TAXONOMIC STUDIES
IN THE
GENUS EUPHORBIA L.
by
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INTRODUCTION

The first comprehensive monographic treatment to the genus *Euphorbia* since the time of Linnaeus was published by Boissier in De Candolle's *Prodromus* (1862) where he recognised nearly 700 species. Later, Pax and Hoffmann, in their synopsis of the genus (in *Engl. & Prantl. Nat. Pfl. 2, Aufl. 19c, 209; 1931*) estimated the number as about 1600. Since that time there have been many taxonomic revisions of individual groups mostly from different European and American floristic regions.

Linnaeus (1754), who understood the cyathium as a flower, regarded it as a generic character. The primitive view of the floral nature of the cyathium is now definitely superseded by a generally accepted interpretation that this organ is a condensed partial inflorescence. However, difference of opinion still exists on the details of the cyathium organisation. While workers of the calibre of Boissier and Pax, who made extensive studies into the genus *Euphorbia* throughout its world-wide range, preferred to keep it in its broad sense (Linnaean view) as a large and very various unit, others, notably Haworth (1812), Rafinesque (1838), Klotzsch & Garcke (1860), and more recently Löve & Löve (1961) have segregated *Euphorbia* into smaller genera of various sizes and degrees of homogeneity, basing the distinctions between them on morphological, anatomical and cytological characters (anti-Linnaean view). Although the delimitation between groups like 'Chamaesyce' and 'Tithymalus' itself had its origin from the time of Herbalists, it was Miller (1739) who first started the segregation of genera from *Euphorbia* in the post-Linnaean era. Those
who believe in the Linnaean view regard the cyathium and *Euphorbia*

as more or less synonymous and do not admit the validity of
differences in habit, spine, stipules, etc. whereas these vegetative
characters are claimed by the Anti-Linnaean school as much weightier
than the mere possession of a cyathium, which according to this view
unites species that are supposedly unrelated in degrees of evolution
(viz. members of tribe *Euphorbieae*). Croizat (1937) and others
advocated segregating the Section *Anisophyllum* (Haw.) Roep. ex Duby
as a distinct genus *Chamaesyce* on the peculiar branching habit and
on the character of interpetiolar stipules. In this group, the main
stem aborts above the first pair of leaves while in sect. *Tithymalus*
(Hill) Duby it is terminated by a cyathium - a fact first observed
by Roeper (1824).

The difficulties for taking major decisions about generic
delimitations are too obvious in a revision of the genus in a
restricted area. Following Boissier, *Euphorbia* has been treated here
 provisionally as a genus with wide circumscription, the emphasis of
this revision being on specific delimitation.

**Cytology**

Unlike the other genera of the family, the genus *Euphorbia* is
extremely variable from the stand point of chromosome numbers.
According to Perry (1943), who based his studies on counts of 69
species, the genus could be divided into 6-, 7-, 8-, 9-, and 10-
series with the 8-series as the probable primary line. A secondary
system with 6-, 7-, 9- and 10 lines arose by aneuploid loss or gain
to establish the present day species. The frequency of polyploidy in the genus as a whole is about 40%. A comparison of chromosome number with life duration indicated a higher percentage of perennials among the species other than those belonging to the primary system of n=8, the greatest percentage being found among the species with the highest basic number, the 10-series. Section *Tithymalus* is a very heterogenous group showing a great variability in 2n numbers, basic numbers and chromosome sizes, all of which suggesting, according to Perry the primitiveness of the group.

Moyer (1934) examined the iso-electric points and electrophoretic mobility curves for the latex particles of 21 species of *Euphorbia* and found that these physico-chemical properties were constant and diagnostic for each species provided that healthy material was investigated. Closely related species have latex particles similar and identical in their electrophoretic behaviour and iso-electric points, while members of unrelated taxonomic groups have latex which differs in respect of this quality.

The present revision takes into account the 84 species which occur in Turkey. The following east Aegean islands, being closest and floristically similar to the Mediterranean Turkey, are also included under the area of revision:—

Imroz (Imbros), Lésvos (Lesbos), Chios (Chios), Sámos, Fournoi, Ikaria (Nikaria), Kalimnos (Calino), Kos (Coo), Nísiros, Tilos (Pisopi), Simi, and Rodhos (Rhodes).

The author took the opportunity of visiting Turkey as a botanist with the Oxford University Expedition in the summer of 1960. Two month's collecting in Iycia, the central region of the Anatolian plateau and on the mountains in the western part of the Buxine province has been of considerable help in providing an opportunity to observe the plants in the field and collect additional material.
A longitudinal section passing through the centre of the cyathium of *E. amygdaloides* (about 20 times enlarged)
Individual parts of the cyathium of *E. amygdaloides* (A, B, & C, about 15 times enlarged; D & E, about 8 times enlarged).

A = a cyathial lobe;  B = bracteoles subtending the monandrous flowers;  
C = a cyathial gland;  D = a monandrous flower without bracteoles;  
E = capsule as seen from base upwards.
Plan of a cyathium of a typical Euphorbia (after Eichler, modified)
The terminology used to describe the different parts of the cyathium and the organs associated with it by the previous workers has often been very confusing. In the present work, an attempt has been made to standardise the terms to be applied to various organs of the complex organisation of the 'umbel' and the cyathium.

The so called 'flower' or cyathium which *Euphorbia* shares with at least 7 other genera of the tribe *Euphorbiaceae* is essentially a condensed inflorescence suppressed in a gamophyllous involucre of five bracts. Each bract has its free end (cyathial lobe) on the margin of the involucre and it may be entire, cleft or laciniate. The sinuses of the involucre bear thick sessile or stalked nectariferous glands which vary in number. Although five seems to be the predominant number, four are found almost as frequently. In the latter case, the fifth sinus serves to lodge the reflexed pedicel of the pistillate flower. The glands may be entire or with two to many horns or in some species provided with a petaloid appendage. In Section *Poinsettia* there is only a single enlarged gland without a petaloid wing. Each cyathial lobe subtends a group of monandrous flowers which develop in a centrifugal order. Each monandrous flower is represented by a single stamen joined to a pedicel by an obscure annular articulation. In many species, each staminate flower is borne in the axil of a minute bracteole which may enclose the latter entirely at its base or may appear on two sides of it or be frequently vestigial or absent. When present, the distal end of the bracteole may be entire, dissected or finely plumose and intertwined with the staminate flowers.
The main axis of the condensed inflorescence within the involucre is terminated by an achlamydeous, solitary, centrally situated pistillate flower which protrudes, by means of its long pedicel, beyond the upper level of monandrous flowers. The pistil consists of a usually three carpelled ovary with 1-3 styles and stigmas. There is an entire or more or less 3-lobed hypogynous disc which represents the vestigial perianth. Each loculus in the inner angle has an axile placentation supporting an anatropous descending ovule with ventral raphe and superior exterior micropyle, capped by an obturator.

The cyathia are either situated singly in the pseudo-dichotomies of the vegetative branches (as in E. chamaesyc) or aggregated into false umbels, the primary axes (primary umbellate radii) of which are subtended by a whorl of foliaceous structures, the involucral leaves. Each primary radius of the terminal umbel usually divides once or more in a cymose (pseudo-dichotomous) manner. The bract leaves in the umbel (involucellar leaves) are usually opposite, 2 or 3 being borne at each fork; they may be free or united. The cyathia in the umbels are usually segregated at the tips of ultimate radii and in the terminal or subterminal forks.

MORPHOLOGY OF CYATHIUM

The following summary of the various interpretations relating to the morphology of cyathium and its parts is based on literature, and does not represent the author's original views.

The uncertainty of the relationships of Euphorbia and its allied genera may be largely attributed to the diverse interpretations of the
morphology of the cyathium. The most notable amongst these are, (1) that it is a true flower, polyandrous and hermaphrodite with distinct calyx maintained by Linnaeus (1753), Adanson (1763), Lamarck (1786) and A. de Jussieu (1824); and (2) that it is a complicated androgynous inflorescence in which the pistillate flower is the ovary and the monandrous flowers reduced to stamens which form lateral inflorescences in the axils of peripheral comate bracts. First conceived by R. Brown (1818), and later accepted in basic principles by Rooper (1824), Wydler (1845), A. de Candolle (1866), Warming (1870), Schmitz (1871), Hieronymus (1872), Müller (1872), Čelakovský (1872) Bentham & Hooker (1883), and Van Tieghem (1875), the latter view is now generally recognised by modern taxonomists.

Haber (1925) put forward anatomical evidence in support of the inflorescence nature of the cyathium. According to her the inflorescence which is cymose is composed of a main central axis and five spirally arranged, sub-whorled axillary branches, each of which is subtended by a bract. The cyme terminates in a naked solitary pistillate flower. Each axillary shoot is, at the base, in the form of a dichasium terminating in a single stamen. Each of the lateral shoots of the dichasium develops into a monochasium of monandrous flowers each subtended by an abortive bracteole without a vascular supply. A slight ring-like indentation below the anther represents the position of an abortive perianth.

The cyathial lobes (involucral bracts).

Linnaeus (1753) regarded them as petals while Payer (1857) and Baillon (1858) interpreted them as sepals. In most species, (fide
Haber, op. cit.), these are of phyllome nature in the axil of which develops an inflorescence branch. The congestion of innumerable flowers resulted in the coalescence of the lateral margins of bracts producing a gamophyllous involucre. The fact that (1) each bract is traversed by a single leaf-trace which represents the union of the three normal traces which may become separate in their distal courses and (2) that the bract initiates the breaking up of the primary stele from which all other branches arise, is a strong evidence that the bract is a phyllome.

The glands

Their position alternating with sepal-like cyathial lobes, and their similarity with corolla in form and function made the earlier botanists (Baillon, 1858) consider them petals. But ontogenetically this view is not tenable; these structures manifest themselves after the cyathial lobes, the staminal groups and a portion of the ovary have developed. Other interpretations were that they represent stipules serving as nectaries (Warming, 1870), and lateral glands of the involucral bracts fused in pairs along with the fusion of the bracts in the formation of the gamophyllous involucre (Bentham, 1880). According to Haber, each gland is fundamentally a highly differentiated remular structure formed by a pair of modified secondary branches of a lateral inflorescence branch including not only the vascular traces of two branches, but the contiguous traces of the adjacent involucral bracts. The specialized function of the glands to act as attractive, nectariferous structures has been brought about by entomophily. The petaloid appendages are closely associated with the gland and apparently a
morphological part of the same unit. However, in some species investigated by Haber, there is only one vascular trace supplying the gland which has been interpreted by her as due to reduction, and contraction of steles resulting in loss of pith and formation of concentric bundles. Schoute (1937) discarded Haber's conception of the cauline nature of the glands on the ground that it was based on a confusion between vascular bundles and stems and that Warming (1870) had already described the gland traces as double, inserted laterally on the traces of the neighbouring involucral bracts.

**Monandrous flowers**

Haber maintains that the axillary shoot of the cyathium (with few exceptions) terminates in a monandrous flower which is the primary staminate flower. This primary axis forms a dichasium by giving rise to a pair of secondary branches. The next branch formed is the one from the lowermost ramus of the dichasium and may be designated as branch 4, thus 4 originating from 2. The next in order is the one from the second branch of the dichasium, the third which gives rise to the fifth. The suppression of floral parts gives rise to a scorpionid cyme, a monochasium. Each monochasium bears a series of monandrous flowers which vary in number (1 - many) in different species.

The pedicel of the monandrous flower (part below the articulation) is supplied with a single concentric bundle (barring a few exceptions) and axial in nature. Ontogenetically, the vascular strands appear first in the pedicel, and later in the filament, which shows that the
stamen is situated upon a definite receptacle, a branch of the mono-
chasmium. The difference in colour between the pedicel and the stamen
in certain species (e.g. *E. splendens*) is further evidence for the
presence of two separate structures. *E. portulacoides* presents
another noteworthy proof in that all the pedicels of monandrous
flowers are ridged while the stamens are smooth. The fact that the
pedicel is subtended fundamentally by a scale reveals that the entire
flower has been reduced to a single stamen.

There has been much speculation regarding the nature of the
articulation. In many closely related genera, particularly in
*Anthostoma* and often in *Euphorbia cyparissias*, the articulation region
bears a whorl of "leaflets". This led Schmitz and Čelakovský to
believe that the articulation is node where "leaflets" may grow or be
suppressed. Haber regards the articulation as the position of an
abortive perianth which together with its vascular supply has vanished
- a view supported by the lack of distinct anatomical evidence of
vascular tissue supplying appendages in this area.

The bracteoles in between the staminate flowers.

These organs have been variously interpreted by different authors;
by Adanson (1763) as petals of individual flowers; by Adr. de Jussieu
(1824), R. Brown (1818), Roepert (1824), and Wydler (1845) as bracts to
the staminate flowers; by Warming (1870) as trichome structures; and
by Schmidt (1906) as bracteoles of rather irregular origin.

When present, each scale arises at the base of the pedicel of a
monandrous flower. The fusion between contiguous scales and between
scales and pedicels is common. The scales are composed of a homogenous parenchymatous cell mass devoid of vascular elements of any type. The origin of scales from the bases of the pedicels of monandrous flowers points to the fact that they represent bracteoles in which the vascular supply has vanished.

The pistillate flower

The disc at the base of the ovary has been the subject of much controversy. Baillon, Lamarck, A.L. de Jussieu, R. Brown, Roeper, Schmitz, Warming and Müller recognized it as homologous to calyx. Celakovsky, Schmidt and others regarded it as representing an abortive perianth, the extreme reduction being a consequence of crowding of numerous flowers in an aggregated inflorescence.

The disc consists of a more or less homogenous mass of modified epidermal and hypodermal tissue and lacks vascular strands. The occasional appearance in this region of appendages which can be seen in all stages of degeneracy, coupled with the disappearance of vascular elements, seems to prove that the disc is an abortive perianth whorl. Consequently, the pistil must be interpreted as a single flower seated on a distinct pedicel which itself represents the main axis of the cyathium. The vascular supply of the pedicel, in some cases, is a distinct siphonostele which gives rise to the carpellary supply at the base of the ovary.
Biology

By reason of its great size, the genus *Euphorbia* displays a bewildering diversity of life form and habit. A majority of species from Tropical Africa have reached the greatest specialization in their cactoid habit. One of the notable vegetative characters of the genus is the presence of latex which, in some species, is responsible for the medicinal properties of the plant body. The laticiferous system originates as a few specialized cells laid down in the seedling in the region of the cotyledonary node, and subsequently develops into branching coenocytes. In mature plants latex occurs in the pith and primary cortex of the axis as well as in the veins, and sometimes in the mesophyll of the leaves. The latex is generally milky in living material and contains rod- or bone-shaped starch grains characteristic of *Euphorbia*.

