting to discover if the species of *Liquidambar* have also retained their interfertility. Accompanying the Plane was an Alder (*Alnus* 13588), discovered here by SCHWARZ, that is intermediate between *A. subcordata* from the Caucasus and the Syrian *A. orientalis*. The trees were frequently over 100 feet tall, in my estimation sometimes as much as 150 feet in height. It also occurred in the *Liquidambar* forest round Köyceğiz, where its foliage was often attacked by the Gypsy Moth.

A fire had swept much of the mountain in 1945, and this, combined with an exceptionally dry spring, no doubt accounted for a rather poorly developed vegetation. The zone of the Black Pine, dominant here from 4,000 to nearly 7,000 feet, held some attractive plants, of which the new *Teucrium sandrasicum* (described on p. 115) held first place, and of which seed was obtained. Related to the lanky *T. creticum* (which does grow on in Crete) this is a most desirable subalpine that fills the dry slopes of Sandras Dağ with its contorted woody little bushes of linear leaves, giving rise to plentiful racemes of lavender lips; the whole shrub is about 9 inches tall and should prove one of the best garden plants in the genus. Nearby grew a new *Alyssum* (13563, 13621) and white-leaved woody *Senecio* (13561), and also the rare and architectural *Eryngium thorifolium* whose glaucous basal leaves are kidney-shaped and inordinately thick. Another plant with extraordinary leaves for its genus was *Celsia thapsiformis*, the rosettes possessing a fine metallic lustre. The silky foliage of *Verbascum caricum* was frequent in the forest, especially where fire had laid areas waste. All Mulleins are called 'Bulls' Tails' by the South Anatolian peasants.

We camped for two nights on the grassy hollow of Gökce Ova at nearly 6,000 feet. The rusty bells of *Digitalis ferruginea* showed in the woods nearby, and there was a wonderful undescribed *Centaurea* (13510) with foot-high stems bearing entire silver leaves and big yellow heads with papery scales; but, alas! no seed. The charming violet-flowered *Calamintha troodi*, resembling a very dwarf *C. alpina*, was abundant in open stony places; it has hitherto been considered endemic to Cyprus. A procumbent white Thyme was frequent (*Thymus* 13497) and I saw one spike of *Cephalanthera rubra* glowing in the shade.

Above the tree-line we found, inevitably, a handsome *Acantholimon* (13530), one of the dwarf pink *Ebeni* (13509), with flowers like Sainfoin, so characteristic of the Turkish mountains, and a charming *Cytisopsis* (13501 *pro parte*) that formed gnarled mats of silvery (and much nibbled) leaves with long golden pea-flowers. *Umbilicus* (*Rosularia*) *serpentinicus* produced its purplish flowers from small smooth rosettes. *Alyssum*—a genus much in evidence on the mountain—was here represented by an exceptionally dwarf and charming species (13537), and there was a caespitose *Convolvulus* (13539), closely related to *C. libanoticus*, with discrete white trumpets. Snow still lay at 7,300 feet on the north side of the summit (it was July 23), and in a steep north ravine below it were several plants we did not see elsewhere. By far the most attractive was a new dwarf *Lamium* (13548) forming wads of reddish little leaves among the serpentine rocks and bearing its ample pink flowers in great profusion. This genus produces some very showy rock plants in Anatolia, but seed is difficult to obtain. There were a few plants of a new yellow *Linum* (13555), related to *L. aretioides*, but quite lacking the concise charm of that wonderful species which is still to be introduced.

DR. BURR secured a colossal centipede on Sandras Dağ, believed to be the almost mythical "Snow Worm" of an early traveller to Bithynian Olympus. This rare animal, said to have exceptional aphrodisiac properties, was rushed by its original discoverer to the ruling Sultan of the time, whose failing powers, one would like to think, were thereby fortified. DR. BURR sent his to the British Museum. My coup was nothing more romantic than an obese wingless grasshopper which I seized, with considerable trepidation, in a Pine tree. It turned out to be the female of a new species of which I had captured a male on Boz Dağ.

We returned to Köyceğiz and drove to the little port of Fethiye (Makri) through magnificent forests of *Pinus brutia*; the valleys were filled with great clumps of blossoming Oleanders. Fethiye is no more than a village in size, but it is marvellously well organized, being the centre of a mountainous but well-populated district. It lies beside a sheltered bay, the little-known peak of Baba Dağ *—ancient Anticragus—rising steeply above it. The ruins of Telmessus, whose elaborate rock-carved tombs recall those of Petra, look out across the bay, and by their very slight degree of weathering (although more than 2,000 years old) emphasise the permanence of a saxatile habitat for plants. Species of Campanula and rosulate *Umbilicus* (*Rosularia*) grew among the limestone ruins, but were very burnt up at the time of our visit.

Joined by LORD KINROSS we left the forest station, where I had been busily drying plants for the previous two days, *en route* for Baba Dağ. Our horses were too high-spirited for my liking, and a kicking match soon caused me to abandon mine to an eager guide; he was thrown a few minutes later. The lower slopes of the mountain were covered with *Pinus brutia*, *Quercus coccifera* and *Styrax*, the former dominant above 2,000 feet. The remains of a *Fritillaria* were noted in the woods; but we were much too late to hunt satisfactorily for this genus which is so well represented in Lycia. There was apparently no Black Pine on the mountain, its place being taken by a forest of *Cedrus libani* subsp. *stenocoma* (discussed further on p. 112). We pitched camp at the convenient Ak Bel Yaylâ which occupies the pass between Baba Dağ and Mendos Dağ. There is no water on the little plain, but a spring is not far off and amiable shepherds bring one the slightly sour milk that is such a refreshing part of one's Anatolian diet. *Phlomis grandiflora* (13693) was common round about, forming 4 foot shrubs with yellow whorls large as its name suggests. In the clearings of the surrounding Cedar forests *Digitalis cariensis* (13691), a slender perennial Foxglove in seed at the time of our visit, was locally abundant.

Although Baba Dağ is only 6,470 feet above sea-level, it has a comparatively rich flora probably due to its proximity to the sea. Striking up through the Cedar forest next morning we noticed a few Peony seedlings, but were unable to find any mature plants; it must be very local on the mountain. The purple hoods of *Scutellaria brevibracteata* were frequent, and the golden spikes of *Umbilicus erectus* occurred among the rocks. The Cedars thinned out at 5,000 feet and were accompanied in the limestone screes by a small-leaved *Acer* (13685) and drifts of Judas trees (*Cercis Siliquastrum*) that must be a wonderful sight in the spring. The cliffs, which had looked very promising from below, turned out to be of a laminated type of limestone not ideal for chasmophytes. But the prickly hummocks of *Satureia spinosa* were billowing with white blossom—a species hitherto recorded only from the islands of Crete and Samos. Another saxatile plant showing Balkan affinities was an unidentified pink *Tunica* (13675).

The peak, consisting of shaly pink calcareous rocks, supported stunted trees of *Juniperus foetidissima* almost to the top. There were two species of *Acantholimon* (13671 and 13669), the familiar *Atraphaxis Billardieri* covered with rosy fruits, incredibly woolly *Verbascum bellum*,

* Not to be confused with Baba Dağ (ancient Cadmus) in Caria.

and a ferocious *Eryngium* (13653) of glittering blue. But the most spectacular plant was an undescribed *Echinops* (13651), discovered by SCHWARZ on Çal Dağ and related to the Kurdish *E. Tournefortii*, which we found on our downward scramble. The heads can be nearly 6 inches across—incredible spheres of pale jade green. As these eccentric baubles are carried on stems of no more than 18 inches, it was a great disappointment that seed of this wonderful species could not be obtained.

Descending for the night to the ruins of Minara (ancient Pinara) at the east foot of the mountain, we examined next day the precipices honeycombed with countless Lycian tombs, and gathered seed of a desiccated monocarpic *Campanula* recalling *C. ephesia*. Here, too, we found *Ballota pseudodictamnus*, a woolly-white species occurring elsewhere in Crete, Kythera and Cyrenaica. Passing through a park-like forest of *Quercus macrolepis* (a tree with magnificent acorns that seems to favour very sheltered positions), we drove back to Fethiye by way of the marshy valley of the Xanthus.

For the rest of my Anatolian journey Kâmil Bilger and I continued alone. Striking an expensive bargain with a lorry-driver, we travelled to Seki Yaylâ north-east of Fethiye. The village of the *yaylâ*, at the end of an elevated plain at 3,600 feet, lies at the western foot of the Lycian Taurus, the whole of which is collectively known as Ak Dağ (White Mountain). We stayed in the little house of the village headman whose graceful hospitality will always remain in my memory. It is a rare enjoyment to stay in a well-appointed peasant home, reclining on rugs and carpets and cushions, while one eats the delicious meals of the Turkish countryside. The district officer, too, was wonderfully kind to us, and found us the guides and five mules necessary to carry our belongings for over a week in the mountains. Travel in Turkey is now an expensive matter, a mule with a man costing about a pound a day.

We made for the ridge known locally as Kara Tepe—Black Top—where SCHWARZ had presumably found *Cedrus libani* subsp. *stenocoma* in 1938. This is the only ridge in the neighbourhood supporting the Cedar, those to the West being covered with Black Pines. It would be interesting to investigate the subtle factors affecting the dominance of these two trees in localities that are superficially similar. When he described the Cedar, SCHWARZ drew attention to the characteristic shape of the tree—pyramidal and slender, like a *Picea*—and this feature may be seen in the photograph taken on Kara Tepe (fig. 39). One cannot help thinking, however, that the form is due to the comparative youth of the trees, and to their close association—as though they had sprung up after a fire. On Tahtali Dağ near Kemer (to be described later), where the trees are well spaced and apparently much older, the pyramidal habit is lost and the trees become flat-topped (fig. 40). Nevertheless, the Turkish Cedars that I have seen remain more or less columnar, never attaining the broad umbrella form typical of the Lebanon tree; the branches are borne horizontally. In the size of its leaves and cones the Cedar of South-West Anatolia (its eastern limit is uncertain) is intermediate between that of the Lebanon and Atlas trees. This has led SCHWARZ to accept the Mediterranean Cedars as belonging to a single species * comprising four subspecies from the Lebanon, South-West Anatolia, Cyprus and North-West Africa. The Himalayan *C. Deodara* he considers specifically distinct.

On ledges of shady limestone rocks in the Cedar forest I was excited to find a form of *Papaver Heldreichii* (13876)—a member of the *Pilosa* section and resembling a *Meconopsis* in habit. From the perennial, though probably short-lived, rootstock rise loose 3 foot panicles of soft apricot-yellow Poppies.

We had mistakenly sent our baggage ahead to the lake on the east side of Girdev Dağ (Eren Dağ), while we made our detour into the Cedar forest. The walk was interminable. Every hour or two we met a shepherd—and once a *yuruk* matriarch (she swore she was eighty) with a camel and a most Rabelaisian sense of humour—but to our enquiries as to the lake's distance away the answers were always the same: "two hours." Having staggered in the dusk to 7,500 feet, we saw the lake glinting malignantly thousands of feet below us. We trudged in the dark down an apparently bottomless gulley, and emerged at last on the plain, only to be attacked by packs of dogs. With considerable difficulty we located our camp, lay down and slept. Next day, too tired to return to the mountain that rose so painfully high above us, we caught insects and botanized fitfully round the shore. I was very pleased to rediscover and photograph some Greek lion-topped sarcophagi found by PETERSEN in the eighties and, so far as one knows, never revisited.

The following day (August 5) we returned to Girdev Dağ, for I was determined not to abandon a mountain which I thought synonymous with SCHWARZ's "Teke Punari Dağ" where he had made so many discoveries. We failed to find anyone who had heard of a mountain of that name, and I am now inclined to consider that Kara Tepe was more likely to have been the place. At 6,500 feet we came to a hollow on the mountainside where a few peasants had attempted to scratch a living from the soil. *Verbascum cheiranthifolium* var. *pisidicum* was flowering in the half-wild fields, and the rusting spikes of *Digitalis ferruginea* stood on the slopes. Among the rocks round about, *Papaver Heldreichii* was full of ripe seed. A new form of the shrubby *Pyrethrum praeteritum* (13788), with complicated grey leaves and adequate white Marguerites, was abundant on the rocky sides of the mountain. At 7,400 feet the herbaceous *Phlomis armeniaca* became the dominant plant, growing with the tawny foliage of *Marrubium Bourgaei*; the mustard-yellow flowers of the *Phlomis* contrasted startlingly with

* SCHWARZ, in his original paper in Fedde, Repert. **54** (1) 26 (1944), described his new Turkish Cedar as *C. libanitica* Trew subsp. *stenocoma* Schwarz. The name *C. libanitica* Trew, however, has been found invalid under Art. 68 (4) of the International Rules of Botanical Nomenclature (1935) as Trew did not consistently adopt the Linnean system of binary nomenclature. *C. libani* G. Don is the first validly published and legitimate name for the Lebanon Cedar, so that the revised nomenclature for the South-West Anatolian tree is as follows :—

Cedrus libani G. Don in Loudon, Hort Brit. 388 (1830) subsp. **stenocoma** (Schwarz) Davis comb. nov.—*C. libanitica* Trew subsp. *stenocoma* Schwarz in Fedde, Repert. **54** (1) 26 (1944). It is clear from the preface to Loudon's *Hortus Britannicus* (1830) that G. Don the younger is responsible for the Linnean arrangement in that work.

the pink of the local *Acantholimon* (fig. 38). A prostrate form of *Ziziphora clinopodioides*, with grey leaves and heads of white or pale lilac flowers, flopped about among the rocks with a golden *Helichrysum* (13985) like the one we had found on Boz Dağ. Another attractive high-mountain species was *Saponaria pulvinaris*; it formed hummocks like those of *Silene acaulis*, ringed by a coronet of red-calyxed flowers. The violet bells of *Campanula stricta* were not to be sniffed at, though the genus in Turkey seldom competes with its marvellous relations in the Aegean. On the spur of the summit, at nearly 8,000 feet, was a handsome monocarpic *Asyneuma* (14029), probably a form of *A. virgatum*, the rigid goat-eaten panicles bearing a profusion of rather large starry flowers of a good blue-violet. On the rocks were an *Arabis* (14000), a lilac *Aubrietia* (13988), and a white night-flowering *Silene* (13773).

A shepherd, his clothes and tent homespun, had pitched his camp near the snow, and came to greet us with a great bowl of milk. Three Sedums grew in the rocks round his tent, among them *S. sempervivoides*. This is the most spectacular member of the genus known to me, the beautiful reddish rosette (unhappily biennial) giving rise to an intensely scarlet corymb of flowers. By the patches of melting snow were a purple *Erigeron* (13983), a yellow alpine *Ranunculus* (13981) and a new *Plantago* (13982) with hairy rosettes shaped like a Butterwort. And so down the steep north-east face to the tiny Bel Yaylâ, situated at the top of the pass between Düger and Girdev Göl, at 6,200 feet.

I was loath to leave the mountain without having a good hunt for *Arnebia* (*Macrotomia*) *cephalotes*—a marvellous Boraginad with silver leaves and heads of flowers as big as golden ostrich eggs—and a small new *Tracheliopsis* SCHWARZ had discovered in the district. Next day we searched the north side of the mountain without finding a sign of the Golden Fleece. But a cliff was full of *Rhamnus eriocarpa* (13812), a rather wonderful chasmophyte with its little velvety leaves covering gnarled and rigid branches curved back against the rock. With it grew the curious pale spikes of *Micromeria cristata*.

From Girdev Dağ we made for Elmali, a large and important village that lies in the central plateau of the Lycian Taurus, at our leisurely rate of progress two days' journey away. Over most of the mountain-side *Juniperus excelsa* was the dominant tree (fig. 37); we often saw its bark, which peels off in long strips, being used for thatching wood-cutters' cottages. Beginning at 4,000 feet, this tree ascends to about 7,000 feet in the Lycian Taurus, and, as it extends eastwards to Afghanistan, is better regarded as a high mountain tree of the Irano-Turanian region than of the Mediterranean. Although it occurs locally in areas of Mediterranean climate, both in Turkey and in the Lebanon, the closely related *J. foetidissima* is more characteristic of the latter climate. *J. excelsa* probably does not occur on the mainland of the Balkan Peninsula.

An attractive plant of this Juniper region was *Salvia potentillifolia*; its procumbent stems, clad with trifoliate grey leaves, bore flowers of a clear pale yellow—an unusual colour for a Sage.