Pollination

The cyathium and its adaptation to entomophilous pollination provides the most notable feature of biological interest. The cyathium is ecologically equivalent to a single flower, the attractive function of the perianth being taken over by the circumfloral, nectariferous cyathial glands which are further elaborated by the colour and the presence of horns and petaloid appendages. Brightly coloured involucellar leaves, in some species, contribute to the attraction. The nectar secreted by the glands forms a completely exposed shallow layer or thin film on the dorsal glandular surface. Percival (1961), using paper partition chromatography has analysed the nectar in different plants. She distinguished eight species of *Euphorbia*.
investigated as belonging to categories of balanced nectar type (with sucrose, glucose and fructose in equal amounts), and dominant fructose-glucose nectar type where these sugars are slightly or strongly preponderent. In most cases, pollination is effected exclusively by flies. Beetles and wasps are also occasional visitors, and in places where the plants grow in dense populations, bees may also be observed. In most species, the cyathium is strongly protogynous and the stigmas are dusted with pollen from a different cyathium during the visits of insects. Later, when the ovary projects far beyond the cyathial margin due to the elongation of the pedicel (which in most cases becomes deflexed), the monandrous flowers elongate one after another and the ovate-globose anthers dehisce by a longitudinal line. The pollen is sticky when ripe. Heinsius (1892) reports that in *E. palustris* L. the cyathia are partly protandrous and partly protogynous; those situated in the middle of 'the umbel', the first to flower, are protandrous and those nearer the periphery are protogynous.

**Dispersal**

The fact that some species of *Euphorbia* have limited distributions may be largely attributed to the seeds (a) being large and heavy, (b) having no efficient means of dispersal, and (c) being uneatable. The widely dispersed species are the ruderal-segetals which are introduced to new areas along with cultivated plants. Nevertheless, a fairly large number of species exhibit some remarkably interesting modes of dissemination which however, are efficient only for small distances.
The fruits, with few exceptions, are dehiscent and in some species the cocci are provided with sticky, sometimes brightly coloured warts, or blunt or spiny emergences (usually on the backs). The function of these extragynal elaborations is not properly understood although the possibility that such fruits might be easily dispersed by their sticking to the coats of grazing animals cannot be ruled out. The outer layer of pericarp is thin and soft and soon becomes dry. The inner endocarp is hard and woody, composed of transverse fibres which are straight when wet but recurve on themselves when dry, so suddenly as to rupture the capsule with explosive force which ejects the seeds for considerable distances. This phenomenon is easily observed under the laboratory conditions when the capsules that have dried out adequately are brought in. The warm room temperature triggers the dehiscence mechanism, the snapping of the dehiscing capsules being clearly audible. The hurled seeds reach distances of up to 10 feet (e.g. *E. stricta*, *E. helioscopia*, *E. taurinensis*, *E. kotschyana*, *E. paralías*). The bursting of the capsule usually results in the three carpels breaking away from the persistent central axis. More often, however, dehiscence results in splitting of the individual carpels on the back to free the seed completely. In cases where the fruit is apparently indehiscent, as in typical plants of *E. cybirensis*, the seeds are released only after the softening and disintegration of the hard fruit wall.

Further dissemination, in which the caruncle plays an important role, is performed by the agency of ants. The caruncle, which provides the elaiosome or the oil-body is formed by the enlarged lips of the
micropyle (outer integument) and varies greatly in size, shape and other morphological details. It is usually white or yellowish in colour and by virtue of its oil contents provides an attractive object to ants, which seek for the seeds so furnished and carry them to their nest. During this process, the ants very frequently eat off the oil body on the way and drop the seed. In such cases, the seed itself remains uninjured so that it may soon germinate and grow. According to Dymes as reported by Ridley (1930) seeds of E. peplus and E. vegetalis have been found in ant-nests.

The biological significance of the brown, shiny surfaces of seeds and the great variety in the sculpturing of seed coat is not properly understood. A few species like E. peplus have seeds with an ashy covering which is very brittle when dry but is changed into mucilage when moistened and swells to form a sticky envelope - an adaptation which presumably helps to anchor the seeds firmly to the substratum during germination. A similar phenomenon has been observed in some members of the family Acanthaceae, Cruciferae, Linaceae, Plantaginaceae, Polemoniaceae etc. (Pamment: 1892).

The ability of the underground part to reproduce is responsible, in some perennial species, for their spread by means of vegetative propagation, but this is efficient only to a limited extent.

Seed structure and germination

The endosperm is copious and fleshy or almost farinaceous; it is rarely cartilaginous or papery. The embryo is straight or rarely incurved and almost equals the endosperm in size. The cotyledons are broad and usually foliaceous and linear or broadly oval.
of the seeds from 68 herbarium specimens from Anatolia (none of the collections being more than 10 years old) sown at Edinburgh Botanic Garden in the spring, 1961, only 11 (1 to 5 years old) germinated. This very low percentage of germination (about 16%) indicates the short viability of the seeds. Germination is epigeal.
ASSESSMENT OF TAXONOMIC CHARACTERS AND THEIR VARIATION

The following account is an attempt to investigate into the serial trends of variation observed in the species covered by this revision. The limitations of such a procedure are fully realised; the views expressed are merely tentative and subject to alteration.

INDUMENTUM

In many species and groups of species, glabrousness or a particular type of indumentum is a well established character of distinction, e.g. all species belonging to Subsect. Myrsiniteae are glabrous and glaucous; E. petiolata is densely woolly; many members of group 'Amygdaloides' have crisply tomentose or pubescent indumentum; several species belonging to 'Petrophila complex', E. macroclada, and others have pruinose-hirtulous leaves at least on juvenile shoots. However, the presence or absence of indumentum cannot be stressed too far as a specific criterion due to its notorious variability, partially determined by habitat; glabrous forms occur sporadically in species which are predominantly hairy. Some infraspecific taxa based on glabrous character are, however, recognised, e.g. E. herniaiiifolia var. glaberrima and E. altissima var. glabrescens.

ROOT

Although the root system in annuals is remarkably uniform the perennating species usually show various modifications of their woody roots from vertical and cylindrical roots to fusiform or globose tubers. In E. apios and its allied species the shape of the root-tuber is of
considerable importance as a specific criterion.

**AERIAL AND UNDERGROUND STEMS**

Being one of the important organs in the general facies of the plant, the aerial stems constitute a useful character in taxonomy. Although there is not much variation in the number of stems in annuals, their mode of branching and posture with respect to ground surface is responsible for different types of habit, viz. erect, ascending or prostrate, the stems remaining simple or branched. In a few perennial species like *E. condylocarpa*, the simple stem is a character of major importance to separate it from its allied species. The presence of scale leaves at the bases of stems is very diagnostic of some species or groups of species. In the case of chamaephytes the appearance of juvenile shoots at the bases of stems gives a very distinct facies characterising a few small groups under some Subsections. The bases of the stems when denuded expose the leaf-scars which by their characteristic patterns, indicate the laxness or denseness of cauline leaves, and an approximate internodal length might prove useful as a taxonomic criterion. The shape of the main stem itself is important. In *E. fistulosa* the inflated nature of the upper part of its fistular stem is one of its major specific distinctions. The bases of stems may be woody (solid or hollow), fleshy or herbaceous. In either of these cases, the surface may be smooth or longitudinally sulcate.

The underground stems most usually take the form of rhizomes either vertical or creeping. *E. virgata* is distinguished from the allied *E. esula*, apart from the foliar characters, by its vertically descending rhizome instead of a horizontally creeping one. A woody
stock and caudiculi are notable features in some species (e.g. 'Petrophila' group, E. hermiariifolia, E. davisi).

CAULINE LEAVES

Barring a few cases where the foliage shows extreme polymorphism in a single species, e.g. E. terracina L., the leaf characters are one of the most obvious and useful taxonomic criteria. The general size (with length-breadth ratio), shape, their density, margin, base, apex, and texture - all contribute towards specific and infraspecific distinctions. Although the pectinate leaf margin in conjunction with another correlating character might form a good criterion for species separation (cf. E. craspedia, E. marshalliana) its value as a character in itself should not be over emphasised; it is partially controlled ecologically. In small groups of allied species where cyathia, capsules or seed characters are of no value for delimiting species, sessile or petiolate nature of cauline leaves is of major importance, e.g. E. dimorphocaulon.

It is generally recognized that opposite leaves is a derived condition from the alternate and spiral phyllotaxy. Section Anisophyllum which exhibits peculiar lateral branching, and elaboration of cyathial glands (characters pointing to the specialisation of the group), also has the opposite leaves and the derived pseudo-stipules. In Section Tithymalus, Subsection Crotonopsisae and Decussatæae can be regarded as groups showing an advanced character of phyllotaxy; E. lathyris (Subsect. Decussatæae) further shows a correlating advanced feature in the absence of bracteoles between the male flowers.
The presence of stipules characterises major groups like sect. *Anisophyllum*. According to Croizat (1960), the stipules of this section represent the two abortive cauline leaves of the same whorl to which the two well-developed leaves belong. Thus, they are in fact pseudo-stipules and, contrary to the true stipules, represent an advanced character.

In the majority of species, all the cauline leaves are more or less of uniform shape throughout the length of main stem, though differing in size on different parts of the stem. In *E. aleppica*, they are heteromorphic, the lower ones being setaceous and the upper linear to broadly linear. In species with juvenile shoots, the leaves on these usually differ from those on the main stem in size and often in shape.

**INVOLUCRAL LEAVES**

In almost all species belonging to Sect. *Tithymalus*, the involucral leaves could be regarded as representing the terminal members of the stem foliage and are either of the same size and appearance as the cauline leaves or differ from them. Although the number of involucral leaves corresponds usually to that of the umbellate radii, very often there is variation. The number, size and shape of these organs form useful criteria for distinguishing species.

**UMBELLATE RADII**

The terms 'pleiochasium' and 'umbellaster' have been proposed by Croizat and others for the 'umbel' of radii formed after the termination of the main axis by the production of a cyathium - a general
phenomenon seen in Section Tithymalus. This 'umbel' differs technically from the true umbel in being an aggregate of inflorescences rather than flowers. Further branching of the main radii in this section is dichotomous or trichotomous resulting from the repeated suppression of terminal growth of individual rays due to the formation of cyathia. The number, length, thickness, and the branching and disposition of the umbellate radii characterise some species or groups of species within reasonable limits. However, one should use caution in recognising these characters as specific distinctions; they are variable in some cases according to age, general growth and habitat of the plant. Nevertheless, in some critical taxa like the two geographical subspecies of E. seguieriana, the number of radii seems to provide the only means of identification.

In Sect. Anisophyllum, the terminal 'umbels' are absent and the stems show an apparently lateral type of branching. As Roeppe interpreted, the branching is really sympodial as shown by the position of cyathia in the forks, but often by reduction becomes apparently lateral - a notable phenomenon characterising this section.

In Sect. Tithymalus, there occur in addition to the terminal 'umbel' few or many secondary infra-umbellary radii which give a characteristic general facies to some species. In a few species bearing these lateral floriferous branches, the cauline leaves borne in the region of these or just below them are distinct in appearance, being shorter than the lower stem leaves - a character which helps to separate species in critical groups, e.g. E. amygdaloides.
It has been seen that, although, the absence of these axillary branches is more or less a rule in few species, rarely a mechanical injury to the terminal part of the stem, as in case of grazing, activates the lateral vegetative buds in the axils of stem leaves resulting in the production of secondary radii.

INVOLUCELLAR LEAVES

Most usually these organs differ in shape from the involucral leaves, and occur in twos or more rarely in threes. Their size (length-breadth ratio), base, margin, apex and rarely the colour constitute useful taxonomic characters. In exceptional cases, as in E. ledebourii, the involucellar leaves are similar to the linear cauline leaves. All the species belonging to group 'Amygdaloides' are well marked by their united involucellar leaves which form a concave or infundibuliform 'plate' - a character which emphasises the naturalness of this group and which is evidently a derived condition.

CYATHIA

Being a feature of fundamental importance in the genus Euphorbia, the cyathium and its various parts provide most valuable criteria for delimiting taxa at different levels.

Cyathial lobes: they are usually 5 in number and of various shapes and measurements in different species. In E. ispahanica they are prominently linear and manifestly longer than broad (4 or more times). In all the other species enumerated here, they are usually ovate or oblong and not more than 3 times longer than broad. They are occasionally ciliate and the tip varies from truncate to bifid. The
velutinous indumentum on both surfaces of the cyathial lobes marks out *E. macroclada* from the closely allied *E. parmonica*.

**Glands:** the term 'nectarium' was applied to these organs by Croisat (1936). These are by far the most important external characters of the cyathium in the delimitation of sections and subsections. Their number (in the species under consideration) varies from 4-5, and is of no taxonomic significance. In *E. pulcherrima*, belonging to Sect. Poinsettia, there is only 1 large gland. The species of Section Anisophyllum are provided with broader or narrower petaloid appendages on the margin of their glands, whereas in Section Tithymalus glandular appendages are absent. Under the latter section, glands with a rounded margin characterise the Subsect. Galarrhaei while the Subsect. Esulae is recognised by the truncate or retuse glandular margin.

Although the presence or absence of horns and their number broadly marks out a group of species from others, it is dangerous to recognize this character on its own as of special taxonomic importance. In *E. cheiradenia* a gradual sequence, starting from glands without horns to those with 2 or 3 and finally to the pectinate-margined glands, has been seen during the different stages of development of glands.

Nevertheless, in some species, the pectinate nature of the gland has been stabilised as a good specific criterion, and in conjunction with other characters is very useful to distinguish *E. denticulata* from its related species. The two horns of the gland, when present, show variability in their measurements, tip, and posture (with respect to each other), and might serve to separate allied species or allied groups.
of species. In most groups of *Tithymalus* the glandular horns, when present, are of the same thickness as the glands, and, being only elongated corners of the gland, appear similar to it in colour. But, in a few groups, notably in Subsect. *Myrsinitaeae* and *E. petrophila*, the horns are thinner than the glands, usually of a different colour, and apparently originate from the under surface of the gland - evidently a trend towards elaboration of gland to form a petaloid appendage.

**Bracteoles in between the male flowers:** excepting Subsect. *Myrsinitaeae* and Subsect. *Decussatae* of Sect. *Tithymalus*, prominent bracteoles occur in the cyathium amongst male flowers. They are either branched irregularly or plumose, and often are ciliate or hirsute. Although the characters of the bracteoles are of no great taxonomic value, their absence certainly forms the most notable feature of Subsections *Myrsinitaeae* and *Decussatae*; at least in Section *Tithymalus*, this might indicate a trend towards reduction.

**Pistillate flower and monandrous flowers:** these do not provide any useful characters for taxonomy, at least in the species studied in this revision.