Descending steeply to the plateau at Yuva (3,600 feet), the Juniper gave way to scrub of *Quercus coccifera*, with frequent bushes of *Celtis Tournefortii* heavily attacked by a coccid. On the limestone cliffs near the ancient tombs, *Rhamnus eriocarpa* occurred again, with grey bushes of a saxatile *Dianthus* (13731). From Yuva—where a platform built round a tree trunk served as an airy lodging—the path skirts the malarial marshes of the Kara Göl. A detour through the latter provided a great many plants we had not seen in Turkey before, including such familiar British species as *Butomus umbellatus* and *Nymphaea alba*, besides numerous Rust Fungi.

Scrub of *Quercus coccifera* (a tree which can put up with a very low summer humidity, as the forests of Edom can show) persists round Elmali, and here and there, on arid banks, grew the rare *Ebenus Bourgaei* and *Moltkia aurea*. The last, with its mats of oblong grey-green leaves and croziers of surprising yellow flowers, is a very lovely plant which deserves all the attention we can give it. Its presence there indicated that we were in the vicinity of the steppe, for it is an Irano-Turanian species. And indeed, driving along the road from Elmali to Antalya, we quickly left the last unhappy traces of Oak behind us and entered into a treeless upland steppe, evidently due to the surrounding range of the Taurus which forms a very effective rain-barrier. Reaching a pass to the West, a few scattered bushes of *Juniperus excelsa* * appeared which, on the seaward side below, presently became co-dominant with *Quercus coccifera*, and below 3,300 feet were replaced by a wonderfully fine forest of *Pinus brutia*; this persisted till we reached the maritime plain of Antalya. We were back in a typical Mediterranean landscape, and thrilling discoveries were to be made in the mountains across the bay.

(*To be continued*)

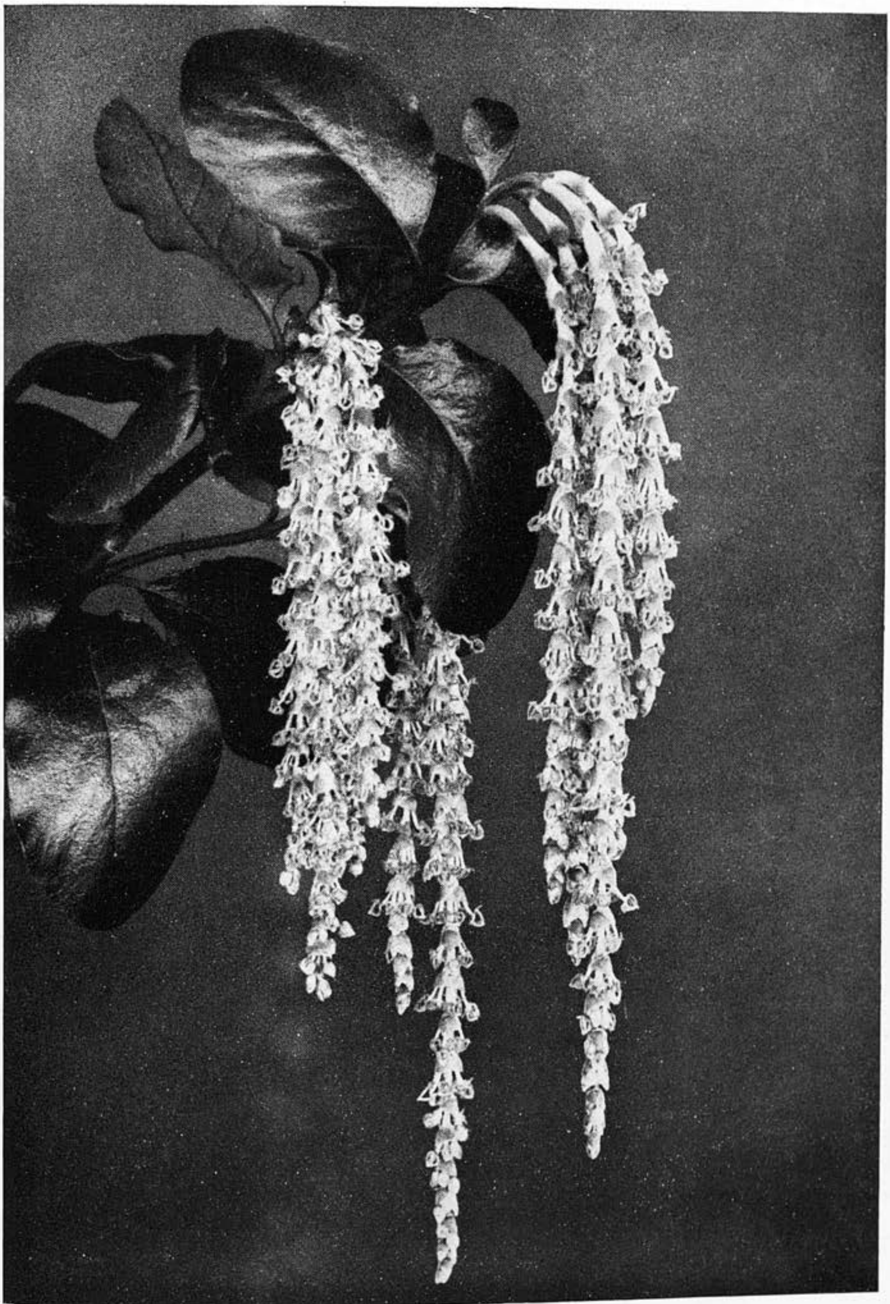
A NEW TEUCRIUM (*T. sandrasicum*) FROM SOUTH-WEST ANATOLIA

Prof. O. Schwarz (Weimar)

Teucrium sandrasicum O. Schwarz sp. nov.

Fruticulosum nanum, praeter foliorum superficiem omnino pube brevissima crispula intertexta hinc inde floccoso-decidua appressim pannoso-tomentellum canum, e basi lignosa valde ramosa caudiculos breves dense foliosos caulesque stricte erectos ad 25 cm altos simplices florigeros emittens; *caules* teretiusculi superne indistinctim quadranguli, sat remote foliati; *folia* subsessilia lineari-lanceolata usque linearia acutiuscula suprema acuminato-spinescentia, margine integra revoluta, subtus cano-pannosa supra cito glabrescentia viridia, sempervirentia, in caudiculis conferta utrinque cana, in caulibus satis remota internodiis saepe breviora 12–28 mm. longa, 0,6–2,5 mm. lata, caulis apicem versus sensim decrescentia; *flores* caulis apicem versus in cymis 3–1-floris axillaribus oppositi racemosi, sat parvi; *pedicelli* folii suffulcientis dimidiam subaequantes vel superantes 4–10 mm. longi calycibus subduplo longiores vel in floribus supremis vix longiores; *calycis*

* In arid areas this tree descends to less low elevations than it does in more rainy localities. It has been suggested that the wood of *Juniperus excelsa* was the Biblical "Cedar of Lebanon" (J. D. Hooker in *Natural History Review*, January 1862).



Photo, N. K. Gould

WINTER FLOWERING SHRUBS

FIG. 34—*Garrya elliptica* (See p. 100)

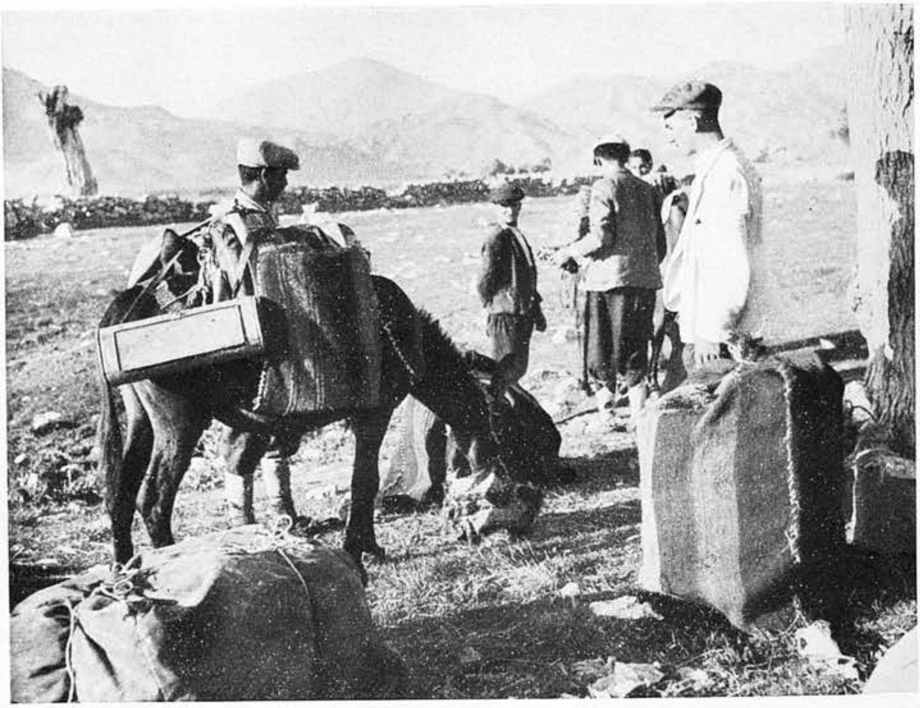


FIG. 35—Striking camp at Girdev Göl in Lycia, 5700 ft.
The flower presses are carried in the sacks

Photos, P. H. Davis

A JOURNEY IN SOUTH-WEST ANATOLIA

FIG. 36—*Pinguicula hirtiflora* on Boz Dağ in Caria, 5500 ft. (See p. 107)

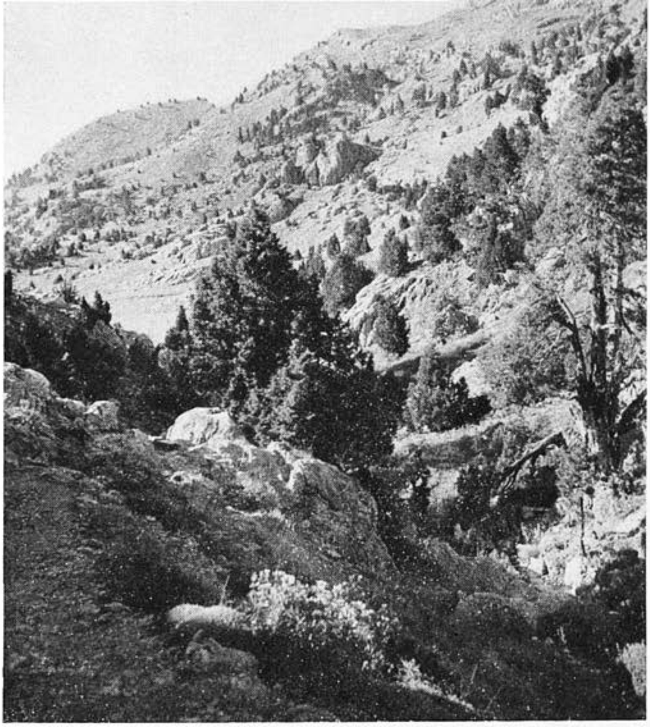


FIG. 37—*Juniperus excelsa* on Girdev (Eren) Dağ in Lycia, 6500 ft. (See p. 114)

A JOURNEY IN SOUTH-WEST ANATOLIA

FIG. 38—*Acantholimon* sp. and *Phlomis armeniaca* on Girdev (Eren) Dağ in Lycia, 7400 ft. (See p. 113)

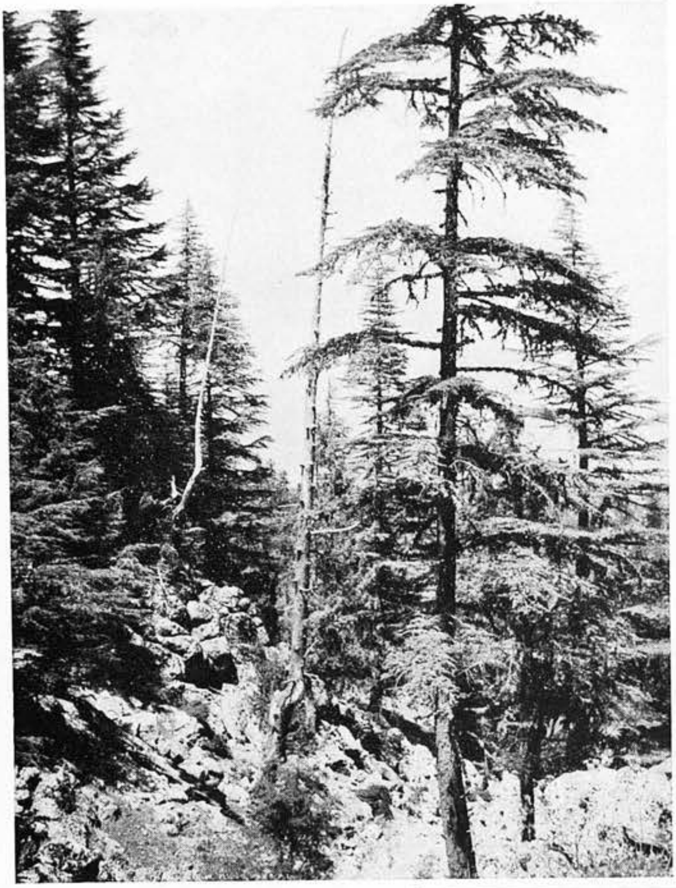


FIG. 39—Young trees of *Cedrus libani* ssp. *stenocoma* on Kara Tepe near Seki Yaylâ in Lycia, 4500 ft. (See p. 112)

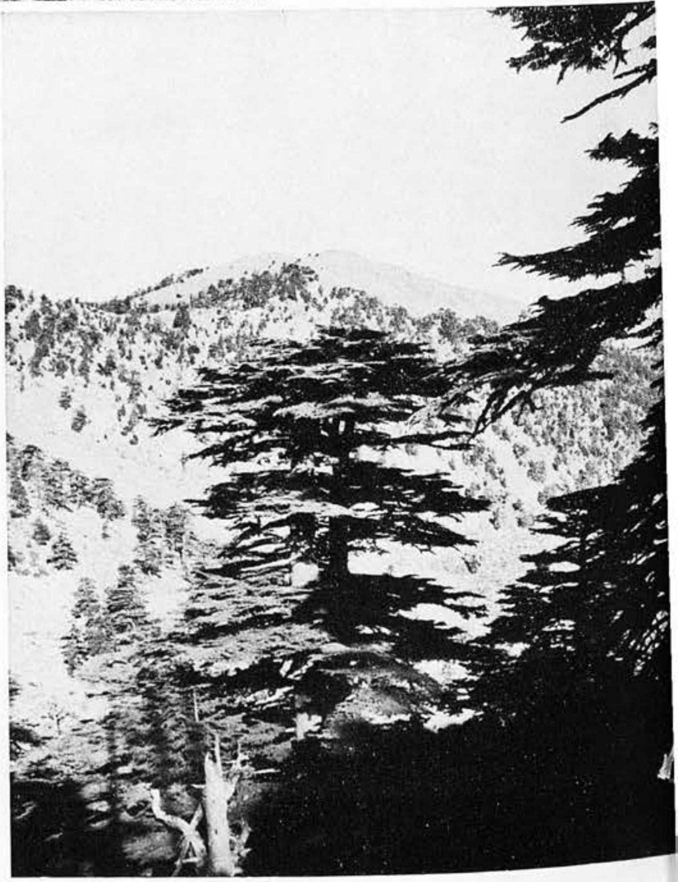


FIG. 40—*Cedrus libani* ssp. *stenocoma* on Tahtali Dağ in Lycia, 6000 ft. (See p. 112)

cano-tomentosi tubus initio turbinato-cylindricus 2,5–3 mm. longus deinde accrescens late campanulatus ca. 4 mm. longus et latus, dentibus subaequalibus triangularibus spinoso-acutatis initio 1 mm. deinde ad 2,5 mm. longis subduplo longior; *corolla* caerulea labio violaceo striata, extus dense brevissime tomentalla, calyce subduplo longior 6–8 mm. longa; *filamenta* exserta minute glanduloso-puberula, ca. 10–12 mm. longa stylum stigmate oblique bifido coronatum subaequantia; *nuculae* oblique oblongo-ovatae flavido-brunneae leviter foveolato-reticulatae.

Floret Jun.–Aug.

Anatolia : Prov. Muğla, Distr. Fethiye, in pinetis apertis lapidosis inter montes Caldağ et Pirnasdağ ad jugum Kirkpunar, solo serpentinico, ca. 12–1500 m., Aug. 15, 1938, Schwarz no. 416 (typus); nec non in lapidosis pinetorum montis Sandrasdağ supra oppidulum Köyceğiz, Jul. 20, 1938, Schwarz no. 1032; Sandras dağ (above Köyceğiz), 1100–1500 m., on serpentine on open south slopes in black pine forest, flowers lavender-blue, Jul. 7, 1947, P. H. Davis 13559, (in Herb. Kew.). Typus in Herb. Hauussknecht, Weimar.