**CAPSULES**

Fruits with seeds provide characters of the utmost importance in this genus for species delimitation. The measurements, shape (including the lobing), keels, wings, warts, spines or other emergences, indumentum or its absence on the coccas - are all very useful as criteria for specific distinction. *E. cybirensis* (a typical variety) is unique in having indehiscent fruits with thick walls. *E. peplus* and
E. herniariifolia are notable for the double wing on the backs of the ooccae. Prokhanov has emphasised (Fl. URSS) the importance of styal length and depth of stigmatic divisions as a criterion to demarcate certain groups. The value of styal length in cases like E. cybirensis and E. microsphaera is unquestionable. In E. pteleolata the styles are undivided.

**SEEDS**

**Surface:** the great diversity in the sculpturing of the seed coat and in the shape and size of the caruncle provide characters of great taxonomic value. The question whether the smooth-seeded species are primitive or derived is debatable. Groups of apparently closely related species, include both smooth and sculptured seeded plants.

The following three sets of closely allied species are taken from three different Subsections of Sect. Tithymalus.

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Species</th>
<th>Seed surface</th>
<th>Geograph. distr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Galarchei</td>
<td>(a) <em>E. gaerttii</em></td>
<td>wrinkled</td>
<td>Turkish Mesopotamia, Amanus, Syria, Anti-Lebanon, Palestine and Iraq.</td>
</tr>
<tr>
<td></td>
<td>(b) <em>E. gaillardotii</em></td>
<td>smooth</td>
<td>Turkish Mesopotamia, Syria, Anti-Lebanon, and Transjordan.</td>
</tr>
<tr>
<td>2. Esulae</td>
<td>(a) <em>E. petrophila</em></td>
<td>pitted</td>
<td>S. Russia, Crimea, Caucasus, Trans-Caucasus, Armenia, central part of N. Anatolia and N. of Cilicia.</td>
</tr>
<tr>
<td></td>
<td>(b) <em>E. glareosa</em></td>
<td>smooth</td>
<td>Crimea, Caucasus, and C. &amp; E. Anatolia.</td>
</tr>
<tr>
<td>3. Myrsiniteae</td>
<td>(a) <em>E. myrsinitea</em></td>
<td>wrinkled</td>
<td>Central Mediterranean as West as Balearic islands, Balkan peninsula, Crimea and probably N. Iran.</td>
</tr>
<tr>
<td></td>
<td>(b) <em>E. marschalliana</em></td>
<td>± smooth</td>
<td>Turkish Armenia, S. Transcaucasia, Talysh, Azerbaidjan to S. Caspian.</td>
</tr>
<tr>
<td></td>
<td>(c) <em>E. veneris</em></td>
<td>smooth</td>
<td>Cyprus.</td>
</tr>
</tbody>
</table>
In the examples given overleaf, the smooth-seeded species in each Subsection show more restricted distribution than the sculptured-seeded ones indicating that the former may have evolved from the latter. Smooth seeds have apparently been derived from the sculptured ones independently in several different groups.

**Caruncle:** it appears that the caruncle is either lost or elaborated during the course of evolution. The following examples of related species chosen from Subsect. *Calarrhacei* illustrate a probable sequence leading to the loss of caruncle in this group. Deciduous caruncles are found in several species and may represent a transitional stage between the carunculate state and the complete loss of caruncle.

<table>
<thead>
<tr>
<th>Species</th>
<th>car. persistent</th>
<th>car. deciduous</th>
<th>car. absent</th>
<th>Geog. dist.</th>
</tr>
</thead>
<tbody>
<tr>
<td>microsphaera</td>
<td>+</td>
<td></td>
<td></td>
<td>Anatolia, Cauc., Iran, Iraq, Syria</td>
</tr>
<tr>
<td>guestii</td>
<td></td>
<td></td>
<td></td>
<td>S.E. Anatolia, Iraq, Syria, Leb. &amp; Palest</td>
</tr>
<tr>
<td>gaillardotii</td>
<td></td>
<td></td>
<td>+</td>
<td>E. Anatolia, Syria, Transj.</td>
</tr>
<tr>
<td>cybirensis</td>
<td></td>
<td>+</td>
<td></td>
<td>From Crete to E. Medit.</td>
</tr>
<tr>
<td>encyrensis</td>
<td></td>
<td></td>
<td>+</td>
<td>C. Anatolia</td>
</tr>
<tr>
<td>helioscopia</td>
<td>+</td>
<td></td>
<td></td>
<td>almost world-wide</td>
</tr>
<tr>
<td>hausalmechtii</td>
<td></td>
<td></td>
<td></td>
<td>N. W. Mesopotamia</td>
</tr>
</tbody>
</table>

Species mentioned here with carunculate seeds have relatively more restricted distributions than those with carunculate seeds, suggesting that the former may have been derived from the latter. Section *Anisophyllum* (which shows many other advanced features such as derived stipules, peculiar branching and cyathial glands with petaloid appendages)
has seeds which are always ecarunculate. In Subsect. Myrsinitiaca
all the species have lost the bracteoles in between the male
flowers, but the caruncle is elaborated into a prominent conical
structure. E. ispahanica (Subsect. Caruncularea) also has a very
large complex caruncle.

The following characters of seed are of major importance:

Measurements; shape (globose, tetragonal, oblong, ovoid,
dorsiventrally subcompressed etc.); surface (smooth, shining or
not, colour etc., and if sculptured tubercular, pustular, transversely
or longitudinally, reticulately or irregularly grooved, or wrinkled or
pitted), (the sculpturing often differing on different sides of angular
seeds); and caruncle (its presence or absence, size, shape, trans-
verse or erect position, presence of longitudinal grooves, apical
pore, retuse base, colour, persistent or deciduous etc.).

Some photographs of representative seed types are appended.
Taxonomic criteria used for specific and infra-specific units

An analysis of the polymorphy within a species population involving a biosystematic study has not been ventured into in this revision. The specific and infra-specific categories, however, have been understood as given below, mainly based upon criteria adopted by du Rietz (1930) and Hedberg (1958).

1. **Species**: the species is the smallest natural population unit permanently separated from other such units by a distinct discontinuity in the series of biotypes (du Rietz). Species may be sympatric or allopatric. In cases of geographical isolation, if all the individuals of one population differ both greatly and constantly from those of the other, the two are taken as representing different species. Specific distinctions in this revision have been based on clearly discontinuous variation in at least two independent characters (following Hedberg) or on more or less discontinuous variation in more than two characters, any of which may break down individually.

2. **Subspecies**: when two populations, each of several biotypes, form more or less distinct regional facies of a species, they are treated as subspecies. The subspecies may be allopatric, differing in only one character, or may have a partly overlapping distribution, differing in one or more characters (often of a quantitative nature) that break down in a zone of overlap so widely that specific recognition would be inconvenient; as for example, *E. seguieriana* Necker subsp. *niciciana* (Borbas ex Novak) Rech. fil., differing from the typical subspecies only in the number of umbellate radii, is partially separated geographically from subsp. *seguieriana* but there is a zone of overlap in which inter-
mediates occur. Borderline cases, especially in allopatric taxa, exist and whether specific or subspecific rank is accorded to them is largely a matter of convenience. Ecological subspecies also occur within sympatric distributions. The subspecies category has not been widely used in Euphorbia, in which the species, though critical, are usually clearly separated.

3. Varietas: if variants tend to form more or less pure populations of one or several biotypes, forming a more or less distinct local facies of a species, they are recognized as varieties, e.g. E. altissima Boiss. var. glabrata Boiss. ex M.S.Khan; E. szovitsii Fisch. et Mey. var. kharputensis Azn. ex M.S.Khan. In normal herbarium material, however, we can only assess population variability from inadequate samples, so there must remain an element of doubt as to the constancy of the character in population.

4. Forma is used for sporadic individual variants. Variants differing in characters such as the presence or absence of indumentum and occurring within the same population, as in E. chamaesyce L., are considered to be formas, but this category has not been formally recognized in this revision since only taxa with a population basis have been accepted. Such variation is discussed at the end of the species concerned.
Map 1. Map of Turkey showing the three phytogeographical areas and the grid numbers cited in the enumeration.
PHYTogeography

The names used to define the three main phytogeographical areas of Turkey are taken from Davis's provisional map (unpublished) reproduced next to page 26.

1. **Euxine province** (of the Euro-Siberian region): forming a belt along the southern coast of the Black Sea - an area of high rainfall and growth of extensive mesophytic evergreen forest, often dominated by *Pbagus orientalis*.

2. **Irano-Turanian region**: stretches across the central and eastern Anatolia and generally takes the form of steppe vegetation.

3. **Mediterranean**: represented on the coast lands of West and South Turkey by *Pbus brutia*, *Quercus coccifera* and maquis and phrygana vegetation. Enclaves of Mediterranean vegetation occur elsewhere, particularly near the coast in the Euxine.

Although these three regions could be recognised in the broad sense, no precise boundaries between them can be drawn; the transition regions in some parts are quite extensive (especially in W. Anatolia) and numerous enclaves occur.

The adjoining two tables summarise the phytogeographical distribution of all the species throughout their whole range. Table I is devoted to Turkish endemics with their nearest allies bracketed together; the latter if non-endemic are shown in parenthesis. Table II shows the distribution of non-endemic species excluding those that are already given in Table I. A cross mark against the species indicates its presence in that region; parenthesis denotes that the species extends only exceptionally in that region. Cases of doubtful occurrence are illustrated by a question mark. Additional information
about the range of distribution or precise region in Turkish geography is given under the last column. The arrangement of the species in the two tables follows more or less the linear sequence of the enumeration.

Out of the 84 species recorded here 16 are endemic to Turkey (about 19%), the greatest concentration of endemics being in the Mediterranean region, mostly in the Taurus mountains. The species nearly allied to Turkish endemics belong chiefly to the eastern Mediterranean (including Greece) and Caucasus; a few are mainly European. About half of the endemics that occur in the Mediterranean part of Turkey are confined to this region alone while the rest penetrate into the Irano-Turanian and Buxine areas. Only 2 species are restricted to the Irano-Turanian region (E. grisophylla and E. haussknechtii).

Of the 16 species endemic to Turkey, 13 also have their closest allies growing in Anatolia; of the latter, however, 12 extend into adjacent countries. The two closely related Lycian endemics, E. pisidica and E. pestalozzae seem to have no close affinities with any species outside Turkey; they are broadly sympatric with each other in Anatolia and altitudinally vicarious. No affinity could be decided for E. schottiana from Cilicia.

Subsections Callarrhacii (34 species) and Esulae (37 species) have about the equal share of the total 16 endemics (7 in the former and 8 in the latter); Subsect. Myrsinitae (7 species) includes only one.
The remaining 69 non-endemic species have rather wide distributions; 50 of them extend from Europe through N. Africa into Orient, and the rest are chiefly centred in Europe. A few, like E. peplus, extend from N. America to the Far East.
TABLE I

Distribution of Turkish endemics and their closest allies.

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<tbody>
<tr>
<td>C. &amp; N. S. (incl.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(excl.</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

| Lelioscopia | + | + | + | + | + | + |
| L. lesogetti | + | + | + | + | + | + |
| L. cytidosperma | + | + | + | + | + | + |
| L. unisonoides | + | + | + | + | + | + |
| L. describens | + | + | + | + | + | + |
| L. macrocarpa | + | + | + | + | + | + |
| L. isophylla | + | + | + | + | + | + |
| L. astroanatolica | + | + | + | + | + | + |
| L. chottiana | + | + | + | + | + | + |
| L. acyrensis | + | + | + | + | + | + |
| L. x birensis | + | + | + | + | + | + |
| L. nussknechtii | + | + | + | + | + | + |

N. J. Lesopot.

 Introduced weed in many parts of the world.

C. Taurus

Disjunct distr. in Pontus and Amanus.

E. Anatolia.

N. W. Mesopot.

Westwards up to Crete.
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</thead>
<tbody>
<tr>
<td>anasunitensis</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>virgata</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Kurdistan</td>
</tr>
<tr>
<td>virgata</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>isidica</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>estalozzae</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>erythrodon</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>glareosa</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>saurica</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>promecocarpa</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>herniariifolia</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Comments for Kurdistan: also in Turkmenistan; introd. in Br. Isl. & Far East

Comments for Iycian Taurus: Iyc. Taurus & S. Lycaonia

Comments for Lycaonia: Lycaonia, Pisdia, Iycia

Comments for C. & S. part of N. Anatolia: Isauria

Comments for Anti-Lebanon: western exten. in Crete
<table>
<thead>
<tr>
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<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>otschyana</td>
<td>+</td>
<td>(+)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>S. &amp; W. Anatolia.</td>
</tr>
<tr>
<td>macrostegia</td>
<td>+</td>
<td>(+)</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td>from Cilicia eastwards.</td>
</tr>
<tr>
<td>obbiae</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>prob. near Istanbul.</td>
</tr>
<tr>
<td>amygdaloides</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Isaurian part of Taurus.</td>
</tr>
<tr>
<td>livisii</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>(+)</td>
<td>+</td>
<td>+</td>
<td>C. &amp; W. Anatolia.</td>
</tr>
<tr>
<td>tripampseros</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>N. Anatolia; westwards up to</td>
</tr>
<tr>
<td>myrsinotes</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>(+)</td>
<td>Balearic Isl.</td>
</tr>
<tr>
<td>Species</td>
<td>Greece</td>
<td>Bel. Pen.</td>
<td>Turkey</td>
<td>Syria</td>
<td>Leb.</td>
<td>Pal.</td>
<td>Comments</td>
</tr>
<tr>
<td>--------------</td>
<td>--------</td>
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<td>--------</td>
<td>-------</td>
<td>------</td>
<td>------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td><em>Aeg. is.</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td>Chiefly in C. &amp; W. Medit.; in Turkey only from Lycia.</td>
</tr>
<tr>
<td><em>Aeg. is.</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td>E. Anatolia; eastern limit near Isfahan.</td>
</tr>
<tr>
<td><em>B. .Anatoli</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td>Lycia; up to Crete.</td>
</tr>
<tr>
<td><em>B. .Anatoli</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
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</tr>
<tr>
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<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td>Bithynia, Cappadocia, Armenia; also N. Eur., Ural, Siberia &amp; Altai.</td>
</tr>
<tr>
<td><em>B. .Anatoli</em></td>
<td>+</td>
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</tr>
<tr>
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<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td>westwards up to Crete; W. Anatolia.</td>
</tr>
<tr>
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TABLE II (Contd.)