The new species is related to *T. creticum* L. (*T. rosmarinifolium* Lam.), *T. brevifolium* Schreb. and *T. Pestalozzae* Boiss., but differs in its relatively long pedicels and acute leaves. The first two have quite a different habit, larger flowers and less acute (not spinous) calyx-teeth; the third, which I have not had the opportunity to compare with the new species, is nearly glabrous and has shorter leaves; the assimilating parts of our plant, with the exception of the leaf surface, are completely covered by a very shortly appressed interwoven tomentum of greyish-white colour.

The plant forms great heath-like complexes on the stony ground of the Black Pine forests, and seems wholly confined to serpentine soil. It certainly shows some relationship to the *T. Polium-montanum* group, which in *Boissier's* "Flora Orientalis" is far removed from the species mentioned above.

A JOURNEY IN SOUTH-WEST ANATOLIA

P. H. Davis

(*Based on a Lecture given to the Society on March* 16, 1948)

PART II

ANTALYA (old Adalia) is built on the top of a tufa cliff over which numerous waterfalls tumble slap into the sea. It is an exceedingly beautiful Turkish town, and has two quite comfortable small hotels where one can even get breakfast—a terrifying *ensemble* of unreliable boiled eggs, olives, jam and rancid cheese. It was an excellent base for dealing with our collections, and the cliffs round the harbour were exciting to investigate. There was *Celsia horizontalis*, the very local and distressingly brittle *Teucrium Montbretii*, and great bushes of *Dianthus actinopetalus* in rosy flower; the latter resembles a less woody *D. rupicola* and shows considerable geographical variation in Southern Anatolia.

I wished to see the wonderful ruins of Termessus that lie on the mountainside about 28 kilometres north-west of Antalya. The *Quercus coccifera* woods were full of *Fontanesia phyllerioides*, its 10 foot bushes hung with winged fruits. The rather sinister *Phlomis samia*, having almost apple-green flowers with a purplish lip, grew stolidly under the trees, and by a spring that curious relict, *Datisca cannabina*, luxuriated. But the find of the day was certainly a new shrubby *Verbascum* (13953) closely related to *V. Pestalozzae*. This remarkable Mullein grew in the walls of the temples, making neat bushes a foot across with rough little leaves like those of a woody *Phlomis*, and producing masses of abbreviated racemes with the seed, unfortunately, already shed. This species, like the Cretan *V. spinosum* now well established in cultivation, should prove an ideal subject for the rock garden. It was a rare experience to watch, from the portal of a tomb carved high in the rocks, Red Deer (*geyik*) playing among the trees by the spacious ruined theatre.

From Antalya I had intended to travel eastwards in the Taurus as far as Ermenek. But the Lycian Taurus south-west of Antalya, with its fabulous maze of limestone gorges, looked so inviting that I decided to change my plans in favour of Tahtali Dağ * which had never been botanically explored. One should always, I think, be prepared to change one's plans in an unfamiliar country, if an area is seen that looks particularly fruitful; like a witch-doctor, one soon learns to smell out the likeliest hunting-grounds.

The peak of Tahtali Dağ—"Mountain of Planks" and ancient Solyma—stands rather isolated from the main range of the Lycian Taurus, and rises in a steep calcareous pyramid of nearly 7,800 feet above the coastal hamlet of Kemer. To that little cluster of cottages we hired a gay Antalyan boatman to take us across the bay, a crossing, on so placid a morning, of three and a half hours by motorboat. There are no roads on the precipitous Lycian coast. In the afternoon, with an adequate bevy of guides, mules and small boys, we straggled out across a narrow coastal plain and soon reached the entrance to the gorge at the foot of Tahtali Dağ and known, in its narrowest part, as Kesme Boğaz. It was a very lovely place, and we decided to camp beneath

* Not to be confused with Tahtali Dağ in Lydia.

the Planes that flanked the ice-green river. There I could bathe in the pools, and potter about collecting. But Kesme Boğaz was much too thrilling to potter in. I moved in jerks, in a series of small runs.

Cupressus sempervirens var. *horizontalis* was abundant on the slopes of the gorge, growing with *Pinus brutia*; but it also clung to the precipices above—the only tree that could—as it does on the cliffs of Crete and Cyprus. A new species of *Origanum* Sect. *Amaracus* (14078), related to the Greek *O. scabrum*, occurred locally, and a single bush of an undescribed shrubby *Phlomis* (14056) was found, resembling the purple-flowered *P. elliptica* from South Persia. In the narrowest part of the chasm, where the river cuts a passage through limestone precipices rising for 2,000 feet on either side, I felt I should burst a blood vessel at the sight of an extraordinary new *Globularia* (14055). This was the dominant plant on the vertical rocks, and formed a shrub up to 3 feet across and about half as much in height, the stems clad in bright green leaves, and bearing unusually spicate inflorescences of lilac-blue. An *Inula* (14050) occurred too, very woody, with broad white leaves bigger than one usually finds in *I. heterolepis*; but the flowers were over. It was very satisfactory to find that wonderful Heath, *Pentapera sicula* (var. *libanotica*?) hanging down the shadier parts of the limestone cliffs in 3 foot bushes of Yew-green. This archaic monotypic genus grows only in the rocks of Sicily, Cyrenaica, Cyprus, Lebanon and South-West Anatolia. The large pentamerous bells are pink in the Oriental variety—at least in Cyprus—but in the Sicilian plant (which flowers more readily in cultivation) they are white.

Leaving the gorge we climbed up through the luxuriant Pine forest towards the hamlet of Kuzdere at 3,300 feet; thickets of *Laurus nobilis* filled the ravines, with *Myrtus*, *Cotinus*, and *Styrax*—all probably relict types. Seeing a cliff looming through the Pines, I ran towards it and found it hung with the most curious new *Echinops* (14213): the leaves, often a foot and a half long, woolly-white and scarcely lobed, were like those of *Onopordon insigne*, and grew at the ends of long curved perennial trunks; it reminded me of *Centaurea Clementei* in the Rif. The heads were white-flowered but impossible to reach, even with my 10 foot bamboo ending in a small saw; the plant flowered only where the cliffs overhung. By throwing many stones one battered head was at last dislodged. Exorbitant bribes to the guide failed to secure any more, though he came very near to breaking his neck.

We shared our lunch with a peasant at Kuzdere, sitting beneath a cultivated tree of *Celtis australis*, and then passed on our way up the steep slopes towards Çukur Yaylâ. No more Cypresses grew above the village, but *Cedrus libani* subsp. *stenocoma* replaced *Pinus brutia* at 3,500 feet. The Black Pine occurred only as a few isolated trees; this species and the Cedar appear to be mutually exclusive. A little below 5,000 feet (a fruitful altitude) we came to a good spring where the mountains enclosed a large rocky hollow. It was a rich collecting ground, one of the most satisfactory discoveries being a new Poppy (*Papaver* 14191) in the *Pilosa* section. The leaves were clad in a dense mat of appressed rather tawny silk—which even extended to the ripe pods—reminding one of *Meconopsis superba*. The flowers were orange like those of *P. Heldreichii*. The very pretty blue *Echinops Ritro*, with a bountiful supply of small blue baubles, was in flower beside two undescribed Labiates: a charming *Ballota* (14181) with very grey leaves and woolly-crested white hoods, and a new *Origanum* Sect. *Majorana* (14185). Sturdy bushes of *Dorystaechas hastata* were plentiful; this monotypic genus related to *Salvia* is apparently confined to this corner of Turkey and is evidently an old type. The shrubby *Phlomis Bourgaei* was found in the vicinity, growing with *P. grandiflora* which we had already seen on Baba Dağ. Indeed, the two mountains have more in common with each other than either has with Girdev Dağ in the central *massif*, probably due to their maritime situation.

At dusk, met by the usual pack of ferocious dogs, we came to the Çukur Yaylâ at 5,300 feet. I do not believe I have ever tumbled out of bed at dawn with greater anticipation (or justification) than I did the following day (August 16), knowing that such a promising unexplored peak was at hand. Passing *Digitalis ferruginea* and *D. cariensis* we were soon out of the Cedar forest and on to the steep west shoulder of Tahtali Dağ. A tremendous scree on the north slope was full of interesting plants for the presses; it needed a couple of hefty fellows to carry them. A form of the intensely aromatic *Calamintha origanifolia* lay on the stones, and, on moving scree, an extraordinary dwarf *Peucedanum* (14196) was found, probably *P. pisidicum*, with simple glaucous leaves; it is closely related to a Cretan species, and with that plant holds a very isolated position in this unwieldy genus. Higher up were the colossal jade globes of the undescribed *Echinops* found earlier on Baba Dağ, besides more homely species of *Acantholimon* and *Astragalus*. The remains of a dwarf Fritillary, harried by the wind, chattered dryly among the stones. A spring expedition to the Taurus should produce many bulbous plants new to cultivation. *Omphalodes Luciliae* grew in the rocks round the summit with the charming and very rare *Asyneuma lycium*; the latter is perennial, pointing the crannies with little glossy leaves like those of *Campanula Zoysii*, and emitting thread-fine stems of 3 inches set with a few small blue stars. There was an excellent yellow *Achillea* (14134) with silver foliage, but one of the greatest thrills was a curious and very attractive Crucifer (14123) that grew in the mobile screes along the summit ridge. At first I mistook its leaves for those of a new *Corydalis*; they grew close on the scree, fat, glaucous and trifoliate—not at all like a Crucifer's; then I found the big flat pods, and finally one or two flowers (which I lost): ample lilac-pink crosses, like those of *Mathiola tricuspidata*, on 3 inch stems. Considerable search in the Kew Herbarium has failed to find an appropriate niche for this plant, and it seems that it may represent the type of a new genus. Seeds have given a few plants that are growing well, so it is hoped that flowers will soon be available for study. It is noteworthy that this plant, like the *Peucedanum* just referred to and the beautiful *Pisum formosum* in the Lebanon, should be confined to moving scree; in such a habitat, competition with other species is greatly reduced, so that the survival of the plant (provided it can withstand the austere conditions) is probably facilitated. It is an example of an evidently relict type confined to a very unstable habitat.

After a hasty lunch Kâmil and I parted on the summit ridge, he taking one of the guides, with a nose like a tin-opener, and I the other. I wished to descend the steep north ridge, for this exposure is usually the richest in the Mediterranean area. The new Crucifer was frequent in the screes, and on outcropping rocks lay pink mats of *Pterocephalus Pinardi*, the frail *Lamium cymbalariifolium*, and *Salvia caespitosa*; the last was out of flower, but must be a very desirable plant as the very large purple hoods sit stemless on the mounds of small pinnate leaves. There was a vivid carmine *Dianthus* (14129) and a form of *Rosa glutinosa* in fruit—a delightful 9 inch species that rambled about in the screes. The scarlet corymbs of *Sedum sempervivoides* were frequent.

When I had descended to the top of the Cedar zone at 6,500 feet, the finding of even the remarkable Crucifer was forgotten in the discovery of a most extraordinary relict chasmophyte—a densely caespitose *Asyneuma* (14563).* The genus *Asyneuma* (with the corolla cleft to the base) is generally considered a poor relation of *Campanula*, and indeed most of the species are rather gawky plants with lanky spikes or racemes. But this new *Asyneuma* flouted the conventions of its race. It sprang from the rock in dense domes, like a Kabschia saxifrage, of tiny pointed rather glaucous leaves forming innumerable rosettes; over this confection were sprinkled the pale lilac-blue stars, singly or in racemes of half an inch. It recalled *Diosphaera asperuloides* in the Styx gorge. The age of a plant 6 inches across was estimated to be at least 40 years. Some chunks of this archaic cake were sent by air from Antalya, and a few seeds were obtained from which plants are now being raised in England. It should probably be planted in scree or crevice in full sun, as on Tahtali Dağ it flowers less freely on the shadier cliffs.

It was late in the afternoon, and we were still far from our camp. We plunged dangerously down the precipitous slopes, falling from Cedars into bushes of *Carpinus orientalis*; these were co-dominant in the steep screes and presumably in the desirable process of stabilising them—a function which our descent must have considerably retarded. Then at last we hit the faint path which leads from Tekirova to Çukur Yaylâ, and trailed, worn out, along it in the dark—but not before a new and very silvery *Verbascum* (14159) had been wrenched from the screes.

Before descending to Kemer the following day I explored the cliffs near the spring at nearly 5,000 feet which we had passed two days before. These were filled with the new caespitose *Asyneuma*, the soft silvery leaves of *Hieraceum pannosum* (14127), and *Staehelina Lobelii*. The latter belongs to a small woody Composite genus centered in the Eastern Mediterranean, and produces masses of grubby white flowers smelling divinely of Cherry Pie. Its affinities are with *S. fruticosa* of the South Aegean. The rarest plant on the cliff was certainly *Siphonostegia syriaca*, the sole western representative of a Himalayan and Chinese genus in the *Scrophulariaceae*. There were only three or four plants of it, and they pouted, on curving glandular stems, petulant lips of amethyst.

* This new *Asyneuma*, together with the new *Globularia* from Kesme Boğaz, is being described for the *Kew Bulletin*.

The rocks of Tahtali Dağ had certainly exceeded my wildest hopes. I am sure that this corner of Lycia, from Tahtali Dağ northwards across the confused serrated mountains to Çalibali Dağ (Bereket Dagh), will yield many more discoveries when visited again. Protected to the West by the main range of the Lycian Taurus, the area seems to catch the clouds which sweep round into the bay of Antalya and pile up on these coastal mountains. Here conditions are evidently ideal for the survival of old species (unlike the higher ranges, it apparently missed local Pleistocene glaciation), and such an area should certainly be thoroughly explored. It is comparable in richness and in the relict nature of its flora only to such favoured Mediterranean ranges as the Sierra de Cazorla in Spain and the White Mountains of Crete.

We sailed from Kemer at night. An hour or so after leaving the shore a storm suddenly bore down upon us from the Lycian Taurus, as it can do so treacherously in Crete on the island's south coast. The little boat was badly tossed about and we came in under the cliffs for shelter. There was a sudden grinding lurch, throwing us to the bottom of the boat. The stern had struck a hidden rock. We tried to free it, but it was a difficult task. The skipper and his mate were in and out of the sea, heaving and pushing, while every now and then a particularly large wave nearly succeeded in overturning the boat. It was not a pleasant thing to happen at midnight, with no conceivable chance of being rescued. We were told to remove our clothes and be ready to swim for it. Have you ever taken off a pair of climbing boots in a rough sea at midnight ? It is not very easy, but they came off in the end, and we clung hopefully to the mast in underclothes of varied type—a forest officer, Kâmil and I, and three soldiers who could not swim. We awaited the worst. The fanged coast was quite uninhabited. The situation was so dangerous that it was frightening only in a coldly numbing way. It seemed to be happening to someone else, and I was mainly concerned, I believe, that someone in Europe, beyond those breakers flogging the cliffs that a few days before had seemed so inviting (and do to-day!), should know of the flora of Tahtali Dağ. Only four or five people would care, but it seemed desperately important at the time. Resisting the attempts of the captain to throw the presses and " less valuable" luggage overboard, I pushed and heaved our baggage into the bows. Whether due to this, or to the renewed exertions of the skipper, or to the audible prayers of the huddled soldiers, the boat came free. There were awkward moments before the engine decided to start, then off we dashed for the open sea (the storm having abated a little) and rolled, rather leakily, back to Antalya. By changing the presses continuously for the next two days not a specimen was any the worse for the adventure. We swore we would never go in a motorboat again. And yet, three days later, we sailed in an elegant motorboat eastwards to Alanya, reclining on sacks of grain.

I was surprised to notice the sandy shore for many miles dominated by woods of *Pinus Pinea*, a tree which we did not see at close quarters in Turkey. The sand dunes along this stretch of coast should produce some interesting plants earlier in the year. North-East of Antalya I noted some wonderful peaks rising out of the Pisidian plains, darkly forested and encircled above by limestone cliffs. Most of these promising mountains, northwards to the lakes of Eğridir and Beyşehir, have never been botanized.

The little port of Alanya is wonderfully striking. Walls within walls, the ramparts, towers and endless serrations cover a large area of the precipitous promontory. A green-leaved form of *Dianthus actinopetalus* flowered rosily on the ruins with a fruiting *Umbilicus* (*Rosularia*); a new *Sideritis* (14493) was found, and the very rare *Ajuga bombycina* with leaves of snowy whiteness. There was a tiny inn which actually had mosquito nets, and the bathing was superb. My plan was to cross the Isaurian Taurus from Alanya to Bozkir in Lycaonia, climbing Geyik Dağ (Gheidagh) on the way—a mountain only visited previously by HELDREICH on his remarkable pioneer journey of 1845.