Distribution of non-endemic Turkish species

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<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>also in Br. Is., M. &amp; S. Russia; in Turkey in W. part &amp; Lazistan; introduced in N. America</td>
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<td>+</td>
<td>+</td>
<td>+</td>
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<td>+</td>
<td>+</td>
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<td>S. E. &amp; G. part of N. Anatolia.</td>
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<td>+</td>
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<tr>
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<td>( + )</td>
<td>( + )</td>
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<td>rarer in W. Anatolia.</td>
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<td>( + )</td>
<td>( + )</td>
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</tbody>
</table>

*Species abbreviations:* 
- C. & S. W. S.: Central & South Western Asia
- Med.: Mediterranean
- L.T.: Levant
- Eux.: Euxine
- mea: Middle East
- Transc.: Transcaucasian
- Iran: Iran
- Iraq: Iraq
- Ant. Leb.: Antiliban
- Ant. Leb.: Antiliban
- Jord.: Jordan
- rus: Russia
- Afr.: Africa

*Comments:* 
- ( + ): Present but rare
- (+): Present but rare
- (+): Present but rare
- (+): Present but rare
- (+): Present but rare
- (+): Present but rare
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<td>Hymatosperma</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+ (++)</td>
<td>+</td>
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</tr>
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<td>+</td>
<td>+</td>
<td>+ (++)</td>
<td>+</td>
<td>W. Anatolia; also in C. Russia.</td>
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<tr>
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<td>+</td>
<td>+</td>
<td>+ (++)</td>
<td>+</td>
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<tr>
<td>Euphorbia</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+ (++)</td>
<td>+</td>
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<tr>
<td>Sanguinaria</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+ (++)</td>
<td>+</td>
<td>up to Aral - Caspian region.</td>
</tr>
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<td>+</td>
<td>+</td>
<td>+ (++)</td>
<td>+</td>
<td>also in Br. Is.</td>
</tr>
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<td>+</td>
<td>+</td>
<td>+</td>
<td>+ (++)</td>
<td>+</td>
<td>in Turkey, from Lycia to Kurdistan.</td>
</tr>
<tr>
<td>Asphodela</td>
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<td>+</td>
<td>+</td>
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<td>+</td>
<td>W. &amp; N. Anatolia.</td>
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<td>+</td>
<td>+</td>
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</tr>
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<td>+ (++)</td>
<td>?</td>
<td>?</td>
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</table>
**TABLE II (Contd.)**

**Distribution of non-endemic Turkish species.**

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<td>Macroceras</td>
<td></td>
<td>+</td>
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<td></td>
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<td>Armenia.</td>
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<tr>
<td>Ophidion longifolia</td>
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<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>N.&amp; N.W. Anatolia, Armenia, Kurdistan.</td>
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<td>Erodium enticulata</td>
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<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
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<td>Cilicia, E. Turkey.</td>
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<td>Erodium xerophyllum</td>
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<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mesopot. &amp; Iraqi Kurdistan.</td>
</tr>
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<td>Erodium salsifolium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Armenia to S. of Caspian.</td>
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<td>Erodium transcaucasicum</td>
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<td></td>
<td></td>
<td>S. Transcaucasia &amp; E. Armenia.</td>
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<td>Erodium cinnamomeum</td>
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<td></td>
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<td></td>
<td></td>
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<td>westwards up to Sicily.</td>
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<td></td>
<td></td>
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<td>also from Mt. Turkestan in C. Asia.</td>
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<td>also in Br. Is. &amp; At. Is., Mexico, Peru,</td>
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<td>Erodium echinatum</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Abyssinia, China, etc.</td>
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<td>Erodium atriplicifolium</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>also Br. Is. Ural Mts. &amp; Sinai.</td>
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<tr>
<td>Erodium hamaesyce</td>
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<td>sporadic weed in N. America.</td>
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</table>
LIFE FORMS AND ECOLOGICAL HABITATS.

In Table III are shown the life forms, altitudinal ranges, and ecological habitats in Turkey of all the species. The terminology of life forms is taken from Raunkiaer (1934). The abbreviations used are:

- Fn = Phanerophyte;
- Th = Therophyte;
- Ch = Chamaephyte;
- G = Geophyte;
- HC = Hemicryptophyte;
- H = Helophyte.

A cross mark against the species refers to the particular altitudinal range or ecological habitat; parenthesis indicates that the species is adapted to that habitat or altitude exceptionally. A question mark denotes that data on that particular item is doubtful.

Most of the 55 perennial species prefer rocky places, often growing in forest, scrub vegetation and in Mediterranean communities with a wide altitudinal range (0-2000 m. and above). Amongst these a majority (32) are Chamaephytes while the others are either Geophytes or Hemicryptophytes. *E. dendroides*, which grows in the Mediterranean maquis, is the only Phanerophyte. Some, like *E. paralia*, are adapted to sandy littoral situations, while *E. palustris* and *E. altissima* are almost exclusively swamp plants. A remarkable autumn-flowering habit has been recorded for *E. dimorphocaulon* which, like all its allied species, perennates by a root tuber.

Amongst the perennials, there are 14 endemics (marked on the table with an asterisk) out of which 13 are either Chamaephytes or Geophytes; 5 of these are restricted to altitudes of 2000 m. and above - a fact suggesting that geographical and altitudinal isolation has played a
considerable part in the speciation of the perennial endemics in Turkey. *E. schottiana* is a Hemicyrptophyte.

A large majority of the 29 annuals (Therophytes) are mainly ruderal-segetals, the most common invasive weed being *E. chamaesyce*; a few also occur in rocky places. *E. peplis* is confined to the sandy beaches and shores of salt water lakes.
### TABLE III

**Life forms and Habitats of Turkish Euphorbias.**

<table>
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<tr>
<th>No.</th>
<th>Species</th>
<th>Life $0\text{-}1200$ m</th>
<th>$1200\text{-}2000$ m</th>
<th>Rocky</th>
<th>Wet places,</th>
<th>Comments</th>
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<td></td>
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</tr>
<tr>
<td>2</td>
<td><em>ispahenica</em></td>
<td>Th</td>
<td>+</td>
<td>(+)</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td><em>acanthothamnos</em></td>
<td>Ch</td>
<td>+</td>
<td></td>
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<td>4</td>
<td><em>thamnoides</em></td>
<td>Ch</td>
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<td>5</td>
<td><em>rytidosperma</em></td>
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<td>+</td>
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<td>6</td>
<td><em>djalilensis</em></td>
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<td>8</td>
<td><em>macrocarpa</em></td>
<td>G?</td>
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<td><em>grisophylla</em></td>
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<td><em>palustris</em></td>
<td>H</td>
<td>+</td>
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<td><em>orientalis</em></td>
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<td>13</td>
<td><em>oblongata</em></td>
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<td><em>cassia</em></td>
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<td><em>austroanatolica</em></td>
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</table>

**Altitude:**
- **Life form $0\text{-}1200$ m, $1200\text{-}2000$ m & above:**
- **Ruderal:**
- **Scrub:**
- **Forest:**
- **Places:**
- **Sand:**
- **Saline:**
- **Swamps:**

*Comments:*
- Often in maquis.
- In maquis & phrygana.
- In Pontus $2000$ m. & above; in Anatus $700\text{-}1200$ m.
- Often in oak scrub.
- Mountain slopes & scrub.
- Often in shady places.
- Also in maquis.
### TABLE III (Contd.)

Life forms and Habitats of Turkish Euphorbias.

<table>
<thead>
<tr>
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<th>1200 – 2000 m.</th>
<th>Ruderal</th>
<th>Rocky</th>
<th>Wet places,</th>
<th>Comments</th>
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<td>+</td>
<td>+</td>
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### TABLE III (Cont'd.)

**Life forms and Habitats of Turkish Euphorbias.**

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<th>No.</th>
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<th>Life form</th>
<th>Altitude</th>
<th>Ruderal</th>
<th>Rocky</th>
<th>Wet places</th>
<th>Comments</th>
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- Certain species are occasionally on sandy flats near lakes.
- On coastal sands.
### TABLE III (Contd.)

**Life forms and Habitats of Turkish Euphorbias.**

<table>
<thead>
<tr>
<th>No.</th>
<th>Species</th>
<th>Life form</th>
<th>0 - 1200 m</th>
<th>1200 - 1800 m</th>
<th>&amp; above</th>
<th>Ruderal Scrub Forest Places</th>
<th>Rocky Places</th>
<th>Sand Saline Places</th>
<th>Wet places, Swamps</th>
<th>Comments</th>
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* Comments:  
  - (+) indicates occasional occurrence.
  - Comments on specific habitats or occurrences are noted in the final column.
### TABLE III (Contd.)

**Life forms and Habitats of Turkish Euphorbias.**

<table>
<thead>
<tr>
<th>No.</th>
<th>Species</th>
<th>Life form</th>
<th>0 - 1200 m</th>
<th>1200 - 2000 m</th>
<th>1200 m &amp; above</th>
<th>Ruderal</th>
<th>Rocky</th>
<th>Scrub</th>
<th>Forest</th>
<th>Places</th>
<th>Sand</th>
<th>Saline</th>
<th>Wet places</th>
<th>swamps</th>
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Plants not collected so far from wild locality.

Data not available.
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<th>Mer. no.</th>
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<th>Ruderal</th>
<th>Rocky</th>
<th>Scrub</th>
<th>Forest</th>
<th>Places</th>
<th>Sand</th>
<th>Saline</th>
<th>Wet places</th>
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<td>on sandy beaches &amp; on shores of salt lakes.</td>
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</table>
TAXONOMY

In the following enumeration, the divisions of Section Tithymalus are based largely on the arrangement given in Boissier's monograph (in DC. Prodr.); a few additional informal groups have also been recognized of species with close resemblances and apparently nearly related, e.g. group 'Aplos', 'Petrophila', 'Amygdaloideae'. All the species annotated are arranged in as natural an order as a linear sequence allows. Section Anisophyllum has been treated as a specialized group with a peculiar branching habit and elaboration in glandular morphology; consequently it follows Sect. Tithymalus.

The records are cited according to the grid reference shown in Map. 1; the letter E or A in parenthesis after a grid number means the European or Asian side of the Bosphorus under that particular square. The specimens cited under each grid are usually one for each province or sometimes for the whole square. Exceptionally, in rare species and in cases where the records are located at two farther points on a square, more than one gathering is cited for each square.

All specimens cited, including the types, have been examined unless stated otherwise. An exclamation mark after a synonym indicates that the type material of it has been seen. Davis numbers include also those collections made with his co-collectors, viz. Hilger (Karamanoglu), Dodds, Hedge, Heywood, Polunin, Goode etc. The collections of Dudley have Davis numbers and accordingly are shown in parenthesis with the letter D. preceding them. 'Khan et al.' has been used for brevity referring to collections made by Khan, France, and Ratcliffe.

Species imperfectly known or doubtfully recorded from Turkey are given at the end of the Subsection Anisophyllum.
Euphorbia Linn., Gen. Pl. ed. 5, 203 (1754)

Syn. Euphorbiurn Hill, The useful family Herbal, ed. 2. 136 (1755).


Ditritra Rafin., Fl. Tell. 4, 114 (1838)

Murtedias Rafin., Fl. Tell. 4, 116 (1838).

Agaloma Rafin., Fl. Tell. 4, 116 (1838).

Allobia Rafin., Fl. Tell. 4, 116 (1838).


An assemblage of herbs, shrubs and trees of widely diverse habits, with acrid, poisonous latex. Stems sometimes thick, fleshy, cactoid, occasionally leafless. Leaves undivided, mostly entire, rarely serrate or dentate, opposite or alternate. Cyathia in terminal cymes or in the forks of the dichotomies or axillary.

Cyathium campanulate, turbinate or hemisphaerical, 4–5, rarely 6–8 lobed, lobes membranous, entire, laciniate or ciliate, often concealed by the glands. Glands nectariferous, alternating with the lobes, 1–4 or occasionally abortive, entire, 2-horned or pectinate, occasionally with a petaloid appendage. Male flowers in the cyathium pedicellate, naked, monandrous, with or without scaly, ciliate or laciniate bracteoles in between, filament with an articulation at the junction of the pedicel. Female flower solitary, centrally situated in the cyathium, protruding
out by means of an elongating pedicel, naked or very rarely provided with 3 small scaly lobes. Styles 3, free or united, undivided or forked. Capsule usually with three 2-valved coccæ separating out from a persistent central column. Seeds with or without a caruncle.


At least 1600 species, predominantly subtropical and warm temperate, and with the exception of Africa, rather poorly represented in the Tropics. They are absent from the Arctic area and play only a minor role in the colder parts of the Temperate zone. Excepting the ruderal-segetals, most species inhabit small distribution areas.

The list of synonymy given overleaf is by no means a complete one; only the names that are better known are included. Synonyms that appear under the Sections and different Subsections in this work have not been cited here.

According to Plinius (1559), the name *Euphorbia* was first applied to one of the medicinal African spurge by King Juba II of Mauretania (contemporary of Augustus) who discovered it on the Atlas mountains, and named it in honour of his court physician Euphorbos.

Boissier (1882) recognized 27 Sections of *Euphorbia* while Pax and Hoffman (1931) arranged the species only in 9 Sections. The present revision covers only two Sections, (1) *Tithymalus*, and (2) *Anisophyllum*, each represented in our area by 32 and 2 species respectively; the former are spread into 7 Subsections.
ANALYTICAL KEYS

The following keys are based primarily on the more obvious vegetative and cyathial characters, and when necessary on those of capsules and seeds which could be easily observed. In living plants and in reasonably well preserved herbarium specimens the bracteoles between the male flowers are quite apparent under the lens simply by cutting open the cyathium. In difficult cases, however, the presence or absence of bracteoles in dried specimens can be determined to the best advantage by boiling up the cyathium and dissecting under the binocular microscope. Measurements for length of seed exclude the caruncle.

In the large Subsections Galarrhac and Esulae, informal groups (designated by capital letters) have been recognised which appear to be rather natural assemblages of species; the species are keyed out separately under each of these groups.

A key based on seed characters alone is given in the Appendix I.
KEY TO SECTIONS, SUBSECTIONS, AND SOME INFORMAL GROUPS

1. Cauline leaves stipulate; leaf-base uniauriculate; cyathial glands with a narrow or broad petaloid wing on outer margin; prostrate, much branched annuals

   Sect. Anisophyllum - p. 63

1. Cauline leaves exstipulate; leaf-base not uniauriculate; cyathial glands without a petaloid wing on outer margin; prostrate to erect, annuals to perennials

   Sect. Tithymalus

2. Cauline leaves opposite, often decussate

3. Cauline leaves decussate, glabrous, entire; cyathial glands 2-horned

   Subsect. Decussatae - p. 265

   (E. lathyris)

3. Cauline leaves not decussate, densely woolly, spinulose-dentate; cyathial glands deeply pectinate

   Subsect. Crotonopsidae - p. 262

   (E. petiolata)

2. Cauline leaves alternate or spiral, not opposite

4. Cyathial lobes linear, at least 4 times longer than broad; caruncle 2 mm. or more long, deeply longitudinally sulcate, excavated on ventral side

   Subsect. Carunculares - p. 68

   (E. ispahanica)

4. Cyathial lobes not linear, usually not more than 3 times longer than broad; caruncle (if present) not more than 1.5 mm. long, exsulcate or only shallowly sulcate, sometimes only retuse at base on ventral side, not excavated
5. Rounded shrubs with pseudo-dichotomous branches; cauline leaves at least 8 times longer than broad.

5. Perennial to annual herbs with usually racemose branches, if pseudo-dichotomous then branches prostrate or ascending; if shrubby, leaves not more than 5 times longer than broad.

6. Cyathial glands with rounded margin, without horns.

7. Seeds smooth.

8. Perennials

8. Annuals

7. Seeds variously sculptured.

6. Cyathial glands with truncate margin, with or without horns, sometimes margin pectinate.

9. Bracteoles in between male flowers prominent, usually plumose, often laciniate or ciliate.

10. Annuals

10. Perennials

11. Involucellar leaves united.

Subsect. Pachycladace - p. 65

(E. dendroides)

Subsect. Galarrhasei

Group A - p. 39
Group B - " 43
Group C - " 46

Subsect. Esulae

Group D - p. 48

Subsect. Amygdaloides - p. 51
11. Involucellar leaves free

9. Bracteoles in between male flowers absent

Group F - p. 54

Subsect. Myrsinitae - p. 60
GROUP A

Subsect. Galarchaei - Cyathial glands with rounded margin, without horns. Seeds smooth; all perennials.

KEY TO SPECIES

1. Capsules smooth or only minutely elevate-punctate, never truly warty
   2. Stems erect, robust, up to 90 cm. tall; cauline leaves larger (6.5-14 cm. x 1-2 cm.), lanceolate; capsules pilose altissima
   2. Stems procumbent, slender, up to 10-15 cm. long, cauline leaves smaller (1-2.5 cm. x 0.3-0.5 cm.), oblong-lanceolate or spathulate; capsules glabrous wittmannii

1. Capsules distinctly warty
   3. Shrubs about 1m. tall
      4. The ultimate dichotomies of umbellate radii persisting as furcate spines in fruiting stage; branches much intricate acanthothamnos
      4. Plants unarmed; branches sparse, open thamnoides

3. Perennial herbs
   5. Herbs with root-tubers or thick woody roots, never with rhizomes or caudiculi
      6. Stems slender, not more than 4 mm. thick, never woody; plants with root-tubers group 'Apios'
7. Stem solitary, erect, unbranched below;
   root-tuber ovate-globose, sometimes fusiform;
   leaves glabrous, cordate-amplexicaul at base... conylocarpa

7. Stems many, prostrate to erect, often
   branched below; root-tuber napiform or
   cylindrical, occasionally fusiform;
   leaves glabrous or hairy

8. Lower cauline leaves shortly petiolate;
   stems dimorphic, flowering stems erect and
   much longer than the sterile decumbent ones;
   autumn flowering... dimorphocaulon

8. All leaves sessile; stems monomorphic,
   all stems floriferous, prostrate to
   erect; spring flowering

9. Root-tuber napiform, occasionally fusiform;
   cauline leaves sparsely or densely
   pilose; leaf-base sub-attenuate or round... apius

9. Root-tuber cylindrical, vertical;
   cauline leaves glabrous; leaf-base
   deeply cordate-auriculate... cardiophylla

6. Stems robust, up to 6 mm. thick, woody at base;
   cauline leaves usually 4-7 cm. x 2-2.5 cm., sparsely
   or densely villose at least on the under surface;
   plants with usually curved woody tap root... oblongata

5. Herbs with thick, woody rhizomes or stems borne on
   caudiculi; never with root-tubers or woody roots
10. Cauline leaves smaller (7–13 mm. x 4–8 mm.), ovate, not more than 1 \( \frac{1}{2} \) times as long as broad, stems filiform, decumbent, many, tufted

schottiana

10. Cauline leaves larger (3–8 cm. x 0.8–2.5 cm.), 2 or more times as long as broad. Stems few to many, erect or ascending

leaves pellucid-punctate; stems ascending, flexuose

austroanatolica

leaves not pellucid-punctate; stems erect, not flexuose

12. Stems robust, up to 1.5 cm. thick at the base, with several crowded axillary shoots above

palustris

12. Stems slender, not more than 0.7 cm. thick at the base, simple or only with few distant axillary floriferous branches

13. Bases of stems covered with prominent scale leaves

14. Stems with axillary floriferous branches above; cauline leaves oblong or oblong-lanceolate; capsules larger (6–10 mm. across); seeds ecarunculate

macrocarpa
14. Stems simple, without axillary floriferous branches

15. Seeds larger (3.5-4.0 mm. x 3.0-3.3 mm.); cauline leaves oblong or oblong lanceolate, greyish green

grisophylla

15. Seeds smaller (c. 0.3 mm. x c. 2.5 mm.); cauline leaves elliptic or elliptic-spathulate, dark-green

ajimilenses

13. Bases of stems not covered with scale leaves

16. Involucellar leaves elliptic or elliptic-rhomboid; cauline leaves sessile, sub-coriaceous

orientalis

16. Involucellar leaves broadly ovate to semi-orbicular; cauline leaves petiolate, herbaceous

aquamosa
GROUP B

Subsect. Galarrhæa - Cyathial glands with rounded margin, without horns; seeds smooth; all annuals.

KEY TO SPECIES

1. Capsules warty or bristly
   2. Mature capsules perfectly globose, with rigid or soft bristles
      3. Styles shorter, only 1-2 mm. long; bristles on capsules reduced to scattered soft papillae
         microsphaera
      3. Styles longer, 2.0-3.5 mm. long; bristles on capsules pointed, rigid or soft
         cybirensis
   2. Mature capsules + trilobed, covered with warts or bristles
      4. Capsules with + rigid, conical bristles; plants dwarf (4-10 cm. tall); seeds scarunculate with fine sticky granular covering, not shining
         ancyrensis
      4. Capsules warty, not bristly; plants taller (20-75 cm. tall); seeds carunculate, shining
      5. Capsules larger, 2.5-3.0 mm. x 2.7-4.0 mm., obscurely trilobed, with few hemisphaerical warts; seeds 1.7-2.2 mm. x 1.5-1.7 mm., broadly ovoid; leaves thick, usually yellowish-green; habit robust
         platyphyllos
5. Capsules smaller, 1.7-3.0 mm. long, distinctly trilobed, with several cylindrical warts; seeds 1.2-1.7 mm. x 0.8-1.2 mm., obovate; leaves thin, usually pure green, habit slender

1. Capsules smooth or minutely punctate or granular rarely softly papillose, not truly warty or bristly

6. Leaves deeply serrate from base to apex; capsule deeply trilobed; caruncle on the seeds shortly stipitate, globose

6. Leaves subentire or serrulate only above the middle; capsule globose or deeply trilobed; caruncle on the seeds sessile and transversely ovate, or absent

7. Capsules globose or rarely only very slightly trilobed; seeds dark brown, shining, sub-compressed-ovoid; caruncle transversely ovate, persistent

7. Capsules ± deeply trilobed; seeds brown, black or greyish but not shining, ovoid, subquad-rangular or ovate-sphaerical; caruncle absent, or minute and deciduous
8. Involucellar leaves subcordate to cordate at the base; stem fistular, gradually thicker towards the top; seeds 3.0-3.5 mm. x 2.5-3.0 mm., ovate

fistulosa

8. Involucellar leaves narrowed, rounded or truncate at the base

9. Capsules minutely granular, densely pilose; seeds 2.0-3.0 mm. x 1.5-2.5 mm., ovate-sphaerical, brown or greyish with brown specks, ecarunculate

eriophora

9. Capsules smooth, glabrous

10. Mature seeds greyish and irregularly furrowed

guestii

10. Mature seeds brown, smooth

gaillardotii
GROUP C

Subsect. Galarrhací - Cyathial glands with rounded margin, without horns; seeds variously sculptured.

KEY TO SPECIES

1. Perennials with several rigid stems, or with a single stem indurated below

2. Stem single with several axillary branches above;
   cauline leaves oblong-lanceolate, villose, base subcordate; seeds 2.0-2.5 mm. x c. 2.0 mm.,
   with + longitudinally arranged minute tubercles,
   very rarely tubercles obscure                    verrucosa

2. Stems many, usually unbranched above, or rarely only with few axillary floriferous branches

3. Cauline leaves larger (2.0-4.0 cm. x 1.2-1.7 cm.), oblong-elliptic, pilose; bases of involucellar leaves truncate or subcordate;
   seeds with many reticulately arranged narrow wrinkles         rhytidosperma

3. Cauline leaves smaller (1.5-2.5 cm. x 0.2-0.5 cm.), oblong-spathulate; bases of involucelle leaves attenuate; seeds with scattered shallow pits cassia

1. Annuals usually with single or rarely many, erect or ascending stems
4. All leaves entire, always glabrous; seeds obtusely tetragonous, subcompressed, brown, covered with minute, crowded, white tubercles, and with 3-4 narrow, transverse furrows on each face. *Phymatosperma*

4. All leaves serrate, pilose or glabrous; seeds with elevated reticulate wrinkles

5. Stems many, prostrate to ascending; caruncle vertical, c. 7 mm. across, subspherical, retuse on the inner side. *Oxyodonta*

5. Stem single, erect; caruncle transversely ovate to suborbicular or obscure or absent

6. Involucellar leaves with deeper and fewer serrations (10-30 per involucellar leaf); seeds smaller (c. 2.0 mm. x c. 1.5 mm.); caruncle obscure or absent. *Haussknechtii*

6. Involucellar leaves with shallow and many serrations (50-60 per involucellar leaf); seeds larger (2.0-2.5 mm. x 1.5-1.7 mm.); caruncle transversely ovate or semi-orbicular. *Helioscopia*
GROUP D

Section Esulae: Cyathial glands with truncate margin with or without horns; bracteoles in between the male flowers usually plumose often laciniate or ciliate; annuals.

KEY TO SPECIES

1. Stems with dense setaceous leaves below the usual linear-lanceolate ones; seeds ecarunculate, tuberculate; bases of stems often denuded showing crowded leaf-scars
   aleppica

1. Stems with no setaceous leaves below the usual ones; seeds ecarunculate, sometimes ecaruncle deciduous, tuberculate or otherwise

2. Seeds with many minute whitish tubercles;
   stems many, densely leafy
   exigua

2. Seeds with furrows, pits or wrinkles in various patterns; plants single stemmed with or without branches; stems usually laxly leafy

3. Coccae of the capsules with 2 narrow parallel wings on the backs; seeds oblong-subhexagonal with 1 longitudinal groove on each of the two inner faces and with a row of 2-4, rarely 5, pits on each of the 4 outer faces; cauline leaves obovate to suborbicular, base long attenuate into a petiole
   peplus
3. Coccae of the capsules with only 1 line of dehiscence on the backs; seeds not oblong-hexagonal, pitted, grooved or wrinkled in various patterns

4. Seeds with 6 longitudinal parallel grooves; cauline leaves obovate to spatulate, sessile or with short petioles; involucellar leaves ovate-rhomboid, usually broader than long, apex mucronate

4. Seeds with pits or wrinkles arranged in various patterns; cauline leaves of various shapes, sessile

5. Seeds dorsiventrally compressed, with 2 rows of 4 or more transverse grooves on each face, sometimes grooves reduced to pits crowded in a more or less reticulate pattern

5. Seeds not dorsiventrally compressed, variously pitted or wrinkled

6. Involucellar leaves linear to elliptic-rhomboid; seeds ovate-tetragonal or oblong-tetragonal

7. Coccae of the capsules acutely keeled; seeds oblong-tetragonal, each of the four faces concave and with transversely and irregularly arranged wrinkles; involucellar leaves falcate

aulacosperma

falcata

azovitsii
7. Coccoas of the capsules obtuse; seeds ovate-tetragonal, with several unequal, crowded pits. *ledebourii*

6. Involucellar leaves shortly or elongated deltoid-rhomboid, ovate or ovate-rhomboid; seeds ovoid or ovoid-oblong. *pinea*

8. Cauline leaves always linear, acute to acuminate; stems densely leafy. *pinosa*

8. Cauline leaves obovate-oblong to linear-lanceolate, obtuse, truncate or retuse, scarcely acute; stems laxly leafy. *taurinensis*

9. Seeds irregularly reticulately-pitted; glandular horns setaceous, 2 or more times longer than the breadth of gland. *arvalis*

9. Seeds with irregularly reticulate wrinkles enclosing sometimes very small pits; glandular horns not longer than the width of gland. *taurinensis*
GROUP E 'Amygdaloides'

Subsect. Esulae - Seeds smooth; cyathial glands with truncate margin, bracteoles in between the male flowers prominent; perennials; involucellar leaves united.

KEY TO SPECIES

1. Mature capsules hairy; leaves tomentose, crisply pubescent or hirtellous on both surfaces

2. Median cauline leaves lanceolate-linear, 8 or more times longer than broad; capsules 5-7 mm. x 5-7 mm., velutinous

   sibthorpii

2. Median cauline leaves obovate or oblanceolate, not more than 6 times longer than broad

3. Cauline leaves 4 cm. or more long, hirtellous or tomentose; stems not branched at base

   thompsonii

3. Cauline leaves not more than 3 cm. long, crisply pubescent; stems woody, branched at base

   davisii

1. Mature capsules glabrous; leaves glabrous, puberulous or pilose, if shortly tomentose then hairy on the under surface only

4. Cauline leaves with cordate, rounded or rarely truncate bases, never attenuate; lamina ovate-lanceolate or ovate-oblong; sterile shoots absent

   oblongifolia
4. Cauline leaves with always attenuate bases; lamina elliptic, obovate or oblanceolate; sterile shoots present

5. Primary involucellar 'plates' smaller, usually 1-2 cm. across at the broadest point, rarely up to 2.7 cm. across; flowering stems with upper cauline leaves very much smaller than the lower

6. Robust habit with many stems forming dense clumps; mature cauline leaves glabrous on both surfaces, coriaceous; seeds 2.5–3.0 mm. x c. 2.0–2.5 mm. — robbiae

6. Slender habit with few stems forming lax clumps; mature cauline leaves usually puberulous at least on the lower surface, if glabrous, the leaves not coriaceous; seeds 2.0–2.8 mm. x 2.0–2.2 mm. — amygdaloideae

5. Primary involucellar 'plates' larger, usually 2.5–4.0 cm. across at the broadest point; flowering stems with upper cauline leaves the same size as the lower or slightly smaller

7. Cauline leaves thin, membranous, dorsal surface not glossy — macroceras
7. Cauline leaves thick, coriaceous, dorsal surface glossy

8. Capsules 5.0-5.5 mm. x 5.0-6.5 mm.; seeds 3.0-3.5 mm. x 2.5-3.0 mm.; indumentum on the under surfaces of cauline leaves, if present, crisply puberulous; cauline leaves usually linear-oblancoolate

kotschyan

8. Capsules 4.5-5.0 mm. x 4.5-5.5 mm.; seeds 2.5-3.0 mm. x 2.0-2.5 mm.; indumentum on the under surfaces of cauline leaves, if present, pilose; cauline leaves usually obovate-oblancoolate

macrostegia
GROUP F

Section Esulce - Seeds smooth; cyathial glands with truncate margin; bracteoles in between the male flowers prominent; perennials, involucellar leaves free