Lengthy bargaining at last obtained the six animals necessary for the ten-day traverse, and the following morning (August 24) we rode off. Several live chickens, at 2*s*. 6*d*. each, dangled at the saddle, and sufficient wine for the journey. On these tiring excursions it is very necessary to do oneself well; and I think I may say we managed it. Geyik Dağ is not easily reached from Alanya, because the deep intervening valleys cut across one's line of attack and necessitate long detours. Our first day's journey took us into the *Pinus brutia* forest, with *Quercus Cerris* subsp. *Tournefortii* frequently accompanying the Pine. In the rocks we found *Michauxia campanuloides*—a monocarpic Campanulad with great bristly panicles of white flowers like an 8-petalled ' Turkscap ' Lily. *Styrax* was heavy with fruit, and I found one plant of a *Dianthus* (14461) with very large, pink, buff-backed flowers, deliciously fragrant. I was delighted to find again the Sandras Dağ *Alnus* growing here and there in the ravines, accompanied by Oriental Planes on apparently schistose rocks. The geology of this part of the Taurus is exceedingly complicated; metamorphic rocks are frequent and one is on and off the limestone half a dozen times in an hour. Entering the Black Pine belt we found two more new Labiates: a rather woody *Sideritis* (14402), related to *S. cypria*, having excessively sericeous leaves, and a red-bracted *Origanum* Sect. *Amaracus* (14397), with the saccate pink flowers of *O. Tournefortii* but the habit of *O. scabrum*. This group of *Origana* certainly reaches its maximum development in the mountains of Southern Anatolia, where the saxatile escapist habit, so characteristic of the outlying species in the Aegean, Cyprus and Cyrenaica, is not developed. The most beautiful of all, *O. amanum*, is still to be introduced: recalling a wonderful *Pseudothymbra* Thyme, its bracts are of the most intense purple and the flowers are an inch and a quarter long. It grows in the Amanus mountains with the longed-for *Tracheliopsis Postii*.

We descended for the night into the beautiful valley of the Kargi Çay where Walnuts (*Juglans regia*) and *Cornus Mas*—at this season covered with red fruits like elongated Cherries—are apparently wild in the ravines with *Rhus Coriaria*. We slept under the Planes near the village of Durbanas.

For the next day and a half we followed along the south side of the Kargi Çay valley, most of the way dominated by the Black Pine. The flora was rich, even so late as the fourth week in August. Another new shrubby *Phlomis* (14250) was found, related to *P. lycia*, and locally the white-spiked *Thymbra Sintenisii* grew on bare rocky outcrops—a considerable westward extension of this rare Labiate's range. Before the confluence of the valley with that of the Derince Dere, I climbed up the steep forested slopes to the foot of some limestone cliffs; they were filled with a white *Potentilla* (14466) and *Staehelina Lobelii* in flower. In drifts beneath the trees, in a mixture of limestone rubble and humus, grew *Paeonia daurica*, with characteristically wide leaf segments and carpels gaping with black and scarlet seeds. No exact Anatolian station for this local species is cited in COL. F. C. STERN's monograph of the genus. It was accompanied by a colossal *Ferulago* (17277) and a herbaceous *Dianthus* (14278) with much fimbriated petals. *Cuscuta monogyna*, an opulent pink Dodder of almost tropical exuberance, embraced a dwarf Vine, *Vitus orientalis*. Another discovery in this valley, mostly in seed, was a new perennial Foxglove (*Digitalis Davisiana*, described on p. 164) whose big pot-bellied flowers of a soft clear yellow hung beneath the Pines. It is coming along in cultivation, despite the attacks of slugs.

Crossing the Kargi Çay at 2,600 feet, we had temporarily descended into the less interesting *Pinus brutia* belt. But the steep calcareous banks of the river supported many deciduous trees: *Platanus* and the Sandras Dağ *Alnus* were the dominants, but there were also *Celtis*, *Fraxinus* (14272), *Juglans*, *Quercus Cerris* subsp. *Tournefortii*, *Populus tremula*, a large leaved *Acer* (14245) and a Lime (*Tilia* 14246). The upper reaches of this valley (where it winds round the north side of the Ak Dağ that lies to the South-East of Köprülü) looked as though it would well repay further investigation; but time drove us on northwards.

At the hamlet of Belister the miller brought us a honeycomb and, while we lay on handsome carpets, did the honours in the noblest manner. Then on over a very desolate stretch of metamorphic rocks to the poor little village of Beydan—one of the very few we saw without a school; there we spent the night in the precincts of a mosque. The place is surrounded by a dry open woodland dominated by large specimens of *Quercus coccifera* and three Junipers: *J. excelsa*, *J. oxycedrus* and *J. drupacea*. The last (frequently called *Arceuthos drupacea*) is a spectacular small tree, the fruits being very large—an inch across—and covered with an almost sky-blue bloom. It was interesting to find the Loranthaceous parasite, *Arceuthobium oxycedrus*, which was common here on *Juniperus oxycedrus* (its usual host) also attacking *J. drupacea*; but *J. excelsa* appeared immune. As parasitism rests on a physiological basis, this might be considered one argument against placing *J. drupacea* in a genus of its own.

Crossing the Gönik valley (3,300 feet) at the head of a gorge, I explored a little way down it, swimming through the torrent; but very soon polished rocks and a waterfall barred further progress. There were the leaves of a saxatile *Geranium* (14292) in the cliffs, and the fabulous grey rosettes of a *Seseli* (14291) foamed into creamy umbels far out of reach.

Geyik Dağ was still not in sight, but before us lay the peak of Ak Dağ to the South of it, which we intended to climb the following day.

Leaving all trees but *J. excelsa* behind, I scrambled up a steep ravine with one of the guides; there was a small purple *Sideritis*—the usual colour is pale yellow—and big mounds of an *Onosma* in the rocks. Coming out on to the open mountainside, I made for a bog at 5,500 feet; it was full of *Parnassia palustris* and *Primula auriculata*, the latter still showing a few peaky flowers of magenta-purple. When we reached the saddle of Ak Dağ we found the slopes gilded by *Euphorbia Kotschyana* and *Marrubium micranthum*, two of the dominant plants of this district, accompanied by scattered individuals of *Eryngium Heldreichii* (14394).

Our tents were pitched on the Gözü Büyük Yaylâ on the north side of the pass, and from there, accompanied by a nimble shepherd lad, we climbed Ak Dağ on August 28. It was, of course, getting very late for flowers. The mounds of spiny *Astragali* were over, but *Stachys citrina*, together with a new alpine *Nepeta* (14329) and a big *Senecio* (14331) with dark entire leaves, was still in bloom on the limestone rocks. This very beautiful *Stachys*, originally discovered by HELDREICH, is 6 inches tall with soft grey oblong leaves; the flowers, borne in big oval heads, are bright lemon-yellow—a rare colour in the genus. From the peak (8,600 feet) we descended steeply north-westwards to a tiny lake lying at the foot of northerly cliffs; there the flora was rich and late. *Lamium striatum* glowed purple among the stones, together with an unidentified *Euphorbia* (14349) and the Parsley-leaved *Scrophularia myriophylla*. *Ajuga chia* var. *latiloba* still produced its bright yellow flowers faintly peppered with red. The big golden heads of a *Doronicum* (14381) shone out boldly against the cliffs, and *Silene Oreades* (another of HELDREICH's discoveries) formed mossy mats in the crevices, giving a lavish supply of white, purple-backed flowers on dwarf and slender stems. As evening drew on, we made our way across the north flank of the mountain, where snow lies all the summer at the foot of a disappointingly barren precipice, to Siricek Yaylâ near which we had camped the previous night.

Having bought a goat from the shepherds, we paused for a day's rest. The animal was roasted on a spit, and we royally feasted the guides and ourselves. Thus fortified, we decided not to climb Geyik Dağ by its apparently barren south flank, but to tackle it from the West which entailed a very profitable detour through the Han Boğaz forest in the upper part of the Uğuz valley. Our way lay along the north foot of Ak Dağ, and I was interested to see in the narrow plains that separate this mountain from Geyik Dağ some colossal holes like bomb craters. It appears that these, which may be 60 feet across and as much in depth, are due to the sudden collapse of the folded limestone rock into caverns beneath.

Gradually descending westwards we soon came in sight of the upper limits of a sparse Cedar forest (*C. libani* subsp. *stenocoma*) at 6,000 feet. Here, in gravel of the dry stream beds, we found *Thymus cilicicus* in flower and seed; it is a very showy species that should be a great acquisition to the rock-garden, for it makes neat little bushes, the branches of which root at the nodes and produce an immense profusion of erect 3-inch stems bearing heads, conspicuously bracted, of violet flowers. Turning northwards, we dropped into a most luxuriant forest of *Abies cilicica*. This Silver Fir was here the dominant tree on the cool north slopes, occasionally parasitised by Mistletoe (*Viscum album*), but young trees of the Cedar were scattered throughout and dominated the drier south slopes across the valley. Thanks to a sparse population, the forests of Turkey are marvellously preserved compared with those of other Mediterranean countries. We could not find, however, a single Fir-cone, though a fortnight later I was to see *Abies Nordmanniana* * fruiting abundantly on Bithynian Olympus. Last year (1948) *A. Pinsapo* seemed entirely barren in Spain, though there had been a bumper crop of cones the previous season.

I climbed to some shady rocks in the *Abies* forest and saw the very lovely sight of *Euonymus latifolius* in ripe fruit. The oval-leaved bushes of this Spindle, 8 to 10 feet tall, were hung with widely winged fruits an inch across, of a clear rose, that trembled above one on stalks as long as a Cherry's. It should certainly be planted where one can look up at its laden branches. The skeleton of a Fritillary (*F. acmopetala*?) grew in the humus of the rocky slopes, and a great variety of other plants: an erect green-leaved *Helichrysum* (14707) with golden heads, a purple *Lactuca* (14692), and species of *Delphinium*, *Cerinthe*, *Linaria*, *Verbascum* and many more. A new and very woolly *Origanum* Sect. *Majorana* (14720) bloomed in the more open places—the fifth new species found in this genus on our Turkish journey.

We crossed the Uğuz valley at a little below 5,000 feet, having no time to explore further its richly forested slopes. We passed on to the west flank of Geyik Dağ where, in dry open places, the grey-leaved, ivory-headed *Carlina oligocephala* was in bloom. Passing several men wearing voluminous veils, we were scarcely surprised to find a large apiary at the head of the valley. We struggled on up the mountainside in the dusk to Kara Boynuz Yaylâ where a pink but rather parsimonious *Colchicum* (14540) was already in bloom. August 31 found us early on the windy saddle west of Geyik Dağ; a small perennial *Campanula* was found in the rocks. Passing an albino shepherd boy who was leading, with the aid of the eeriest whistle, four black goats across the ridge, we began the steep ascent. The vegetation did not differ fundamentally from that of the Ak Dağ we had climbed three days before, but, being somewhat higher (though not so high as some maps would have one believe) there were several attractive species we had not seen before. The most characteristic plant of this limestone mountain was *Vicia gregaria*, an erect purple Vetch which dominated large areas above 7,200 feet, just as *V. canescens* does in the high Lebanon. The shepherds say it is a common plant in the alpine regions of the Isaurian Taurus. *Campanula cymbalaria* was still blooming in the shady rocks (a frail and glossy little species that repays starvation in the garden), and a big-flowered *Arenaria* (14578) rambled about in the scree by a late snow pocket. *Stachys citrina* was found again, and, on the steep screes near the summit (which probably does not exceed 8,800 feet), I found a few individuals of *Lamium eriocephalum* which BOISSIER considered one of the most beautiful plants in the Taurus. This alpine annual has very

* According to H. Czeczott in Fedde, Repert. Beih. **107,** 257 (1939), *Abies Bornmuelleriana* cannot be specifically distinguished from *A. Nordmanniana*.

minute leaves and marvellously woolly heads, nestling among the stones, from which peer the big hoods of clearest rose. A tiny purple *Allium* (14544) was still in bloom, and so was *Saponaria pulvinaris*. On the summit itself was *Jurinea depressa* with rosettes of simple grey leaves that held in their centre large pink heads of a warm fragrance. The guide knew the species only from this locality, and told us the legend of a lost shepherdess in which the plant played a magical rôle. Its properties are much esteemed by the peasants, and our guide took a large bunch of the plant home to his wife. I did the same for Kew.

Descending the east side of the peak we found the glaucous fat-leaved *Ranunculus brevifolius* still in bloom with another alpine Buttercup (*Ranunculus* 14560). But the most spectacular find was a *Campanula* (14563) which is apparently a variety of *C. compacta* discovered by HELDREICH on Davros Dağ in Pisidia. I had already seen the capsules of this plant on Ak Dağ, growing on the windiest rocky ridges at 7,500 feet, but on Geyik Dağ a single individual had strayed from its companions to lead a lonely existence on a cool slope by a snow patch. Some distance away I could see its big wide stars of intense violet, rather like those of *Campanula Hawkinsiana*. The very deeply divided flowers are borne singly on erect 3-inch stems that rise from a tight wad of narrow little leaves. Seed of this lovely species had already been mostly shed, but, by picking hundreds of capsules vibrating in the cold north wind, a few were obtained for distribution (under *Asyneuma* 14563) and promise good results.

We spent an icy night at Sobüçimen Yaylâ at nearly 7,000 feet, and rode on by way of Haydar Dağ towards Bozkir. Having left the watershed of Geyik Dağ behind us, the hills took on the aspect of steppe, being dominated by *Euphorbia Kotschyana*, *Marrubium micranthum* and spiny *Astragali*. Once we found a very gnarled woody *Polygonum* (14662) and an unindentified *Noaea* (14594). *Potamogeton filiformis*—a species with a decidedly northern distribution—was fished out of a high lake.

The costumes of the women are very beautiful in this part of Anatolia: they wear their hair in many elaborate plaits, and cover the crown with a head-dress of silver discs; others wear dark blue turbans of immense width. Turkish trousers are the rule, often protected at front and back by aprons of scarlet and gold.

The undulating plateau, averaging at least 6,000 feet, is cut by the two Karance valleys (the upper waters of the Göksu of Ermenek) and there, protected from the shrill winds, were sparse relict woodlands of Cedar, Cilician Silver Fir, Black Pine and *Juniperus excelsa*—the latter usually dominant in the parts we crossed, though reduced to windswept scrub at the rim of the valleys. There was an intricate *Gypsophila* (14621) in flower, and it was satisfactory to collect seed of *Phlomis rigida*. This is surely the most handsome herbaceous species in the genus, the stems of 2 or 3 feet bearing brachycephalic golden whorls at least 3 inches across. The smaller *P. linearis* var. *plumosa* was also found in this district. It was disappointing to have no time to explore the cliffs and forests of the northern Karance valley near the beautiful willow-margined Sau'jak Yaylâ. A striking feature of the landscape were the stone towers, with a platform above, that stood singly upon the hillsides. They resembled enormous dovecotes, but investigation showed that they were beehives built in this manner to prevent the honey from being robbed. Occasionally the tower was replaced by the decapitated trunk of a large Juniper. Finally we descended steeply from the hilly plateau to the large village of Bozkir. A vast unidentified *Echinops* (14581) was found in a cemetery, and there was an indescribably dirty inn. The bus to Konya whirled us through a typical steppe vegetation of the chalk, but with *Juniperus excelsa* forming open woodlands on the harder limestone. Rattling down the gorge it was agonising not to be able to stop: I could see a *Dianthus* and a big *Michauxia* in the cliffs, and the milk-white heads of, it seemed, *Tracheliopsis tubulosa.*

Konya was once the capital of the Seljûk Sulṭans of Rûm. It marked the end of our Taurus journey. There we stayed for three days drying and labelling the collections, and made by taxi a couple of sorties into the neighbouring slightly saline marshes dominated by *Juncus maritimus. Limonium globuliferum* was not uncommon, an eccentric sea-lavender with its flowers in tight heads—not, one must admit, an advantage. Much more attractive was *Celsia pyroliformis* whose graceful yellow racemes rose from leaves surprisingly like a Mertensia's.

Bithynian Olympus lay ahead. We took a bus and bumped, painfully but magnificently, across the wastes of Central Anatolia to Ankara and beyond. The great salt lake, Tuz Gölü, stretched itself in the September sun, glimmered and blinked farewell.

A NEW DIGITALIS (*D. Davisiana*) FROM SOUTHERN ANATOLIA

V. H. Heywood

Digitalis Davisiana Heywood, sp. nov.

Ex affinitate *Digitalis ambiguae* Murray a qua foliis coriaceis angustioribus, inflorescentia plerumque ramosa, laciniis calycis obtusis vel obtusiusculis, laciniis corollae lateralibus semper obtusissimis inter alia discrepat.