KEY TO SPECIES

1. Stems decumbent, procumbent, or ascending; habit suffruticose, dwarfish, (stems usually not longer than 20 cm.) slender (not more than 2 mm. thick at base), many

2. Cauline leaves manifestly petiolate, not more than 2 times longer than broad; capsules with coccae two-winged or two-lined on the back

3. Capsule 3-4 mm. x 2.5-4.0 mm., ovoid to ovoid-oblong; coccae with 2 parallel narrow undulate wings on the back; seeds sub-tetragonous with 2 parallel grooves on the ventral side and few pits on the dorsal side; caruncle small (c. 0.5 mm. long), conical

herniariifolia

3. Capsule 2.5-3.0 mm. x 1.4-1.7 mm., narrowly oblong; coccae with 2 narrow lines on the back; seeds cylindrical, sparsely pitted; caruncle large (0.7-1.0 mm. long), oblong or subsphaerical

issurica
2. Cauline leaves sessile (if subsessile, leaves linear), 2 or more times longer than broad; capsules with only a single line of dehiscence on the coccas

"Petrophila" complex

4. Cauline leaves tomentose, linear, sessile or sub-sessile; seeds 2.0-2.2 mm. x 1.3-1.7 mm., ovoid, subcompressed and reticulately pitted

pisidica

4. Cauline leaves glabrous or pruinose-hirtulous, always sessile

5. Seeds smooth

6. Umbellate radii very much condensed to form dense 'heads'; young capsules velutinous; stems densely leafy throughout

erythrodon

6. Umbellate radii open, spreading; young capsules glabrous; stems laxly leafy towards the top

glareosa

5. Seeds pitted

7. Cauline leaves glabrous, glaucescent, young leaves with involute margins

pestalozzae

7. Cauline leaves at least when young pruinose-hirtulous, margin of young leaves not involute

petrophila
1. Stems erect or ascending, taller (usually longer than 20 cm.) more or less robust (usually 3-7 mm. thick at base) few to many

8. Cauleine leaves with cordate bases; leaves ovate or ovate-oblance; seeds ovoid, smooth

agraria

8. Cauleine leaves with rounded, broad or narrow but never cordate bases; seeds of various shapes, smooth or pitted

9. Cauleine leaves with 3-5 nerves from the base, never linear; young leaves usually pruinose-hirtulous

10. Cyathial lobes velutinous outside;

leaf apex long-mucronate or acuminate; seeds smooth

macroclada

10. Cyathial lobes glabrous outside;

leaf apex obtuse or shortly mucronate; seeds smooth or wrinkled

11. Capsules longer (4.5-6.0 mm.), apex attenuate, always glabrous; seeds with crowded deep vermiciform anastomosing wrinkles

cheiradenia

11. Capsules shorter (3.0-4.0 mm.), apex subcompressed, at least when young usually pilose to velutinous;

seeds smooth

pannonica
9. Cauline leaves with a single mid-vein (if 3-nerved, leaves always linear), nerves sometimes obscure; young leaves always glabrous

12. Leaves on main stems densely imbricate

13. Leaves thick, coriaceous; seeds ovate-globose, smooth, greyish, often with darker spots

13. Leaves thin; seeds ovoid, irregularly reticulate pitted

12. Leaves on main stems usually lax

13. Cyathial glands ecornate; leaves on main branches always linear, long mucronate; capsules 2-4 mm. long; seeds 1.5-2.5 mm. x 1.0-1.5 mm., ovoid

13. Cyathial glands always 2-horned; leaves on main branches linear or otherwise, leaf-tip various

14. Capsules larger (5-6 mm. x 6-7 mm.); upper cauline leaves gradually tapering from the middle into an acuminate apex, thick and firm, always shining on the dorsal surfaces

14. Capsules smaller (not more than 4 mm. x 5 mm.); upper cauline
leaves acute, acuminate or obtuse; usually not shining on the dorsal surfaces

15. Leaves on sterile branches similar to those on main stems, oblanceolate to obovate, truncate or retuse; seeds 2.0-2.5 mm. x 1.5-1.8 mm., oblong-cylindric, grey; caruncle stipitate, projected and beaked on one side

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15. Leaves on sterile branches (if present) narrower than those on main stems, acute, mucronate or acuminate

16. Leaves on main stems ovate to ovate-lanceolate, secondary nerves always prominent on the lower surfaces; seeds 2.5-5.0 mm. x 1.7-2.0 mm., ovoid-oblong, caruncle almost discoid, slightly retuse on the ventral side

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16. Leaves on main stems elliptic-lanceolate to rhomboid-lanceolate or linear-lanceolate to elliptic-oblong, secondary nerves obscure on the lower surfaces

17. Leaves on main stems elliptic-lanceolate to rhomboid-lanceolate; seeds c. 2 mm. x c. 1.5 mm., ovoid-subtetragonal

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*terracina*  
*iberica*  
*sanasumitensis*
17 Leaves on main stems linear-lanceolate to elliptic-oblanceolate; seeds c. 2.5 mm. x 2.0 mm., ovoid virgata
Subsect. *Myrainiteae*

Cyathial glands with truncate margin; bracteoles in between the male flowers absent.

**KEY TO SPECIES**

1. Involucral glands without horns, glandular margin pectinate

2. Primary umbellate radii usually not more than 5 rarely up to 8, no secondary infra-umbellar radii; seeds narrower 4.0-4.5 mm. x 2.0-2.8 mm., with irregular vermiform wrinkles; leaf margin usually entire, sometimes scabrid \textit{denticulate}

3. Primary umbellate radii usually 6-15, often more, with usually several secondary infra-umbellar radii; seeds broader, 4.5-5.5 mm. x 3-3.5 mm. with more or less longitudinally arranged discontinuous pustules; leaf margin usually cartilaginous \textit{denticulate}, often pink \textit{craspedia}
1. Involucral glands distinctly 2-horned, glandular margin entire

3. Leaves lanceolate, 4 or more times longer than broad; leaf apex acuminate-spinose; cocci of the capsule acutely keeled; seeds smooth
   *rigida*

3. Leaves not lanceolate, not more than 2 times rarely 4 times longer than broad; leaf apex obtuse or mucronate, rarely acute or acuminate; seeds smooth, or vermiculate-rugose

4. Primary umbellate radii 8-20
   5. Seeds smooth or obscurely rugose; caruncle conical, acute at the apex; cauline leaves prominently pectinate-margined
      *marschalliana*

5. Seeds distinctly vermiculate-rugose; caruncle conical but concave at the apex, cauline leaves subentire or scabrid
   *myrsinites*

4. Primary umbellate radii only 3-6, rarely 7
6. Seeds vermiculate–rugose; caruncle stipitate; cauline leaves rhomboid or rhomboid—orbiculate  

6. Seeds smooth, rarely obscurely rugose; caruncle sessile; cauline leaves broadly elliptic or elliptic–rhomboid

anacampseros

armena
Sect. Anisophyllum

Cauline leaves stipulate; leaf base uniauriculate; cyathial glands with a narrow or broad petaloid wing on outer margin; prostrate, much branched annuals.

**KEY TO SPECIES**

Leaves membranous; stems filiform; capsules c. 1.5 mm. x c. 2 mm.; seeds c. 1.3 mm. x 0.8 mm., ovate-tetragonal, with many irregular, sometimes anastomosing wrinkles

chamaesyce

Leaves thick; stems up to 3 cm. thick; capsules c. 4 mm. x c. 4 mm.; seeds c. 2.5 mm. x c. 1.5 mm., subtetragonal-ovate, smooth

peplis
Genus Tithymalus (Tourn. ex) Hill subgenus paralias (L.) Rafin., Fl. Tell. 4, 115 (1836).
Genus Euphorbia L. subgenus paralias (L.) Prokh. in Komarov, Fl. URSS. 14, 303 (1949).

Herbs, rarely shrubby, never succulent. Cauline leaves usually alternate, rarely opposite, exstipulate. Involucellar leaves opposite, rarely ternate. Branches bearing cyathia in cymose pattern, often disposed in umbels. Cyathial glands 4-5, rarely more, flat, apex rounded or truncate, entire, two-horned or denticulate. Bracteoles in between the male flowers with apex laciniate or plumose, sometimes obsolete. Seeds carunculate or ecarunculate. The largest section consisting of about 800 species.

Type species: Euphorbia peplus L. (cf. Hillspaugh: 1909)

Although the epithet Tithymalus was used in the pre-Linnaean time in the sense of what is now known as Euphorbia L. (sensu lato), its post-Linnaean usage has been largely restricted to apply to all or part of Euphorbia L. Sect. Tithymalus in Boissier's interpretation. Tithymalus as a genus was first validly published by Hill (1756). Tithymalus Trew (1754) and Tithymalus Gaertner (1791) should be treated as illegitimate names as the authors in both cases cited Euphorbia L. as a synonym.

Shrubs with thick branches, denuded below. Cauline leaves alternate. Cyathia in terminal 'umbels' or 'panicles'. Cyathial glands truncate, often 2-horned. Seeds carunculate, rarely scarunculate.

A natural group characterised by shrubby habit and thick sappy branches; it comprises of 15 species distributed in the Atlantic islands, the Mediterranean region, Socotra island, Java, New Zealand, and Norfolk and Fiji islands in the Pacific. Probably related to both Subsections *Galarrhaeae* and *Esulae*. 

Syn. E. divaricata Jacq., IC. Fl. Par. 1, 9, t. 87 (1784).


Rounded shrub about 1 m. tall, dichotomously or trichotomously branched, glabrous. Branches sappy, stout. Younger ones (leaf-bearing) reddish, the older (denuded) brown and marked with leaf-scars. Cauline leaves 3.5-5.5 cm. long, and 4.0-7.0 mm. broad, sessile, linear-lanceolate, attenuated at the base, obtuse or acutish, paler on the under surface. Involucral leaves similar to foliage leaves, slightly smaller. Umbellate radii 3-5, 2-3 cm. long, once or twice bifid. Involucellar leaves rhomboid-semiorbiculate, 7-12 mm. x 8-12 mm., yellowish. Cyathia campanulate, lobes oblong 2 to 3 mm, margin fimbriate; glands peltate, transversely ovate, margin truncate or semilunar with 2 short horns, hairy on the ventral surface. Capsule c. 5 mm. x 4-6 mm., deeply trisulcate, apex truncate, coccæ laterally subcompressed; styles 2-3 mm. long. Seeds c. 2 mm. x c. 2 mm., subcompressed-ovate, smooth, yellowish; cauncle sessile, oblong. Micro- or nano-phanerophyte. 2n = 18 (D'Amato: 1947 in Darlington & Wylie: 1955).

Described from Italy, Crete and Stoechades island (Îles d'Hyères) (Herb. Linn. No. 89 - sterile).

Two species from Atlantic islands, _E. piscatoria_ Ait. and _E. regisjubae_ Webb. resemble _E. dendroides_ L. in general facies, but the latter is always recognizable by its smooth seeds and usually fewer umbellate radii.

Distributed throughout the Mediterranean, though rare in the East, often in maquis on south limestone slopes.
Subsect. Caryunculares Boiss. in DC. Prodr. 15(2), 111 (1862).

Cauline leaves alternate, often sharply denticulate. Cyathia in terminal 'umbels'. Cyathial glands truncate, often 2-horned. Bracteoles in between the male flowers large, plumose, or laciniate. Seed ovoid, smooth; caruncle large conical, longitudinally sulcate.

8 species distributed in the Mediterranean region but also extending through Iran up to Baluchistan. Related to Subsections Galarrhaei and Esulae, probably more nearly so to the latter.

Syn. E. coriacea C. Koch in Icnnae 21, 730 (1843).

E. megalantha Boiss., in DC. Prodr. 15 (2), 111 (1862) and Pl. Cr. 4, 1093 (1879), pro parte - non Boiss., Diagn. 1 (7), 95 (1846).

Tithymalus ispahanicus (Boiss.) Klotzsch & Gr. in Abh. Akad. Wissen. (Physik.) Berlin 37, 89 (1860).

E. vanensia Asn. in exsicco. G. & B. Post, Eastern Turkey trip, no. 720 (1906) (nomen).


Perennial, (-30) 46-63 cm. tall, stems 2-6 mm. thick, sulcate, bearing scale leaves below ground level, occasionally with some sterile axillary branches with narrower leaves. Cauline leaves (-4.5)

6-9 cm. x (-4) 6-15 mm., oblong-lanceolate. Involucral leaves (-2)

5.5-7.5 cm. x 8-27 (-35) mm., lanceolate, broadly ovate or broadly ovate-deltoid, base rounded or subcordate, usually oblique, acute or acuminate. Umbellate radii (-2) 5-6, 2 or more times divaric. Involucellar leaves + similar to involucral leaves. Cyathia hemisphaerical; lobes linear, 2-3 mm. long; glands transversely ovate-oblong with truncate margin and usually 2 short horns. Capsules 6.0-7.5 mm. x 4.5-6.0 mm., ovate-oblong; coccias rounded. Seeds
3.5-4.0 mm. x 2.8-3.0 mm., smooth, oblong, truncate at both ends, greyish; caruncle c. 2 mm. long, broadly ovate-conical, deeply multisulcate on the dorsal side and excavated in the centre on the ventral side. Fl. Apr. - Aug. Geophyte.

Type: [Iran] prope Ispahan, Aucher 5287 (G)


A weed of disturbed steppe and fallow fields, reaching an altitude of 2000 m.

Although Boissier described E. ispahanica in 1846, he later regarded it as conspecific with the closely related E. megalantha Boiss. However, morphologically and geographically E. ispahanica is quite distinct; it has larger capsules (6.0-7.5 mm. x 4.5-6.0 mm., instead of 4.5-5.0 mm. x c. 5 mm.), larger seeds (3.5-4.0 mm. x 2.8-3.0 mm., instead of c. 3 mm. x c. 2.8 mm.), taller more robust stature, usually thicker more rigid umbellate radii, and usually thicker broader involucral leaves. E. ispahanica is more northerly and westerly in distribution, being found on the Caucasus, S. Transcaucasia, Armenia, Azerbaidjan, Kurdistan, Iraq, with its eastern limit near Ispahan in Iran. E. megalantha is almost confined in Iran east of Ispahan.
The caruncles in *E. froedini* were described by Rechinger as "valde depressa non prominente", but the isotype at Vienna shows the large ovate-conical caruncles and the linear cyathial lobes of *E. ispahanica*; *E. froedini* can be regarded as only a depauperate form of the latter and evidently conspecific with it.