Species glaberrima radice perenni; a basi indurato caules numerosi ad 50 cm. alti ascendentes foliati parce pilosi sed rachis inflorescentiae glanduloso-pubescens; folia coriacea lucida in utraque pagina glaberrima sparse glandulosa, margine crassiuscula cartilaginiuscula remote et minute argutiserrata (raro subintegra); folia basilaria ignota, inferiora lanceolata, ad basin sensim attenuata, superiora lineari-lanceolata, longe acuta, sessilia semiamplexicaulia superne diminuta; flores magni in racemo laxiusculo plerumque inferne ramoso, pedicellis glandulosis calyce longioribus praesertim post anthesin apice incrassatis suffulti; bracteae inferiores lanceolatae acutae pedicellos aequantes, superiores minutae pedicellis multo minores; calycis segmenta elliptica obtusa vel obtusiuscula dense glanduloso-pubescentia; corolla magna, ventricosa, sensim ampliata extus pubescens 3.5 cm. longa flavescens, intus fusco-aurantiaco-reticulata; labium superius abrupte truncatum vix emarginatum; labium inferius laciniis lateralibus rotundis ad

3–4 mm. prominulis atque lobulis minutis ad basin praeditis, lacinia intermedia 6–7 mm. longa deltoidea obscure trilobata apice obtusa fimbriata lateralibus duplo latiore et longiore atque lobulis minutis ad basin praedita; stylus glaber ovario quadruplo longior; capsula ovata vel oblongo-ovata acuminata dense glandulosa puberula reticulato-venosa; semina fulva, leviter curvata, testa valde reticulata et foveolata.

Floret Jun.–Jul. (Aug.).

Anatolia: Prov. Antalya (Isauria): Kargi çay between Durbanas and the Derence dere (N. of Alanya), c. 1,000 m., in Black Pine forest, flowers pale yellow netted inside with orange-brown, perennial, Aug. 24, 1947, P. H. Davis 14401 = TYPUS IN HERB. KEW.; between Kargi çay and Belister, Aug. 26, 1947, P. H. Davis 14324.

The discovery of this attractive yellow-flowered species is of considerable importance to our knowledge of the genus *Digitalis*. It is most nearly related to *D. ambigua* Murray, a species with a wide extension in W. Europe, stretching eastwards through the Balkans and N. Caucasus to the Urals and Russian Altai, but not occurring in Anatolia unless the record given by BOISSIER in his Flora Orientalis—Bithynian Olympus—is accepted. This record is dubious as no other collection from this locality has been traced.

D. Davisiana resembles *D. ambigua* Murray but differs in its more indurated slender habit, narrower leaves of stiff leathery texture, and branched inflorescence; the flowers are similar to those of *D. ambigua* Murray in size and colour, differing in the obtuse calyx segments, the deltoid obtuse median lobe and the rounded lateral lobes of the lower corolla-lip, each lobe being provided with two tiny lobuli at the base. The new species is also related to *D. ciliata* Trautv., a species with a circumscribed distribution, being endemic to the alpine and subalpine regions of the Caucasus. It is easily distinguished from *D. Davisiana* by its more deeply serrate papery leaves, unbranched raceme, non-glandular rachis, smaller corolla and glabrous calyx.

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THE TAURUS REVISITED, 1949

P. H. Davis

I HAD come to continue the work begun on my earlier journey in the Lycian Taurus of Turkey in 1947. It was July 7, 1949, when we left Kemer for the mountains. Ill-luck dogged us on Tahtali Dağ. The pack-animals proved unusually refractory, the guides and horsemen ineffectual. My zoologist friend, DR. MALCOLM BURR, developed ptomaine poisoning which, complicated by accumulating disorders, forced him to beat a painful, but wise, retreat. I was left with Kâmil Bilger, cheerful veteran of my first visit to the same mountain, the indefatigable A. Attila, and an excellent soldier as escort. As I recorded our plant discoveries of Tahtali Dağ in an earlier number of the JOURNAL*, I will do no more than write of features that I did not stress before. On the present occasion we were climbing the mountain five weeks earlier in the year, so that the flora would normally have been better developed than on my journey of 1947. But the winter had been exceptionally severe, the spring unusually dry; as a result, the Mediterranean vegetation was more desiccated than I have ever seen it; though *Vitex agnus-castus* bloomed freely as a Buddleia on the coastal plain, *Arbutus Unedo* was dropping its leaves. *Globularia Davisiana*, which in 1947 was discovered in flower in the great gorge, on my second visit showed no intention of blooming. Seed was obtained of the excessively rare *Phlomis*

* *Journ. Roy. Hort. Soc.* **74** (4), 1949. In the present account, as in the earlier one, I have placed my herbarium numbers in parenthesis after species that are unnamed or provisionally determined. Both expeditions were generously supported by the Society.

chimerae, but none of that wonderful new species of Echinops (Fig. 34) whose great jade globes up to 5 inches across had so impressed me on my first visit to Lycia; it, too, had failed to flower.

Above the Cedar zone (*Cedrus libani* subsp. *stenocoma*) the state of the vegetation improved. An undescribed *Alkanna* (15059) was flowering among the stones, its dark blue corollas glinting among the narrow ashen leaves. The remarkable new Crucifer (an undescribed species of *Ricotia*) that before had been found in fruit, was now a mass of ample rosy crosses on northerly stone-slides; its trifoliate glaucous leaves arise from centrifugal runners—a habit which it repeats (if carefully tended) on an English scree. *Salvia caespitosa* produced its big tubby flowers of a light lilac, stemless over grey mats of neat pinnate foliage; seed of this beautiful plant was obtained later. By the last pockets of snow a small blue Scilla (15043) was still in flower, while, on the summit ridge at 7,500 feet, Attila picked the diminutive *Viola crassifolia* whose puckered lavender flowers are as small as its fat round leaves, less than a quarter of an inch across. Another alpine plant that I saw in flower for the first time was *Lamium cymbalariifolium*. This should certainly be a treasure for the rock-garden. The flowers, of a fine clear pink, are over an inch long, and hover upright above metallically lustred leaves that are very much smaller. The plant rambles about in the high limestone screes of Lycia. A few seeds ripened in the press, and it is hoped that the plant will become established in cultivation.

After DR. BURR's illness had forced him to leave us, we moved on northwards to Çalbali (Bereket) Dağ—though not before a large black scorpion had emerged from a flower press in an all but successful attempt to add to the casualties. We passed through forests of *Pinus Brutia*, and macchie where a Paeonia (15199: probably a form of *P. mascula*) was found. Beneath the Pines grew *Salvia grandiflora* and the pale sulphurous whorls of *S. potentillifolia*, while under the Cedars which replace the Pines at 4,000 feet were scattered the dingy ivory spikes of *Digitalis cariensis*. Where the woods had been cleared, the large-flowered, biennial *Verbascum glomeratum* stood by the thousand in a splendour of silver and gold; in rocky places the new *Verbascum Davisianum* was found. In this region *Dorystaechas hastata*, a monotypic Labiate genus with grey leaves like a Salvia and spikes of small white flowers, was abundant on rocky slopes.

The weather was against us. Not having rained since mid-winter, it decided to do so to mark our visit. Clouds, that for the last few days had gathered on the higher peaks, grew, took on the purplish brown of an ugly bruise, and descended. The peasants, whose crops had been shrivelling up, treated us as benevolent conjurors. Collecting was difficult in the steady downpour, as we had come poorly prepared for such an unreasonable assault. It was impossible to climb quite to the summit of Çalbali Dağ, but we got very near it before a bombardment of hailstones made a retreat necessary. Nevertheless, we found some wonderful plants on a north precipice at 7,000 feet. I shall never forget *Verbascum Pestalozzae*, originally discovered "in Lycia" but almost certainly collected on this very peak which had previously been botanized only by DR. PESTALOZZA over a century ago. It is a woody-based, caespitose perennial forming a greyish dome of oval, 2-inch, star-haired leaves like those of a shrubby Phlomis; over these stand, in immense profusion, 4-inch racemes whose yellow corollas are so much larger than those of *V. spinosum* that one is bound to acknowledge PESTALOZZA's Mullein as the houri of the genus. Growing in the same cliff was another of the doctor's discoveries: *Minuartia Pestalozzae*; this plant forms glossy green hummocks of wide flat needles, and resembles nothing so much as a white-flowered Acantholimon—a most desirable development in a genus of absolute frights. Here, too, were *Myosotis olympica* var. *laxiflora*, a neat 2-inch *Aethionema* (15277) with clear pink flowers, and a *Senecio* (15273) aping *Doronicum*. On the surrounding slopes were the great thorny domes of *Onobrychis cornuta* covered with pea-flowers of deep purple—a species that seems amenable to cultivation and, unlike *Erinacea Anthyllis* (which it resembles in habit), has not shown itself temperamental in the matter of flowering. Lower down (5,300 feet), the white rays and very conferted foliage of *Pyrethrum praeteritum* dominated the mountainsides.

It is remarkable how different the flora of Çalbali Dağ is from that of Tahtali Dağ which is only 20 miles distant; the proximity of the latter to the sea is probably connected with the difference. But the whole region supports a large proportion of relicts, and we were to find two more on our gradual descent to Antalya: an undescribed *Rubia* (15369) with triangular glaucous leaves and a new *Helichrysum* (15429). The latter, related to rare Ægean types, hung out of a limestone precipice in great woolly mounds of blunt oval leaves, and bore corymbs of golden tintinnabulous capitula. Only a 10-foot bamboo with a small saw attached (my inseparable companion on Mediterranean cliffs) was able to secure it for the press. The goats had dealt with anything more accessible.

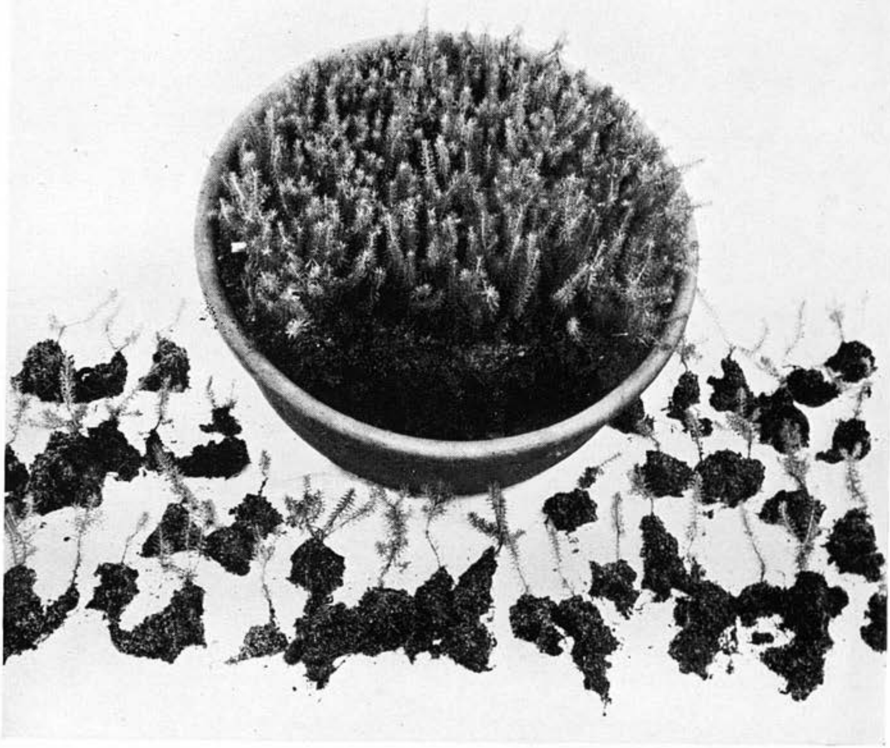
After a ten-day tramp we were back in Antalya, still bathed in sunshine while clouds clung resentfully to the peaks. I was sorry to have to part with the soldier. He was an amiable cheerful soul who, when not confiscating shepherds' knives that exceeded the permitted length (10 cm.), proved most useful, not only in Spreading Awe, but also in catching grasshoppers new to the collection I was making for the British Museum. He would, at the end of the day, extract some formidable monsters from the pouches of his cartridge belt, all of which I lovingly stuffed with cotton-wool. The shepherds came from miles around to watch the operation.

On my previous expedition I had gazed from Antalya north-eastwards to the fine peak of Bozburun Dağ rising out of the Pisidian plains. In 1949 I was able to visit it, and other mountains beyond as far as the lake of Beyeşhir. The journey, covering 150 miles of difficult country that had not been previously botanized, took 15 days. Because of the unusually dry season, there was very little pasturage; nor had the harvest been gathered in this mountainous region. Consequently it was exceedingly difficult to feed the horses, and we were forced to change our guides and animals four times on a journey that would have been hard enough at any time. With all these difficulties Kâmil most patiently and competently coped, despite considerable pain from a septic arm. It would, I believe, be hard to find a region in Turkey that offers more natural obstacles to travel.

Taking our first relay of wizened pack-horses from the village of Gebiz, we set off to climb Bozburun Dağ from the North. The river-valley we ascended (Sinni Çay) contained many trees of *Liquidambar orientalis*, providing a new record of this remarkable relict some 150 miles east of its centre in S. Caria. *Periploca graeca* clambered over blossoming Oleanders, and hung out its curious horned fruits that are partially joined together like Siamese twins. Ascending into the zone of *Pinus nigra* subsp. *Pallasiana*, we found drifts of *Sideritis erythrantha* colonizing screes that crossed the forest; its whorls of deep violet flowers and wide grey leaves were most attractive. Woodcutters with whom we spent the night dwelt in the forest. The costumes of the women are particularly gorgeous: flounced skirts of scarlet and yellow, indigo turbans, and ornaments of gold. These people live entirely by their trade, and do not keep flocks or cultivate; they are relatively well-off, handsome and very hospitable. I found them the most likeable of the peasantry we came across in a country where nearly all are kindly (though often obstinate and lazy) and honest as the day.

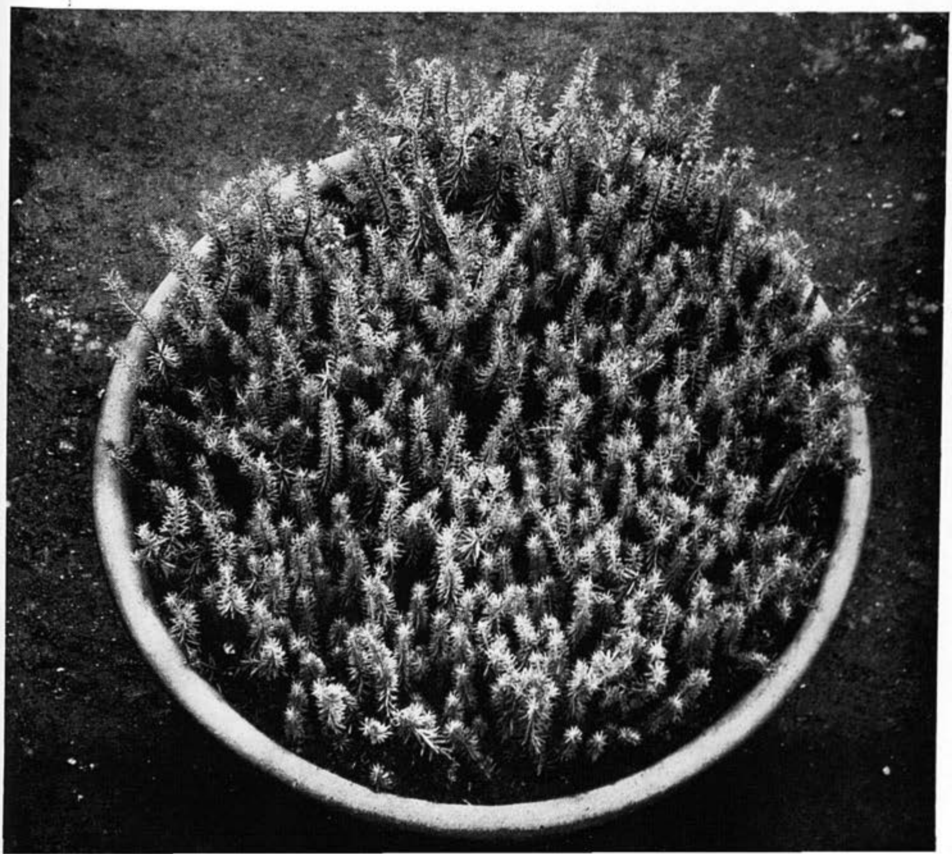
We finally pitched camp at Tozlu Çukur Yaylâ at 6,000 feet. Above the summit-ridge, in precipices of calcareous conglomerate weathered into curious shapes like the limbs of giants (Fig. 31), was a great variety of alpine plants. The raspberry-pink flowers of *Silene Echinus* were scattered singly over its hummocks of unkind glandular needles—a late-blooming species whose seed I have since been able to obtain. On the slopes *Daphne oleoides*, with wax-white tubes, grew abundantly with species of spiny *Astragalus* in purple and white. *Pterocephalus Pinardi* spread mats of cut grey leaves, and covered them with Scabious-heads of a fluffy pinkness. In suitable nooks, the north conglomerate cliffs were pointed by *Omphalodes Luciliae* (Fig. 35), its wide-eyed flowers of powder-blue perfectly foiled by the glaucous leaves. In the same cliff grew a charming new species of *Hypericum* (15580); it formed a neat shrub a few inches high, covered by small corymbs of soft yellow flowers and bearing its little oval leaves in whorls of three—an unusual arrangement for a St. John's Wort. Woody, white-flowered species of *Anthemis* (15610) and *Potentilla* (15588), and violet-filigreed *Campanula cymbalaria* were among the other inhabitants of those conglomerate cliffs. Hiding under overhanging boulders were the pink attenuated flowers of the diminutive *Valeriana oligantha;* it had to be winkled out. Higher up the mountain the minute *Muscari pulchellum* (15664) and an *Ornithogalum* (15647) were still flowering where the snow had recently gone. *Scutellaria orientalis* subsp. *alpina* (15646) was abundant and most attractive, its inch-long hoods of bright yellow scattered profusely over tiny, oak-like leaves; in this region the bracts were reddish and somewhat toothed. The genus *Scutellaria* produces some very spectacular yellow-flowered species in the Orient, but as many of these are inhabitants of the dry mountainous steppes further to the East they may be found temperamental in cultivation.

The summit itself proved impossible to climb from the north side, and we descended to Taşli Yaylâ for the night. There, where compact



HARDY HEATHS

Figs. 29, 30—Propagation of Hardy Heaths from cuttings. Cuttings were inserted the second week in July. No. in pan 432, diameter 14 inches; depth 5 inches (See p. 50)



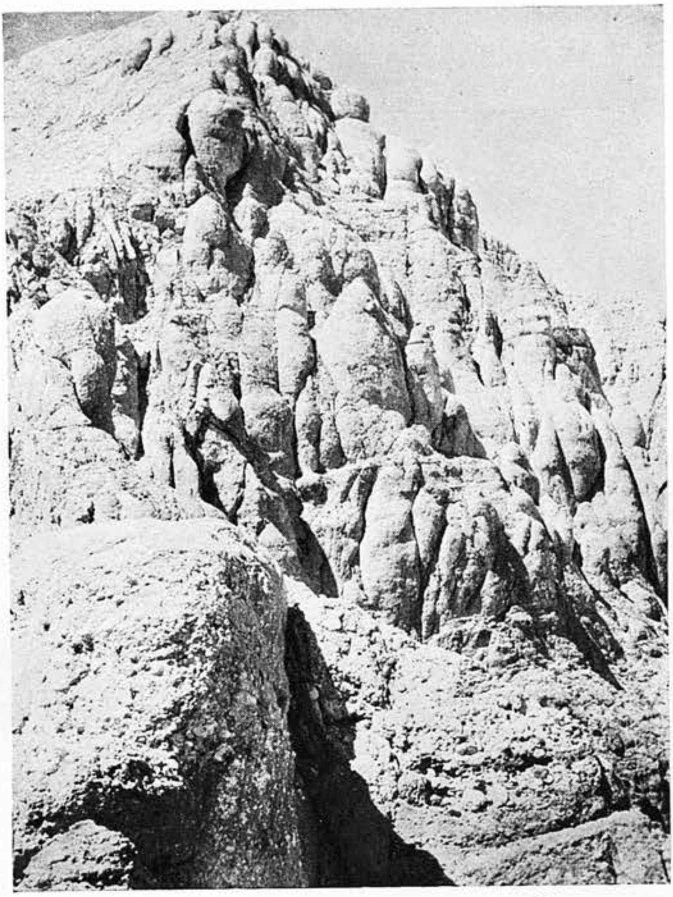


Fig. 31—The conglomerate cliffs of Bozburun Dağ, 7,000 feet (See p. 57)

Photos, P. H. Davis

Fig. 32—The summit of Dedegöl Dağ (9,000 feet), with Bozburun Dağ in the distance (See p. 59)

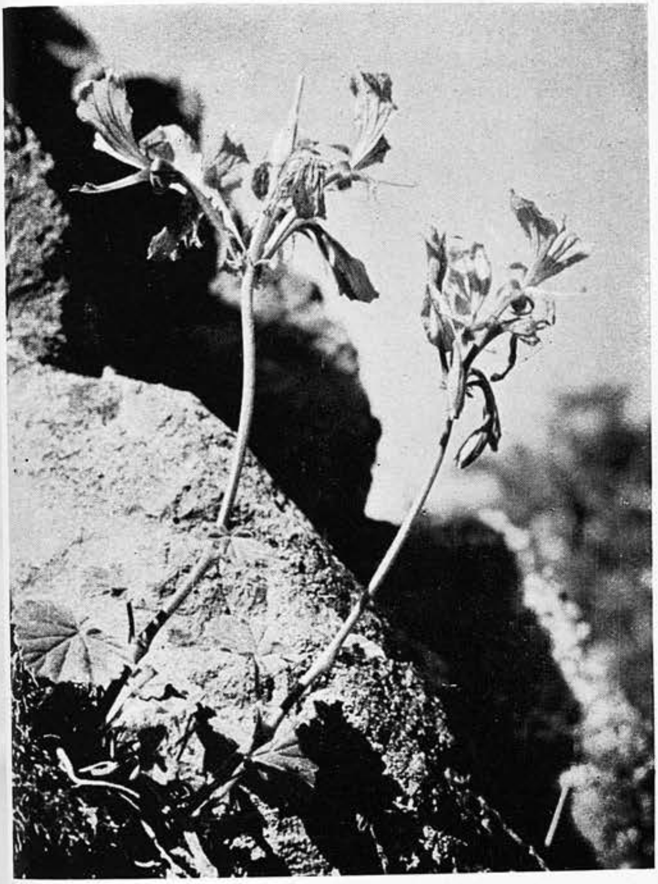


Fig. 33—*Pelargonium Endlicherianum* on metamorphic rock, Dedegöl Dağ, 4,000 feet (See p. 58)

THE TAURUS REVISITED, 1949

Fig. 34 — Echinops sp. (Davis 36511) in Lycia, 5,000 feet (See p. 55)

Photos, P. H. Davis

Photo, P. H. Davis

THE TAURUS REVISITED, 1949

Fig. 35—*Omphalodes Luciliae* in Pisidia, 7,500 feet (See p. 57)

NOTES FROM FELLOWS

Fig. 36—*Eucomis punctata* (See p. 63)

limestone replaces conglomerate, I was excited to find a new *Omphalodes* (15680) related to *O. Luciliae*—a species that has hitherto stood without any near relatives. It grew in rock-cracks at the mouths of caverns, and differed from its sister species in its more robust habit, broader calyx, white flowers and fimbriated nutlets; a packet of the latter have led to its introduction. Near by, *Geranium glaberrimum* (15770) grew in the rocks, a rare species with glossy leaves and large flowers of a good reddish purple.

Travelling northwards, we made our way down the Kozlu Dere, a wooded though dry ravine filled with native species of Almond, Plum, Pear, Maple and Ash. Then, crossing the shoulder of Sarp Dağ where that wonderful alpine butterfly, *Parnassius Apollo*, was on the wing, we came to an area of metamorphic rock. There was a handsome new shrubby *Phlomis* (15872) with bicoloured flowers and leaves showing a white, frost-like margin, and the pink hop-like heads of *Origanum saccatum* which I had previously discovered in Isauria. In the woods were a Hazel (15873) and *Cornus mas*. At last we reached the village of Selköşe; there we spent a day tending our presses while arrangements were made to find horses and guides more efficient than the riff-raff we had endured on Bozburun Dağ.

From Selköşe it is a stiff climb through Black Pine forests, scarred by avalanches, up the southern slopes of Dedegöl Dağ, a peak of over 9,000 feet locally notorious for its windy weather. On a metamorphic rock at 4,000 feet *Pelargonium Endlicherianum* (Fig. 33) hung out its fierce magenta flags; and a *Sempervivum* was found—I believe the first Houseleek to be discovered in the Taurus. Above 4,500 feet the metamorphic substrate, supporting the primrose-yellow *Scutellaria salviifolia*, gave way to the limestone of the higher parts of the mountain. We camped at Oruz Gaz Yaylâ (5,500 feet), and found some attractive plants on its northerly limestone cliffs: species of *Pyrethrum* (15932), *Aubrietia* (15932) and *Iberis* (15939) sprung from the crevices; an unidentified *Ribes* (15938), whose gnarled branches were pressed back against the rock, bore tiny glossy leaves and a mass of little orange-gold currants that will, I hope, give rise to the same decoration in our rock-gardens. *Nepeta cilicia*, with violet tubes over an inch long, was still in bloom.

The ascent of the peak, taking two more days, was so steep that only the three strongest pack-horses could stagger up the pass in a wind that, blowing from Central Anatolia, ladled clouds over the ridge like an angry cook. The rest of the caravan (for by this time our baggage, swelled by large collections of pressed specimens, necessitated 7 horses hired for £1 a day each) was sent to Hoyran to await us. The precipitous south screes were not as bare as they had looked from a distance. The handsome lemon-yellow heads of *Stachys citrina* and a prostrate *Hypericum* (15957) contrasted with the profuse violet flowers of *Thymus hirsutus* var. *ciliato-pubescens*. An unusual Crucifer, *Anchonium elichrysifolium*, with clumps of grey, strap-shaped leaves and racemes of heavily fragrant, yellow flowers, was scattered about, much grazed. Another Crucifer has been recognized as a new perennial species of lilac-flowered *Ricotia* (16000). In the rocks on top of the pass were the stone-hard spheres of *Saxifraga Kotschyi*. But the wind caught us in its full, cold violence, and sent us plunging down the north slope to the comparative shelter of a cirque. Dedegöl Dağ, being far from the sea and under the direct influence of the plateau climate, develops its flora late: many species were in full flower that we had found seeding on Bozburun Dağ. On the whole, however, the floras are strikingly different. We spent the night at a *Yürük* encampment at 6,800 feet, and, with an excellent young guide, reached the summit on August 3 (Fig. 32). On the way up there is a tarn where obvious traces of local glaciation are to be seen—evidence of the severity of this mountain's climate during the Pleistocene Period, and no doubt partly responsible for a well-developed northern element in its flora. Here were *Erigeron alpinus*, a form of the big, violet-rayed *Aster alpinus*, and the furry, milk-eyed *Androsace villosa* var. *congesta*. An extremely dense and glandular Mossy Saxifrage (16024) grew in shady precipices with *Omphalodes Luciliae*. The windiest ridges supported *Campanula compacta*, a delightful species with deep violet corollas borne singly and divided nearly to the base into lanceolate lobes. In the screes were the sessile heads of the annual *Lamium eriocephalum*, the rosy flowers peeking out of excessively woolly-white calyces. There was also an alpine Polygala (16036) with relatively large, dove-grey flowers almost invisible among the stones, and the exasperating beauty of *Pisum formosum*. The last has never been in cultivation, nor does its late-flowering habit make seed-collecting easy. The large flowers, poised like butterflies above the shingle and the round, fat, glaucous leaflets, are of the purest carmine.

The going was rough, and, an hour after I had fallen and smashed our only Iodine-pencil, my guide cut open his knee on the rocks. I sent him back to camp where Kâmil did the best he could for him. Next day we made a long descent to Hoyran on the lake of Beyşehir. Striking metamorphic rock again at 6,000 feet, I was pleased to find our native *Asplenium septentrionale*—the first time that I had come across it in the Mediterranean. In screes derived from the same rock was a small perennial *Viola* (16075) with deep yellow flowers—perhaps *V. odontocalycina*. After a battle with shepherd dogs (inevitable in Anatolia), we descended into the Cedar forests where we found one of my earlier discoveries, the yellow-belled *Digitalis Davisiana*.

Marshy ground round the lake at Hoyran provided a striking contrast to the alpine vegetation we had seen for the last few days. Purple Loosestrife, Frogbit and other plants familiar in English ponds and marshes luxuriated. I pressed as many as I could while waiting for the motor-boat to take us across the lake to Beyşehir; from thence we travelled by bus to Konya. There, in the old capital of the Seljûk Sultans of Rum, bad luck came to us once more. Kâmil, who had been in pain for the previous two days, was found to be suffering from appendicitis, and had to be flown in considerable haste to Ankara, where he eventually made a complete recovery.

I had to abandon the idea of obtaining another interpreter, and soon set off by post-bus to Ermenek in the Isaurian Taurus, by way of Karaman. My Turkish was almost non-existent, but somehow the rest of the journey was completed without any very serious hitch. I shall never forget that bus-ride to Ermenek. The road exists in patches between the holes, and descends one valley in hairpin-bends so sharp that it is impossible for the bus to get round them at one attempt. The brakes were uncertain; when the bus-driver stopped and decided to back, his assistant leaped out and flung a stone under the wheel to stop us from tumbling over the cliff.

Ermenek is a charming, rather large village situated in a south-facing bay of mountains at 4,000 feet. Though in the winter cut off by snow from Karaman for nearly 5 months, it is a prosperous spot with not only a plentiful supply of delicious fruit but also its own electric light and a bare, clean "guest-house." When a rich and little-known flora is added to these attractions, it will be seen to provide an excellent base for a botanist. The flora to the North of Ermenek is intermediate between that of the Mediterranean and the steppe, the latter element being favoured by the dry chalky soils that are widespread. Among the many attractive plants of the chalk (mostly seeding in mid-August) were *Salvia Montbretii*, with white linear leaves like those of a *Helichrysum* and woolly whorls of big blue flowers, and two members of the *Boraginaceae*: the golden-tubed *Moltkia aurea*, and *Paracaryum angustifolium* which carries cyathia of deep blue flowers larger than those of any garden Forget-me-not. Attractive endemics were the glaucous-leaved and purple-spiked *Origanum leptocladum*, and *Verbascum isauricum* with violet stamens.

Despite the dangers of the ride, I was anxious to collect in the Kamiş Deresi through which I had passed in the dusk on that hazardous bus-trip. I hired a local lorry for the purpose, and found the ravine full of interesting plants. The most striking feature was a plant-association probably confined to the mouths of innumerable caverns that line the gorges in this region. This community included the large bicoloured *Erodium pelargoniflorum* and *Campanula leucoclada* (both discovered near Ermenek by HELDREICH in 1845); the latter springs from the most minute cracks, forming neat clumps of inch-wide leaves like those of a diminutive *Antirrhinum Asarina* but of a crisp, lettuce-like texture; the flowers are slender, milk-white tubes borne in a row on little arching stems. In the same caves grew the tufted *Valeriana speluncaria*, and new species of *Euphorbia* (16161) and *Teucrium* (16181). I also visited Oyuklu Dağ above Kamiş Deresi, but found less of interest for the garden. The violet sprays of *Lactuca brevirostrata*, however, were not to be sneezed at; more attractive was *Pyrethrum flabellifolium*, bearing, above spathulate silver leaves, yellow corymbs carried on stems a little too tall, perhaps, when seen away from their native cliffs.