Despite certain variation in the size and shape of cauline, involucral, and involucellar leaves, *E. ispahanica* is always recognizable by the long linear cyathial lobes and the characteristic large caruncles. *E. ispahanica* Boiss. var. *brevicaulis* Nábeck, cannot be regarded as more than an aberrant form with shorter stems and much longer and divaricate umbellate radii.

Endemic to areas cited above.
Subsect. Galarrhacei (Haworth) Boiss. in DC. Prodr. 15 (2), 113 (1862).


Herbs or shrubs. Cauline leaves alternate, rarely the upper ones verticillate. Cyathia in 'umbels', rarely reduced to a solitary cyathium. Cyathial glands transversely oval, margin rounded, not truncate nor bihorned. Bracteoles in between the male flowers hirsute or plumose. Seeds chiefly carunculate.

Over 100 species in the temperate regions mainly centred in Europe and the Mediterranean, but also in Tropical Africa extending as far south as Cape. Related to Subsect. Esulae.

Clabrous spinous much branched compact shrub 0.5-1 m. tall.

Branches rigid, much intricate, leafless and twiggy below.

Cauline leaves crowded, subsessile, elliptic-lanceolate or oblong-lanceolate, entire, mucronate. Involucral leaves similar to cauline leaves. Umbellate radii 3-4, once or twice bifid, much abbreviated, the ultimate branches persisting as bi-furcate spines in the fruiting stages. Involucellar leaves obovate. Capsules 3.0-4.0 mm across, globose-trilobed; cocciæ with many hemisphaerico-cylindrical warts. Seeds c. 2.0 mm. x c. 1.5 mm. ovoid, brown, caruncle minute, depressed. Fl. Mar. - July. Woody chamaephyte.

Syntypes: In regione sempervirenti totius Greciae, Bithynia et Moemo, Grisebach (w - non vide); insulis Leucadia et Corcyra, maggiari (B ?)

On rocky slopes, in Pinus brutia forests on serpentine and limestone (Marmaris), forming one of the elements of the Mediterranean maquis and phrygana from sea level to 300 m.

This species has been often confused previously with another closely related species E. spinosa L. (distributed mainly in the C. and W. Mediterranean, and N. Balkan peninsula) but differs chiefly in its shorter, narrower, bi-furcate spines which originate from the radii of the umbel, instead of the longer wider simple 'spines' of the latter which represent the blunt persistent fertile branches. In habit E. acanthothamnos resembles Poterium spinosum and, like the latter, in Greece often affords protection against grazing for non-spiny herbs (Davis, obs.).

In Turkey, E. acanthothamnos has been reported only from the Lycian coast near Marmaris. Outside Turkey, it extends from the Dalmatian coast through Greece (including Aegean islands) to Crete, being more eastern in its distribution than E. spinosa.
Euph., t. 80 (1863).


*E. dumosa* Boiss., Diagn. 1 (12), 110 (1855) - non E. Meyer ex Boiss. (1862).

*E. hierosolymitana* Boiss., Diagn. 1 (12), 110 (1855).

*E. thamnoides* Boiss. var. *hierosolymitana* (Boiss.) Boiss., in DC. Prodr. 15 (2), 131 (1862).

Glabrous, twiggy shrub about 1 m. tall. Young plants with napiform root. Branches rigid and twiggy, sparsely branched.

Cauline leaves subsessile, elliptic or elliptic-spathulate, entire, obtuse, acutish or mucronate. Involucral leaves similar to cauline leaves. Umbellate radii 4-6, once or more bifid and abbreviated.

Involucellar leaves obovate or elliptic, usually yellowish.

Capsules 3.5-4.5 mm. x 4.5-5.5 mm., deeply trilobed; coccae with many crowded shortly conical warts. Seeds 2.5-3.8 mm. x 2.0-2.5 mm., ovoid, brown, smooth; caruncle subglobose, depressed. Fl. Jan. - June. Woody chamaephyte.

Syntypes: In collibus regiones calidioris Syriae ad Berythium et Tripolin, Poissier (G; K - type of *E. dumosa* Boiss.); Sidonem, Gaillardot (W - n.v.); [Turkey (C3]), in Iycia prope Adalia[Antalya] Pestalozza (G); Bourgeau ((K; E); [Turkey (C1)] circa Ephesum, Aucher 837 (P?); Cypri, Labillardiere in h. Deless. (G - missing).
On limestone rocks, in Mediterranean communities near the coast (0-30 m.). *E. thamnoides* shows affinities with *E. bivonae* Steud. ex Boiss. (Sicily, Malta and N. Africa), but is distinguished by its elliptic or elliptic-spathulate leaves (instead of linear-lanceolate), and by its obovate, obtuse involucellar leaves (instead of elliptic and mucronate). It is probably also related to *E. rhytidosperma* Boiss. et Bal.; see under the latter for differences.

*E. thamnoides* is an eastern Mediterranean species, extending from W. and S. Anatolia (where it has been recorded only from Lycia and near Izmir) to Cyprus, Syria, Lebanon, and Palestine.

Boiss., *C. Ruph.*, t. 85 (1866).

Rhizomatous perennial. Stems many, up to 60 cm. tall and 2-3 mm. thick, glabrous, slender and twiggy. Cauline leaves 2.0-4.0 cm. x 1.2-1.7 cm., laxly arranged, subsessile, oblong-elliptic, pilose, very minutely serrulate towards the apex, obtuse or acute. Involucral leaves similar to cauline leaves. Umbellate radii 5, slender, 1 to 2 times divided. Involucellar leaves broadly ovate to suborbicular, truncate to subcordate at base. Capsules deeply trilobed; cocci with conical-cylindrical warts. Seeds broadly ovate-sphaerical, brown with many reticulately arranged narrow wrinkles; caruncle depressed, subsessile. Fl. Apr. - May. Geophyte.

Type: [Turkey (05)]: in fauce Guzel Dere Ciliciae littoralis supra Sedichig non procul a Mesina, floret fine Maii, fructus maturat Junio, Balansa (C; K; EM). Cilicia: Kagiraki, Apr. 1896, Siehe 178 - as *E. dulcis* L.

*E. rhytidosperma* is probably allied to the shrubby *E. Mediterranean* *E. thamnoides* Boiss. which it chiefly resembles in leaf-shape and capsule, but is readily distinguished by its herbaceous habit, pilose leaves (instead of glaucescent), broadly ovate or suborbicular involucellar leaves with truncate or subcordate base (instead of elliptic or obovate), and its rugose seeds (instead of smooth). *E. rhytidosperma* is endemic to the Cilician Taurus.
(6) *E. djimilensis* Boiss., Fl. Or. 4, 4, 1104 (1879).

Perennial with thick cylindrical vertical rhizome. Stems many, up to 35 cm tall, erect, simple, sulcate, with scale leaves at the base. Cauline leaves 3.0-4.0 cm x 1.4-1.7 cm, elliptic or elliptic-spathulate, sessile, entire or serrulate or obscurely denticulate towards apex, obtuse, sparsely pilose or glabrous, mid-vein white and prominent on the under surface. Involucral leaves similar to cauline leaves, smaller. Umbellate radii 3-5, abbreviated. Involucellar leaves ovate. Capsule 4.5-5.0 cm x 6.0-6.5 cm, deeply trilobed, depressed at both ends, coccace with crowded shortly cylindrical warts. Seeds c.3.0 mm x c.2.5 mm, broadly ovate, light-coloured; caruncle subglobose. Fl. July - Aug. Geophyte.

Type: [Turkey (A8)]; in regione alpina Ponti Lazici prope Djimil [river Cimil near Rize], 1980 m., Jul. [1866], Balansa (holo. C; iso. K).


On mountain slopes reaching 2400 m., often in alpine or subalpine meadows.

*E. djimilensis* resembles *E. macrocarpa* Boiss. et Buhse in its erect, simple stems with scale leaves and in the prominent mid-vein
of its leaves, but can be easily separated by the elliptic or elliptic-spathulate leaves, by the lack of axillary floriferous branches and by its smaller capsules and smaller, carunculate seeds.

Although *E. djimilensis* is mainly centred in the eastern part of Buxine province, it has been collected from Amanus, a disjunct distribution exemplified by several other predominantly Buxine species like *Rhododendron ponticum*, *Fagus orientalis*, *Lathyrus aureus*, *Aristolochia pontica*, etc.
(7) E. squamosa Willd., Sp. Pl. ed. 4. 2 (2), 916 (1800). Boiss.,

Io. Euph., t. 74 (1866).


Tithymalus asperus (M. B.) Klotzsch & Gr. in Abh. Akad. Wissen.
(Physik.) Berlin, 37, 76 (1860).

Mosc. 12, 196 (1860)!

E. aspera M. B. var. oligadenia Boiss., in DC. Prodr. 15 (2),
124 (1862)!

Perennial with a woody stock. Stems up to 65 cm. tall, pubescent-
hirtulose, crisply-pubescent or glabrous, cylindrical, slender, not
more than 4 mm. thick at the base, smooth, with several arillar
floriferous branches above. Cauline leaves 3.5-6.5 (-10.0) cm. x
1.8-3.0 (-4.0) cm., sparsely arranged, petiolate (petioles up to 6 mm.
long), elliptic-oblong or elliptic-lanceolate, repand or subentire,
acute or acuminate, membranous, bright-green, usually paler on the
lower surface. Involucral leaves similar to cauline leaves, slightly
smaller. Umbellate radii 4-6, slender, several times dichotomously
divided, more or less divaricate. Involucellar leaves broadly ovate
or semidorbicular, base truncate or subcordate, rarely rounded, apex
obtuse, acutish or mucronate. Cyathial glands broadly transversely
ovate with rounded margin, ecornate. Capsules 3-4 mm. x 4-5 mm.,
coccae rounded and covered with cylindrico-filiform warts, sometimes
pubescent. Seeds 2.5-3.0 mm. x 2.0-2.3 mm., ovate-subcompressed,
brown, smooth; caruncle ovate-trigonous, retuse on the inside.

Fl. May - Sept. Hemicryptophyte.

Holotype: [Turkey]: In Cappadocia, Tournefort (P - n.v.; photo. E).

A7: prov. Trabzon, dist. Maçka, 2 km. from Hamsiköy, 1320 m.,
10 July 1958, Huber-Morath 16082; S. of Trabzon, 200 m., 19 May 1931,
R. Götz 286. A8: prov. Rize, dist. Hemşin, Ortaköy - Çat, 1700 m.,
2 Sept. 1952, Davis 21263; prov. Artvin, Hopa, 50 m., 7 July 1931,
R. Götz 736.

On rocky slopes in hazel scrub and bushes, and in both evergreen and deciduous forests, reaching 1700 m.

E. squamosa Willd. was described from Cappadocia and E. aspera M.B. from Caucasus. Boissier observed (Fl. Cr. & in DC. Prodr.) that E. squamosa is an unsuitable epithet. Nevertheless, he cites the type of E. squamosa as one of the specimens representing E. aspera. A photograph of the type of E. squamosa examined at Edinburgh shows only a scrappy upper part of a stem with two axillary floriferous branches and a few separate radii of the umbel. However, the presence of slender infraumbellary radii, the general appearance of capsule with cylindrico-filiform warts and the shape of the involucellar leaves is conclusive enough to equate this plant with Colchic specimens. The type locality "in Cappadocia" seems to be erroneous; Tournefort also visited Georgia and might have collected it from there.

E. squamosa, in its habit, looks like E. macroceras (a species
with connate involucellar leaves) with which it overlaps in its distribution, but easily separated by its free involucellar leaves and warty capsules.

Probably endemic to easternmost Colchic area in Turkey, Caucasus, Transcaucasia, and N. Iran.

Many stemmed perennial with lignified persistent root. Stems up to 55 cm. tall and up to 5 mm. thick, sulcate, hirtellous with scale leaves at the base, and above with numerous infra-umbellary branches. **Cauline leaves** 3.5-6.0 cm. x 0.8-1.5 cm., sessile, oblong or oblong-lanceolate, entire, acute, pilose at least on the margins, sometimes amplexicaul-subcordate at base. **Involucral leaves** more or less similar to cauline leaves but smaller. **Umbellate radii** 5-7, only once or twice divided, stunted. **Involucellar leaves** very broadly ovate to almost orbicular. **Cystidia** solitary on each axillary branch; glands ecornate. **Capsules** 6-10 mm. x 5-10 mm., deeply trilobed, depressed at both ends; coccias rounded and covered with several cylindrico-filiform warts. **Seeds** 4-5 mm. across, globose, brown, sometimes with greyish specks, smooth, ecarunculate. **Fl. June - July. Geophyte?**

**Type:** [N. Persia]: Ssamangesbirge, an einem grasigen buschigen Abhange, 1 June 1849, Buhse (Holo. G; Iso. W, photo. E).


Among rocks and between oak scrub, often on open slopes and in hollows, reaching 1930 m.

**E. macrocarpa** is allied to **E. grisophylla** M.S. Khan; see the description of the latter for differences.

Perhaps confined to **E. Anatolia, N. Iran and Caucasus (Talysch).**
E. grisophylla M. S. Khan, spec. nov.  Fig. 1.

Affinis E. macrocarpae Boiss. et Buhse sed foliis caulinis sub sessilibus, radiis secondariis infr umbellum plerumque nullis, capsulis et seminibus multo minoribus, seminibus ovoideis differt.

Perennis, glabra vel pubescenti-hirtella. Radix ignota. Caules floriferi plures, erecti ad 80 cm. alti. plus minus fistulosi, striati, sparse foliosi, saepe superne ramosi, basi ad 7 mm. crassi squamosis imbricatis provisi. Folia caulina mediana 30-70 mm. x 15-30 mm., sub sessillia (petiolus non plus quam 2 mm. longa), oblonga vel oblongo lanceolata vel ovata, integra, subreppanda, acuta vel mucronata, membra nacea, griseo-viridia. Folia involucri 4-5, elliptica vel elliptico rhomboidea vel late ovata, 25-45 mm. x 20-35 mm., acuta vel acuminata. Radii primarii umbellae 4-5, 25-75 mm. semel vel bis bifidi. Folia involucellae 10-27 mm. x 15-30 mm., late ovata, suborbiculata, flavescenti-viridia, basi plerumque subcordata. Cyathia campanulata, 3-4 mm. longa, lobis oblongis obtusis ciliatis extus glabris intus velutinis, glandulis subreniformis eornutis flavescentibus vel fuscis (in sicco). Bracteolae inter flores masculos latae, laciniatae et ciliatae. Capsula 4.5-7.0 mm. x 5.0-6.5 mm., ovoidea, trilobata, coccis rotundatis verrucis pluribus cylindrico-filiformibus provisis, stylis 2.0-2.5 mm. longis, a medio coaltis, apicem versus bifidis. Semen c. 4 mm. x c. 3 mm., late ovoideum, griseum, laxe, caruncula minutissima munita.