Back at Ermenek, I was able to gather together a very efficient team of men and horses, and, plentifully supplied with wine, fruit, cheese and live chickens, set off southwards to cross the Taurus to Anamur. We forded the sweltering valley of the Göksu, where a horse loaded with flower-presses lay down in the river, and plodded up to the hamlet of Sarivadi; there I was able to meet the charming young *Kaymakam* of Ermenek who was then touring the district with his wife. He was one of those rare individuals—a Turkish official who spoke English. After feasting with him in the *muhtar's* house, I retired early and at sunrise was on my way up the ravine known as the Hamitseydi Boğaz. This is filled with a forest of *Abies cilicica* (seen also on the spurs of Oyuklu Dağ), and held some fine rock-plants on its limestone outcrops. The *Campanulaceae* were represented by three species: the monocarpic *Michauxia Tchihatcheffii* which produces hispid spikes of deeply cut, 8-lobed flowers, an unidentified dwarf *Campanula* (16243), and a new *Tracheliopsis* (16244) closely related to *T. tubulosa*, with slender flowers of a very pale blue. New Labiates were much in evidence, and included a *Calamintha* (16225) smelling strongly of Pineapple, a sulphur-flowered *Nepeta* (16275), and two *Salviae*; one of these Sages (16247) was an attractive shrubby species with trifoliate leaves and compact heads of lilac hoods. The great thrill for the garden, however, was *Macrotomia* (*Arnebia*) *cephalotes*, a paragon in the *Boraginaceae*. It was abundant on low sunny rocks near the shepherd encampment of Beşkuyu ("Five Wells"), though the dryness of the season had caused it to bloom very poorly; it was disheartening to see the countless dead stems of the previous year's flowering. The plant has a woody rootstock that produces a deep violet dye like that of *Alkanna tinctoria*. The narrow pointed leaves are covered with densely appressed, silky hair, and the stems, rising stiff and bristly for about a foot, expand into a 5-inch head of long-tubed flowers having a limb as big as a shilling; they are brimstone yellow. I was able to gather enough seed to distribute sparingly to my subscribers, but an effort to obtain more did not bear fruit. I offered, in what proved to be disastrously inadequate Turkish, a considerable sum of money to some young shepherds for every bag of *Macrotomia's* fruiting heads they could bring me that evening to Beşkuyu. Sunset came. I saw, converging upon me from several directions, shadowy figures bowed down, not with paper bags, but well-filled sacks. Bankruptcy or sudden flight seemed the only choice open to me. But I held my ground, incredulous. The sacks were full of the leaves and violet roots of *Macrotomia*. They had collected two seeds! My Turkish dictionary did not contain words suitable for the occasion.

The highest part of the range proved, in mid-August, surprisingly poor in beautiful plants. But there was one notable exception: *Trachelium myrtifolium*. This delightful species was first discovered by HELDREICH near Ermenek, and has never been found elsewhere. In limestone cliffs it forms little mounds 3–4 inches across; the many brittle stems, an inch or two tall, are closely clad in oval hairy leaves, and bear 1–5, half-inch tubes of lavender blue with an included style. At Ermenek, where I also found it, the flowers were white; seed of both colour forms was collected, and the species should be a fitting companion for *Diosphaera asperuloides*. A plant of less beauty but of some peculiarity was an alpine *Erodium* (16304) with flowers the colour of tinned salmon.

The descent to Anamur was rather uneventful, though I was glad to collect seed of the shrubby *Phlomis monocephala* that I had discovered further west in 1947. The severe winter had completely ruined the Banana crop at Anamur. I took a bus to Silifke, on my way eastwards to Mersin. The road would well repay a more leisurely visit, particularly above Gilindere and in the region of Gülnar. Several new species were collected when the bus had a series of heaven-sent breakdowns. One, a remarkable woody *Verbascum* (16353), was actually discovered by torch-light!

I do not propose to write in detail of the rest of my journey. It was to mountains that had previously been fairly well explored botanically, and so late in the summer that the flora was far past its peak. But I should like to mention some of the best plants I found there, particularly those that were introduced to cultivation.

After setting right some little difficulty with the *Vali* of Adana, I was allowed to proceed to (though not to photograph) Dildil Dağ in the north part of the Amanus Mountains. The latter run roughly from N. to S. (*i.e.*, at right-angles to the main Taurus range), have a high rainfall, and are formed predominantly of non-calcareous rocks. Climbing Dildil Dağ from Haruniye, I found *Fagus orientalis*, *Buxus longifolia* and *Carpinus orientalis* the dominant woody plants. On shady, rocky slopes I collected, and sent home by air, rosettes of the relict *Wulfenia orientalis*—a species originally described from this area but never introduced to cultivation. This has now flowered at the Royal Botanic Garden, Edinburgh, and promises to be the best plant in its small genus. The doubly crenate leaves are extremely coriaceous and glossy; the slender violet flowers are almost an inch long and borne in lax racemes. Of the three other species in its genus, *W. orientalis* is most nearly related to *W. Baldacci* of N. Albania, which differs from it in having thin leaves and shorter corollas. Another beautiful plant of Dildil Dağ is *Origanum amanum;* it occurs only on limestone. Incomparably the finest member of Section *Amaracus*, the stems of 4–6 inches bear cordate, ciliate leaves and end in erect heads of large purple bracts; from the latter protrude rosy tubes nearly 1½ inches long. Even *Thymus longiflorus* is not more beautiful than this alpine *Origanum*, which is, unfortunately, so rare and late-flowering that I am doubtful if good seed was obtained. But a plant sent back by air has received an Award of Merit.

Having returned to Mersin, I visited the famous Cilician Gates, and, after obtaining horses at Pozanti, set off for the limestone magnificence of Bulgar Dağ. It was the beginning of September; sharp night-frosts and a cutting wind made camping at 8,000 feet less pleasant than usual. Bulgar Dağ is very heavily grazed, so that the best plants are found only in the steepest places, unless they happen to be unattractive to the goats and camels that graze as high as 10,000 feet in the Taurus. To me the loveliest plant was the endemic *Draba acaulis*. It grows in cliffs above 8,000 feet, and forms aretioid domes as woolly and tight as those of *Raoulia eximia* in New Zealand. The tiny yellow crosses are virtually stemless and, when the plant is growing in full sun, smother the cushion. There was still seed to be had, and it has germinated freely. Another good plant was *Gentiana Boissieri*, a prostrate member in Section *Pneumonanthe* that was flowering in local patches of close turf. I crawled about on all-fours on a dioritic slide, trying to locate the dwarf, blue-flowered *Linum carnosulum*; but it eluded me. And so, excessively weary, I tottered down to the railway at Çiftehan and caught a train to Konya.

On my way to Ankara, I hired a car to visit the salt lake Tuz Gölü. It seldom rains in Central Anatolia, but on that occasion it made up for lost time. It poured for three days. The plain, covered with *Artemisia fragrans* (16639), was turned into a sea of white mud, in which the car alternatively stuck fast and gyrated in leisurely circles. A happy day was spent chugging along the light railway of a salt factory, collecting from the bogie as I went: wonderful wide-winged *Salsolae*, architectural *Ferulae*, and *Reaumuria hypericoides* (16626) with rosy flowers like those of *Boykinia Jamesii*; there were also a salt-loving *Acantholimon*, the remains of a dwarf Iris, and a *Limonium* (16631) with the habit of *Thymus Serpyllum*. The rich halophyte flora of Central Anatolia is full of interest, and very little known.

But it must be admitted that Tuz Gölü, which for years it had been my ambition to visit, on that particular day resembled the North Pole rather than a salt lake. Squalls of icy rain, driving horizontally, slapped me in the face, repeatedly; even leaking gum-boots and a member of the *Tamaricaceae* could scarcely dispel the Arctic illusion. It needed a Turkish bath for that.

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ONCOCYCLUS IRISES IN THE LEVANT

By P. H. DAVIS

DYKES, for convenience, divided the Oncocyclus Irises into two "sets": one of dwarf species from the mountainous districts of North and West Persia, Central and East Asia Minor and Transcaucasia; the other of taller species from Palestine, Syria and Mesopotamia. Further acquaintance with the distribution and phytosociology of the section however, invalidates this division, and a grouping that seems to me more satisfactory is suggested here:

1. *An Irano-Turanian* group composed of species with relatively small flowers which are not conspicuously spotted.
2. *A Mediterranean group* containing larger species with conspicuously spotted flowers.

It should be noted that no clear-cut division can be made in this section: these two groups, based as they are on phytosociology and general appearance, possess intermediate forms.

Only those plants from Lebanon, Syria, Palestine and Transjordan will be specifically considered, and, as the appearance of these is well and intricately described in DINSMORE'S revised edition of POST'S *Flora of Syria, Palestine and Sinai* (1933), I shall mainly concern myself with their ecology and distribution. The specific value of several of DINSMORE'S microspecies is debatable, but while endeavouring to steer a middle course I shall not attempt a critical survey of their taxonomy.

The cultivation of these Irises—and indeed of any plant from the Eastern Mediterranean—may be more successfully attempted if we note here three phytogeographical territories, first recognized in the Levant by EIG (1936). As each of these possesses distinct climate and vegetation, they are of great significance.

(*a*) *The Mediterranean* territory includes the Lebanon, Cis-Jordan (Palestine), West Transjordan and the Jebel Druze (Syria). The rainfall here is the heaviest within our area, and ranges from 500 mm. to at least 1,700 mm. in the Lebanon; the humidity is also relatively high. This region is characterized by such plant communities as *Pinus halepensis* forest, *Quercus coccifera* macchie, and the widespread secondary association of *Poterium spinosum*. Terra-rossa, a heavy red soil derived from hard limestones, predominates.

(b) *The Irano-Turanian* territory receives less rainfall than the Mediterranean (300–500 mm. in Palestine), and a lower summer humidity. It comprises the North and West Syrian Desert, the Near Negeb (South Palestine), a narrow strip on either side of the Jordan Valley, and a belt to the east of the Mediterranean territory in Transjordan (part of the Syrian Desert). It is essentially a *steppe* region in which the *Artemesia herba-alba* association (a community rich in geophytes) is of particular interest to us. This territory also comprises most of Persia and Central and East Anatolia.

(c) *The Saharo-Sindian* territory receives an erratic rainfall less than that of the other regions. It includes the South and Central Syrian Desert, the Lower Jordan Valley, Sinai and the adjacent parts of South Palestine. It supports a sparse *desert* vegetation, or in parts is completely barren.

The rainfall in these territories may occur any time from October to April, complete drought prevailing throughout the summer. In the Lebanon, Antilebanon and higher Jebel Druze snow lies for several months.

All the species noted here are limestone plants unless otherwise stated.

The Irano-Turanian Group

A series of closely related, dark purplish-brown species is found mainly in the regions of steppe vegetation in our area:

I. nigricans Dinsm. is frequent in Moab between the desert and the sown land, being centred in the transitional area between Irano-Turanian and Mediterranean territories. Conspicuous in March, it grows in strong clumps on heavy terra-rossa soils in corn and fallow fields where it is known by the Bedouin as " Farouk's hat." It appears to be very variable under differing ecological conditions.

I. petrana Dinsm. is scarcely distinguishable from the former except by its smaller size and heavy fragrance. It is the southern counterpart of *I. nigricans*, being vicarious with it on the windy steppes of Edom. I have found it under almost desert conditions on chalky soils south of Ma'an.

I. atropurpurea Bak., the only species in this group occurring in Mediterranean territory, is found on lime-free sandy Pleistocene soils in the Plain of Sharon. The special soil conditions of this area support many steppe and desert plants, and there can be little doubt that this microspecies originated quite recently from related Irano-Turanian species. A short-stoloned form occurs on stable dunes at the species' northern extension (Even Yehuda). and Dr. W. Bigger has found there, among the blackish-brown type, a yellow-flowered variety. Forms of *I. atropurpurea* have been described by Dinsmore from the Hauran and Gilead.

An apparently still undescribed species in this dark-flowered series occurs in the north-west Syrian Desert, being long-stoloned and having intensely fragrant flowers with a distinctively shaped yellow beard. I have met with it on the steppes near Qaryatein and Palmyra, growing always in *Artemesia herba-alba* association on soils of both marley and terra-rossa type. Though unnamed, it may be the most widespread Oncocyclus species in our area, the association in which it grows covering thousands of square miles.

Another species occurs on the eastern flanks of the Antilebanon.

I. atrofusca Bak., with purplish-brown flowers and erect foliage, is a rare plant confined, according to Dinsmore, to dry eastern slopes of the Judean hills, where it grows on marley soil.

I. Heylandiana Bois et Reut., reported by that rather unreliable traveller, Canon Tristram, from the plains of the Orontes, has apparently not been seen there again.

Two violet-flowered species, at least in colour very distinct from the above forms, must be included in the Irano-Turanian group:

I. antilibanotica Dinsm., was discovered by Dr. W. A. West in the range from which it takes its name, growing at 2,000 m. above Bludan. The locality it occupies once supported bears and a *Juniperus excelsa* forest, but is now invaded by Irano-Turanian tragacanthic communities of mountain type. This species, which lies under snow for five or six months, is more luxuriant on basalt intrusions than it is on the adjoining slopes of hard limestone. Its bright bicoloured flowers are exceptionally striking, the standards being much lighter violet than the falls.

I. Helenae Barb. (*Mariae* Barb.) is unique in being the only

Photos, Peter Davis.]

FIG. 32.—IRIS NIGRICANS

(See p. 94.)

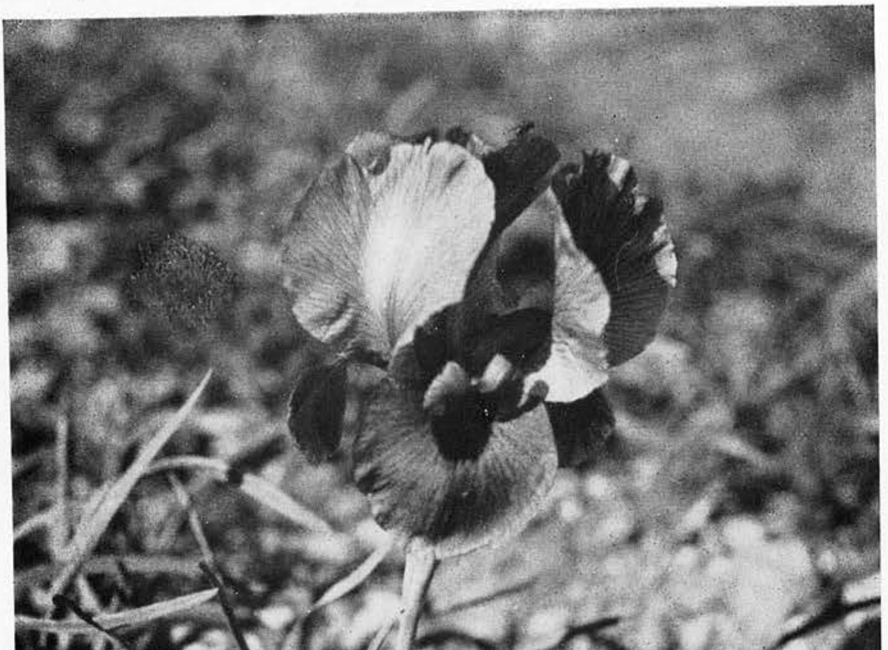

FIG. 33.—IRIS HELENAE
(See p. 94.)

FIG. 34.—IRIS BIGGERI
(See p. 95.)

FIG. 35.—IRIS NAZARENA
(See p. 95.)

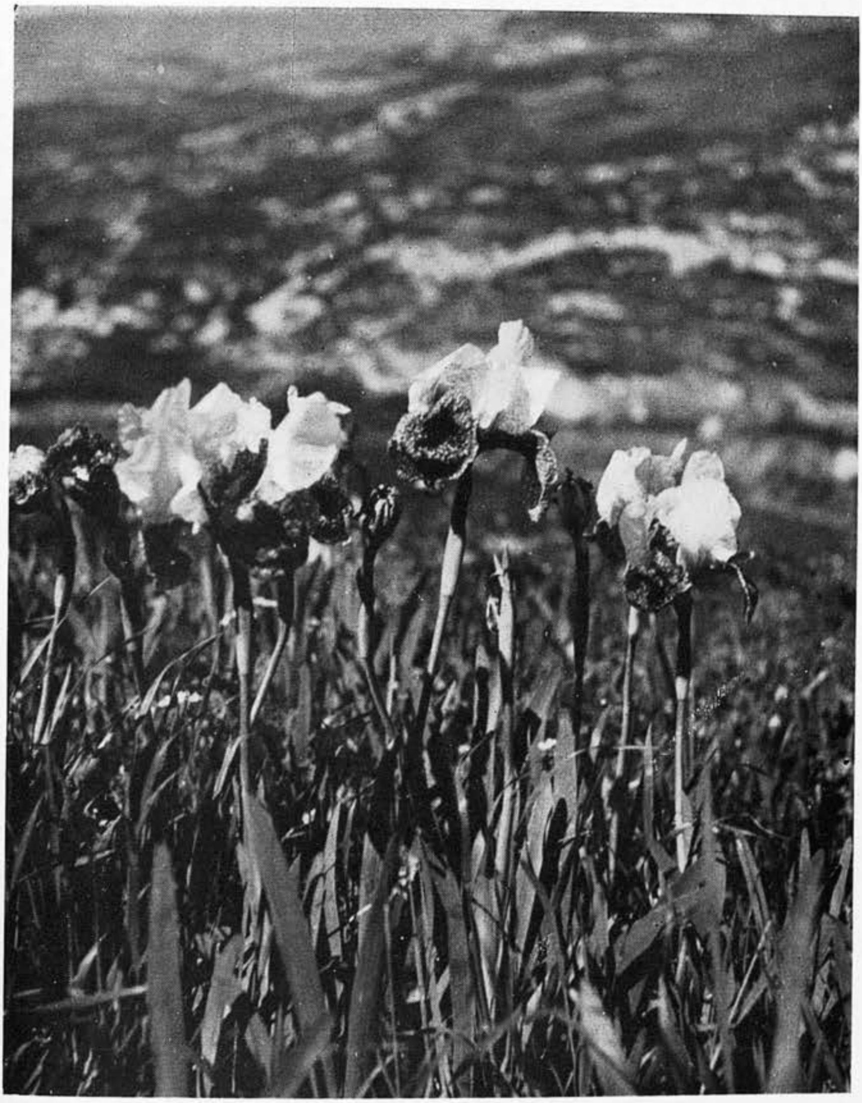

FIG. 36.—IRIS NAZARENA.
(See p. 95.)

Fig. 37.—Iris basaltica
(See p. 96.)

Saharo-Sindian Oncocyclus, and is therefore subject to even drier conditions than the other species. It is confined to sandy soils in South Palestine and the adjacent borders of Sinai, where it is found both on recent dunes and in sandy Barley fields. Owing to its obvious affinities with the Irano-Turanian species, I have, as in the case of *I. atropurpurea*, retained it in this series. It is very dwarf, with rosy-lilac flowers and strongly recurved glaucous foliage.

The Mediterranean Group

Within our area more species have been recognized here than in the Irano-Turanian group, but as the specific rank of several of these is doubtful I shall not deal with them all separately.

I. kasruwana Dinsm., *I. sofarana* Fost. and *I. Westii* Dinsm. comprise a series of microspecies found in the Lebanon between 1,300 and 1,800 m., with big, dusky purple, heavily freckled blooms. They occur in terra-rossa soils in secondary communities, always in sunny exposures and often on stone piles; another has been reported from the Cedars, growing on what was considered by Zumoffen a terminal moraine. All are covered with snow in winter, and for this reason are difficult to flower in Beirut, where the mild winters encourage growth months before it is due to start in the mountains. A yellow-flowered form of *I. sofarana* was found by Dr. West.

I. Biggeri Dinsm., is almost certainly *I. Haynei*, inadequately described by Baker. It is another freckled purple beauty resembling the species just referred to, but is found on Mount Gilboa (Lower Galilee) where it grows on terra-rossa in phrygana of *Poterium spinosum*. Several white-flowered clumps were discovered by Kushnir. In North Gilead an Iris occurs which should probably be referred to *I. Biggeri*.

I. hauranensis Dinsm., was described from Samakh (Lake Tiberias), where it is planted on basalt graves. In 1942, walking up the adjoining valley, I was interested to find this plant wild on ledges of the basalt gorge a little below sea-level; it appeared to have come from the *Quercus ithaburensis* zone above. It might be considered intermediate, both phytogeographically and in appearance, between *I. Biggeri* (which under cultivation it increasingly resembles) and the variable *I. nigricans* aggregate in the Irano-Turanian group. *I. jordana* Dinsm. may well be the same plant.

I. auranitica Dinsm., one of the finest of all, is unique in having fragrant flowers of old and sonorous gold. It is known only from Jebel Druze, where it flowers in May on dusty southerly slopes of Quaternary lava at 1,600 m. Though nominally in the Syrian Desert, Jebel Druze supports a Mediterranean vegetation and has a considerable snowfall.

I. Lortetii Barb. and *I. samariae* Dinsm., are scarcely distinguishable Palestinian species, the former growing on the terra-rossa of Upper Galilee, the latter on the drier and eroded slopes of Mount Ebal. They both have flowers of particularly fine shape and distinctive, smoky, mysteriously rosy hue.

I. nazarena (Foster) Dinsm. is very different from any so far listed in this group on account of the exceptionally large spots on its falls, wide green leaves and long-stoloned habit. The latter characteristic may be related to the difficulty this species has in setting seed. In 1943—admittedly an unfavourable spring—I could find only three capsules on many hundreds of plants, whereas other species were fruiting well. The species grows near Nazareth on red soils in *Poterium phrygana*, but is also found on banks of chalk. The pale lilac standards, handsome above the brown-spotted falls, are easily snapped by wind. Its area in Palestine falls between that of *I. Lortetii* and *I. samariae*.

I. hermona Dinsm., resembling a non-stoloniferous *I. nazarena*, grows on the southern foot-hills of Hermon at 900 m. *I. Bismarkiana*—one of those strangely elusive plants of REGEL—may be identical.

I. basaltica Dinsm., is so like *I. susiana* that Dr. WEST has suggested that the latter is but the cultivated form of *I. basaltica*. The fact that it is found near a Crusader castle, where it is known by the Arabs as *susân*, strongly recommends the theory. It grows on Pleistocene basalts no less black than its heavy, veiled and funerary blooms.

From the above notes it will be seen that these Irises are of remarkably limited distribution. Not only this, but except for one or two species in the Irano-Turanian group they are found exclusively in unstable secondary communities caused by man's interference with the primary vegetation. This shows that the Mediterranean species are unable to compete successfully with higher communities and survive in a state of precarious equilibrium. Their preference for southerly exposures, even in Palestine, and their absence from the coast hills where the summer humidity is higher than in the hinterland, suggest that these plants belong to an even more xerophilous type of vegetation than that which dominates the Mediterranean territory of the Levant at the present day.

This is not the case with the Reticulata section, confined in our area to typical Mediterranean territory. In the Lebanon *I. histrio* is a common plant in the sub-alpine region, but in Palestine it grows only on the cool heights of Upper Galilee where it shares a bed of humus with *Cyclamen coum*. Farther south it is vicarious with *I. Vartani* which, on the deforested hills of Samaria and Judea, is confined to steep northerly exposures. Thus we may assume a southerly extension from the Amanus (where *Bakeriana*, *histrioides* and *histrio* occur), down the West backbone of the Levant, and that this occurred under Mediterranean conditions. The history of the Oncocyclus section is less easily unravelled.

The cytology of the Oncocyclus Irises, so far as it has been investigated by SIMONET (1932, 1934), does not help us to elucidate their distributional problems. Considering their taxonomy, however, we find that morphologically the most distinct species, and therefore the oldest (*paradoxa*, *acutiloba*, *iberica*), are Irano-Turanian plants from Transcaucasia, Armenia and North Persia. One is therefore led to assume that this area—adjacent to that of the Regelia section further east—is the one from which the section spread, for although many species are recognized in the Levant, they are by comparison younger types.

One might, therefore, suggest that the species found in the Levant have originated in the south-westerly expansion of the Irano-Turanian group from their mountainous home south-west of the Caspian, and that these broke up into new forms as they met with a change in ecological conditions. Thus the Mediterranean group probably originated from the Irano-Turanian forms when they reached the Mediterranean territory in the Levant. This differentiation is still in progress.

When the Oncocyclus Irises first penetrated into the Mediterranean territory we may never know for certain, but, judging by the insistence of the Mediterranean species on as dry an exposure as possible, we may assume that they did so during a dry period in the Quaternary—that is, they are of Inter-pluvial or Post-pluvial origin. If they penetrated into Lebanon and Palestine during an Inter-pluvial, the succeeding uncongenial Pluvial period (combined with probable glaciation in the Lebanon) may well have caused gaps in their distribution, followed by further differentiation into microspecies during Post-pluvial times. Though some may be of hybrid origin, it is more likely that the climatic oscillations of the Quaternary, resulting in the isolation of populations, are primarily responsible both for the formation of microspecies and their distribution.

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Fritillaries in the Eastern Mediterranean

By P. H. Davis.

THE Eastern Mediterranean is an area exceptionally rich in Fritillaries, many of which are of very limited distribution. In this article I propose to deal mainly with the ecology of those species which I have seen in their natural habitats, in the hope that it may serve as an aid to their cultivation. We must not, however, expect a faithful imitation of their edaphic environment to be an infallible key to their success in the British climate; it is necessary to consider *why* a plant is found in particular ecological conditions in the Mediterranean, and to use our knowledge so that a balance is struck between soil conditions and the vagaries of an Atlantic climate.

The genus *Fritillaria* is found primarily in hilly or mountainous terrain, where the soil is full of stones and drainage of the sharpest. In Western Iran Bornmuller has recorded as many as nine different species from a mountainous area the size of Yorkshire and dominated by an Irano-Turanian (steppe) climate. But in the countries bordering the Eastern Mediterranean the genus is found chiefly in areas of true Mediterranean climate; comparatively few species occur in the adjacent steppe, and none at all in the desert. Consequently a few remarks on the East Mediterranean climate will not be out of place here. Rain generally falls from October to the end of April, though it may persist longer in the mountains, and is usually heavy and intermittent; the fogs and glooms of England are unknown. The annual rainfall is not less than 50 cm., and in the Lebanon may be as much as 180 cm. on the peaks. Throughout the summer complete drought generally prevails for four or five months, with correspondingly low humidity. Snow lies in winter above 3,000 ft., but below this level frosts are not severe. Nevertheless, although many species grow at low altitudes, the genus is remarkably hardy in Britain.

A plant-community particularly rich in Fritillaries is that of the spiny Burnet, *Poterium spinosum*. This *phrygana* consociation is probably the most widespread secondary community in the Eastern Mediterranean (it does not occur in the West), growing on hillsides up to 3,000 ft., where Oak and Cistus scrub have been destroyed. It is best developed on *terra-rossa*—a heavy red soil containing 10-40 per cent. lime and with a low humus content—derived from hard limestone; in it many characteristic bulbs are found. The Fritillaries which I have seen in the Poterietum are the following Aegean species: *F. macrandra* Baker (*F. rhodokanakis* Orph.) on the island of Hydra—a very beautiful bicoloured species, the squat maroon bells having their inner tepals strikingly tipped with a brassy lustre; (Fig. 37) *F. græca* Boiss. et Sprun.; *F. obliqua* Ker-Gawl.; (Fig. 35) *F. conica* Boiss., an elegant green-funnelled plant from the Peloponnesus that is often two-flowered when the soil is rich and deep; (Fig. 38) *F. Davisii* Turrill, discovered on the Mani peninsula, and related to *F. macrandra* Baker, but with bells of a uniform deep maroon.

In Greece the Burnet *phrygana* occurs also on schists and shales, and it is on these non-calcareous formations that two Cycladean endemics occur: *F. Ehrhartii* Boiss. et Orph. from Andros (there is the larger-flowered var. *Octavii* Gandgr. from Syra); and *F. Tuntasia* Heldr. on Kythnos. The habit and grape-like blooms of the latter resemble those of *F. obliqua* Ker-Gawl in general appearance rather than *F. Ehrhartii* Boiss. et Orph., to which, on account of its undivided style, it is most closely related in the scheme of classification initiated by Boissier. (Fig. 36.)

All the species referred to above prefer, so far as I have seen them, northerly or westerly slopes. Their bulbs grow several inches deep, and are often wedged between stones or pressed beneath them. They do not form clumps, but are scattered singly over the hillsides, propagation being almost entirely by seed. The thorns of the Burnet help to shield the plants against the ravages of goats.

Many Fritillaries occur in woods. On the limestones of West Crete we find *F. messanensis* Raf. not only in the Pine woods at low elevations in the White Mountains, but also in woods of evergreen Oak at 3,000 ft., and in the Cypress forests above them. I have also collected it in East Crete, growing in the *phrygana* of ravines round Toplou, where it is perhaps a relic of former woodland vegetation. *F. sphaciotica* Gandgr. is very likely a synonym for this species, which is known with certainty only from Sicily, Crete and Greece.

In the calcareous *Pinus halepensis* forests of Samos, *F. citrina* Baker (*F. pineticola* O. Schwarz) occurs locally on the slopes of Mt. Kerkis. This is in cultivation under my herbarium number 1659, and, like *F. messanensis* Raf., is a relatively late-blooming species; the seed-pods are conspicuously winged. On the west slopes of the Lebanon, *F. Alfredæ* Post grows in the woods near Brummana—the *locus classicus.* I have only seen it on sandstone in a *Pinus halepensis—Pistacia palæstina* association, but I am told it also occurs on limestone at Aley, growing under *Quercus Aegilops.* It is a very slender green-leaved species with modest greenish funnels powdered with bluish bloom. Another woodland species was collected in the Lebanon: *F. acmopetala* Boiss. (No. 5870). It grows in the marvellous forests of *Abies cilicica* that clothe the sub-alpine slopes of Jebel Akar (limestone), living in deeper shade than any other species I have found. But in Cyprus *F. acmopetala*—with larger flowers than in the Lebanon—fills a few *terra-rossa* corn-fields on the north coast. The species has not been found in the wooded hills above, and it seems possible that in Cyprus the plant has been accidentally introduced from the Lebanon or Anatolia. The only other woodlander I have seen (and then only in fruit) is the familiar *F. imperialis* L.; in south-west Iran it occurs in open calcareous forests of deciduous Oak in the neighbourhood of the Kuh-i-Dinar.

Another series of Fritillaries occupies the higher calcareous screes of Greece and Asia Minor. *F. græca* Boiss. et Sprun. var. *Guicciardii* Boiss. I know from the summit of Mt. Parnes (Attica) where it grows wedged between blocks of limestone; it bears, like the type species, one flower in nature. The dwarf golden-flowered *F. Pinardi* Boiss (perhaps a variety of *F. caucasica* Adam) is found in the windy screes of Baba Dagh in Caria at 6,000 ft. In the Lebanon I have seen *F. crassifolia* Boiss. et Huet at sub-alpine elevations, growing in crevices of limestone rock or in the screes below them. Much handsomer, however, is *F. Olivieri* Baker in the Antilebanon. It must be considered an Irano-Turanian species with its main distributional area in Western Iran. The Syrian form, with big bells of sinister dusky green, has leaves that are glaucous and inordinately fat. It is magnificent when it inhabits deep soils at 7,000 ft., especially those purplish clays derived from basalt. Fritillaries always seem to appreciate a rich soil when they can find it. *F. Olivieri* increases by seed and by bulblets, dozens of the latter surrounding the parent bulb at flowering time. *F. hermontis* Fenzl, which I have not seen, dwells in the draughty gravels that crown the bald summits of Hermon. All these high-altitude Fritillaries are under snow for several months of the year.

On shady ledges of limestone cliffs in the Lebanon and Palestine the tall and many flowered *F. libanotica* Baker is frequently found. It is particularly happy on the humous covered ledges of Mt. Carmel; there it grows with *Lilium candidum* beside the nests of Griffon vultures that dash alarmingly past you as you cling to the rocks. *F. libanotica*, however, by no means insists on these dramatic eeries, and occurs anywhere at low elevations in rocky limestone soil, forming large clumps with many flowering stems. The tepals are usually greenish, thinly veined with brown, but in Cyprus, where I have only seen it in a chalky ravine near Lefkara, the flowers are purplish brown. The shady sandstone gorges of Petra in Transjordan support a very luxuriant wide-leaved form; occasionally individuals occur in which the bracts have aborted, and it seems probable that this was the plant described as *F. arabica* Gandgr.

Darlington's studies on the cytology of the genus give no evidence that tetraploidy has played any part in the speciation of Fritillaries.* All the species investigated, with the exception of a few autotriploid

* Darlington, C. D.—"The External Mechanics of the Chromosomes, III," Proc. Roy. Soc., Series B., No. 823, Vol. 121, p. 290-297.

forms, were found to be diploid. He saw evidence of structural hybridity only in the diploid *F. latifolia*, *F. pontica*, and *F. Elwesii*.

I have found no Fritillary hybrids in nature, but as I have never seen two species growing together, or even vicarious with one another, hybridisation was not to be expected. Dr. W. B. Turrill—to whom I am indebted for the naming of many species referred to in this paper—has said that "the species concept breaks down more or less entirely in this genus."* In cultivation careful hybridisation might prove a useful tool to taxonomists. Boissier's classification of the genus, though convenient, does not always appear a very natural one; several species, remarkably similar in their gross morphology, are widely separated on account of their styles being divided or almost entire. By crossing various species—or attempting to do so—the affinities of some Fritillaries might be more truly ascertained.

The occurrence of so many endemics, each confined to its own island, mountain or promontery, suggests that many species have arisen through geographical isolation, in some cases probably as a result of the foundering of the Aegean land-mass during the Quaternary period. The disjunct distribution of such species as *F. messanensis* Raf., however, indicates a greater antiquity for at least some of the species. Although many are plastic and difficult to separate, a few are taxonomically so distinct that it is hard to believe them of particularly recent origin.

Owing to their rarity and the shortness of their flowering season, Fritillaries are readily overlooked. Further exploration of the Levant—and of Turkey in particular—may lead to the discovery of new species, and certainly add to our knowledge of others.

* Turrill, W. B.—"The Genus Fritillaria in the Balkan Peninsula and Asi Minor." Journ. Roy. Hort. Soc., Vol. 62, part 8 (1937).

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