Holotype: CO10: prov. Hakârî, Cilo dağ, in gorge between Cilo yayla & Diz deresi, 2400 m., rocky slope, 10 Aug. 1954, Davis & Polunin
(Davis 24250:E). A9: prov. Erzerum, about 10 km. east of Kosor
dist. Şatek, Kambos dağ above Hurnuz, 2100 m., 31 June 1954, Davis 25456.
B9: prov. Van, dist. Gevaş, Artos dağ, 3030 m., 16 July 1954, Davis 22745,
dist. Çatak, Kavuşşahap dağ, 3100 m., 23 July 1954, Davis 25212.

In its general habit, presence of scale leaves, and in the
characters of cyathial glands, capsules and seeds, *E. grisophylla*
shows affinities with *E. macrocarpa* Boiss., but differs by its much
smaller capsules and seeds (the latter being broadly ovoid), subsessile
cauline leaves and usually by its lack of infra-umbellary secondary
radii. Although overlapping in its distribution with *E. macrocarpa*
in E. Anatolia, *E. grisophylla* does not extend beyond Armenia in the
north; it is probably a geophyte on mountain slopes and screes, reaching
an altitude of 3100 m.
Fig. 1. Holotype of *E. griscophylla* M.S. Khan.
A very robust rhizomatous, glabrous perennial reaching 1 m. in height. Stems up to 1.5 cm. thick at the base, usually fistular, profusely branched. Cauline leaves 4.0-6.5 cm. x 1.0-2.5 cm., sessile, elliptic-oblong or oblong-lanceolate, obtuse or acutish, entire or remotely denticulate. Leaves on axillary shoots narrower, elliptic-lanceolate or linear-lanceolate. Involutural leaves similar to cauline leaves. Umbellate radii up to 8, short and condensed forming in early stages sometimes a capitulate umbel. Involucellar leaves 11-15 mm. x 7-13 mm., yellowish, obovate or elliptic, obtuse. Cyathial glands transversely oblong, ecorinate. Capsule 4.0-5.0 mm. x 4.0-5.5 mm., globose-trilobed, depressed at both ends; coccas rounded with short cylindrical warts. Seeds 3.0-3.5 mm. x 2.5-3.0 mm., ovate-oblong, smooth, brown; caruncle small, discoid, slightly projected to the ventral side, retuse at 1 or 2 ends, deciduous. Fl. Mar. Helophyte. 2n = 20 (Perry: 1943; Polya: 1950; Shimoyama: 1959 in Löve & Löve: 1961).

Described from southern Sweden, Germany and Belgium (Hort. Cliff.; Herb. Linn. No. 69).

Usually associated with damp marshy places, swamps, moist places near the ponds and in the areas of streams and rivers, up to 900 m.

*E. sauliana* Boreau ex Boiss. (in DC. Prodr. 15 (2), 1266: 1866) was described from Lydia "prope Magnesiam Meandri [Prov. Aydin]." Boissier claims that although *E. sauliana* shows close affinities with *E. palustris*, it was reported by Boreau to have retained its diagnostic characters in cultivation for a period of several years. *E. sauliana* is said to differ from *E. palustris* in its more elongated and thinner axillary shoots, much narrower leaves, narrower involucellar leaves and much smaller and shorter warts on the capsules. The type of *E. sauliana* at Geneva has narrower (5-8 mm.), more pointed leaves. However, plants evidently belonging to *E. palustris*, collected from two isolated localities (viz. Prov. Konya, Siehe 153 - as *E. virgata* var. *orientalis* Boiss.; and Prov. Karakose, Balik gölü, Haradjian 4223) show that the breadth of cauline and involucellar leaves and the thickness and length of axillary shoots varies quite considerably in this species. The three areas in Turkey where *E. palustris* has so far been collected are Bithynia, Cappadocia, and Armenia. More material might throw light on the nature of the taxon, *E. sauliana* and the validity of the size and width criteria of young axillary shoots, cauline and involucellar leaves.

*E. palustris* is very similar in habit to a Caucasian species *E. eugeniae* Prokh. (in Komarov, Fl. URSS 14, 735: 1949) of which
there is a photograph at Edinburgh of the type in Leningrad.

*E. eugeniae* is said to differ chiefly in its smaller capsules (not more than 3.5 mm. long) with pectinate-form processes on the upper dorsal parts of coccae, and in its shorter stature (not more than 65 cm.) with stems only 4-6 mm. thick at base.

*E. palustris* is mainly a European species with a distribution extending from southern Spain through Central Europe to most parts of N. Europe, and towards the east up to the Urala, Siberia and Altai. Towards the south, it reaches Greece; in Turkey it has so far been known from the three isolated areas mentioned above.


Glabrous perennial with many twiggy stems up to 1 m. tall and up to 7 mm. thick, usually with several axillary floriferous branches below the terminal umbel. Cauline leaves (-3.0)5.0-8.0(-12.0) cm. x (-0.5)0.8-2.0 cm., often strict, sessile, elliptic-lanceolate or oblong-lanceolate, usually entire, rarely obscurely serrulate towards apex only, acute or acuminate, subcoriaceous, mid-vein usually white and prominent on the under surface. Involucral leaves elliptic, elliptic-rhomboid or rarely lanceolate. Umbellate radii 4-7, one or more times dichotomously divided. Involucellar leaves elliptic to broadly elliptic, rarely ovate. Cyathial lobes oblong, truncate, ciliate; cyathial glands broadly transversely oblong. Capsule 4-5 mm. x 4-5 mm., deeply trilobed, sparsely pilose, coccas rounded and covered on the backs with two rows of short crowded warts giving a wrinkled appearance. Seeds 3.5-4.0 mm. x 2.0-2.4 mm., ovate, yellowish-brown to light brown; caruncle small, sub-globular. Fl. June - Aug. Geophyte.

Described from Orient (Herb. Linn., No. 60 - only the right hand specimen of this sheet named as E. orientalis could be referred to this species; the other plant on this sheet probably belongs to E. palustris L.).


Common by the side of rivers, on rocky metamorphic, igneous or limestone slopes, eroded bare clay hills dried up river beds and moist valley floors, reaching 2900 m.

_E. artvinensis_ Borm. et Woron. was distinguished by its authors from _E. orientalis_ chiefly by the shorter umbellate radii bearing solitary cyathia on each radius and by its narrower stems. But, it has been seen that plants collected from river side and moist places are usually robust with normally developed umbels whereas gatherings from dry situations like eroded clay hills etc. exhibit the characters described for _E. artvinensis_. The leaf-width also seems to vary within rather wide limits. _E. artvinensis_ probably represents an ecotype of _E. orientalis_ adapted to dry and unfavourable conditions; similar variants may occasionally result from grazing.

Sterile specimens of _E. orientalis_ can be easily mistaken for _E. altissima_ Boiss. which, however, is more southern and western in
distribution; see the discussion under the latter for differences.

_E. orientalis_ is confined in Turkey to the Eastern provinces viz. Pontus, Armenia, and Kurdistan. Outside Turkey, it extends to Caucasus, Azerbaidjan and reaching N. Iraq towards the South.
(12) **E. altissima** Boiss., Diagn. 1 (5), 52 (1844). Boiss., Icon. Ruph., t. 66 (1866). Map. 2


Wissen. (Physik.) Berlin 37, 80 (1866).

A many stemmed perennial up to 1 m. tall. Stems up to 1.3 cm. thick. **Cauline** leaves 6.5-14.0 cm. long, 1-2 cm. broad, lanceolate, thin, sessile or sub sessile, base narrow, margin serrulate at least above the middle, acute. **Involucral** leaves lanceolate or elliptic-rhomboid. **Umbellate radii** 5-8, 4-12 cm. long; with many axillary infra-umbellar radii. **Involucellar** leaves ovate, elliptic or elliptic-rhomboid. **Capsules** 3.5-5.0 mm. x 3.5-5.0 mm.; cocciae rounded, granulose or punctate, always pilose. **Seeds** 2-3 mm. long and 1.8 mm. broad, broadly ovate-sphaerical; caruncle minute, depressed. Fl. Apr. - July (-Sept.).


Key to the varieties.

- Cauline leaves tomentose on both surfaces, or pilose at least on veins or margins --------------- a. var. **altissima**
- Cauline leaves glabrous on both surfaces ------------ b. var. **glabrescens**

a. var. **altissima**

Syntypes: [Turkey] (C2): ad rivuloso circa Denisle [Denisi] Boissier (G); Laodiceam [Denisi] in Phrygia australi, June, 1842, Boissier (G, K).

B7: prov. Manisa, Taytén [Tatan], 3 km. from Salihli, 31 May 1938, Huber-Morath 5276.
B7: prov. Elaziğ, Harput [Harput], Erzuruk [Erzülük], 20 Apr. 1889, Sintenis 809; prov. Malatya, Malatya - Elaziğ, 21 km. E. of Malatya, 880 m., 16 June 1949, Huber-Morath 9400. C2: Denizi-Cardak,

b. var. glabescens Boiss. ex M. S. Khan, var. nov.

A typo foliis caulinorum utrinque glabris differt.

Holotype: [Turkey (Lydia)]: plaine de Sardes, September, [a. ?], Balansa 195 (d).


Common along the edges of streams and in humid places, with an altitudinal range from 700 m. — 1100 m.

E. altissima is related to a European E. villosa Waldst. & Kit. (E. pilosa auct. incl. Boiss., Fl. Or. — non L.; E. procera M.B.) which, however, differs by its glabrous capsules and broader shorter cauline leaves. A specimen from Marienfeld (Transcaucasia) distributed by Hohenacker under the name E. procera M.B., and mistakenly referred to E. altissima by Boiss. (Fl. Or.) does, in fact, represent E. villosa Waldst. & KIt. which evidently reaches Caucas; E. altissima is absent from Caucas. Out of fruit, E. altissima is easily confused with E. orientalis L. which it resembles in leaf-shape and size of umbellate radii. The latter, however, is more northerly and easterly in distribution, extending from Armenia and the Pontus through Azerbaidjan into the Elburz Mts.
and S. E. Iran. *E. altissima* differs from *E. orientalis* in its thinner serrulate leaves (instead of subcoriaceous and almost entire), and capsule with verrucose coccae.

Outside Turkey, *E. altissima* is restricted to Syria, Iraq, Anti-Lebanon and Cyprus; in Turkey it is absent from Buxine province.

**Note:**

Some hairy Iraqi specimens (no seeds available) (e.g. dist. Mosul, supra Sirsank, 1300-1400 m., 10-12 July 1957, K. H. Rechinger 11649) have more slender stems and much narrower and smaller cauline leaves than *E. altissima*, and appear to represent a distinct taxon allied to that species.

Boiss., in. Euph., t. 76 (1866).


*E. erioclada* Boiss. et Heldr., Diagn. 1 (7), 88 (1846).

Perennial, usually erect, up to 60 cm. tall with a lignified root. Stems up to 6 mm. thick and woody at the base, sparsely or densely villose or villose-hirsute, sometimes with axillary branches above. Cauline leaves (-3.0)4.0-7.0 cm. × (-1.5)2.0-2.5 cm., sessile, oblong or oblong-lanceolate, serrulate towards the apex, obtuse or acutish, rounded or narrowed at base, sparsely or densely villose at least on the under surface, rarely young leaves glabrous on both surfaces. Involute leaves similar to cauline. Umbellate radii 4-5, 2 or more times divided. Involute leaves narrowly ovate, ovate-oblong or ovate-lanceolate. Cyathial glands broadly transversely oblong, margin rounded, ecornate. Capsules 3-4 mm. × 3-4 mm., deeply trilobed, glabrous, coccæ rounded with short, more or less hemisphaerical to shortly conical warts. Seeds 2.5-3.0 mm. × 1.5-1.7 mm., subcompressed-ovoid, brown, smooth and shining; caruncle transversely ovate to reniform. Fl. May – Aug. Geophyte.


Aeg. Is.: Midilli (Lesvos), prope Dip (Ntip) ad sinum Kolpos Jeras, 18-24 May 1934, K.H. & F. Rechinger 5657, in monte Olympos ad pagum Ajassos, ca. 400-700 m., 19 May 1934, K.H. & F. Rechinger 5623.

Usually in shady, moist places, from sea level to 700 m.

_E. sessiliflora_ Boiss. et Sprun. (Diagn. 1 (5), 52: 1844), which was described from mont. Adelphi in Euboea and later reduced to a variety of _E. oblongata_ by Boissier himself (in DC. Prodr. 15 (2), 126: 1863) and regarded by Nyman as a subspecies (Consp. Fl. Europ. 1, 649: 1881), was distinguished by its shorter stature, smaller, more obtuse leaves with greyish tomentum and obsoletely serrate margin, and short "capituliform" umbellate radii. I have not seen the type specimen but examined some plants from Aznavour Herbarium, Geneva (e.g. Constantinople, bord du chemin, 3 June 1894, _Azn._ 1858) labelled as var. _sessiliflora_ Boiss. which show several stems and very much condensed umbellate radii. However, the possibility that it might represent only a depauperate form growing in unfavourable situations cannot be ruled out. More material (including the type) needs to be examined before deciding on the status of this taxon.

The relationships of _E. oblongata_ are rather obscure. In general facies, it approaches more or less _E. verrucosa_ Linn. (_E. pubescens_ Vahl) which, however, has tuberculate seeds and is further distinguished by its oblong-lanceolate cauline leaves. _E. oblongata_ was mistakenly described by Grisebach as an annual; in fact, it is a perennial with a thick lignified root.

Each of the 2 sheets under the name _E. pilosa_ in Sibthorp's herbarium at Oxford consists of a mixed gathering of _E. oblongata_ Griseb. and
E. verrucosa L. (E. pubescens Vahl.).

E. oblongata is mainly centred in Greece, Crete and Thrace, but reaches Troas and the Bosphorus in its eastern extension; it probably also occurs in the Buxine province of European Turkey.

Syn. Tithymalus wittmanni (Boiss.) Prokh., in Komarov, Fl. URSS 14, 377 (1949).

Perennial with woody stock. Stems several, procumbent, 10-15 cm. long and c. 1 mm. thick, filiform. Cauline leaves 1.0-2.5 cm. x 3-5 mm., oblong-lanceolate or spatulate, mature leaves serrulate at least towards apex, obtuse or acute. Involucral leaves 1.0-1.5 cm. x 4-6 mm., elliptic, acute or obtuse. Umbellate radii 3-5, slender, unequal, 1.5-3.5 cm. long. Involucellar leaves similar to involucral leaves but smaller. Cyathial glands eornate, margin rounded. Capsule c. 3.5 mm. long, ovate-sphaerical; coccae granular. Seeds c. 2.0 mm. x c. 1.5 mm., smooth, brown, shining; caruncle c. 0.5 mm. long. Fl. Apr. Chamaephyte.

Type: In saxosis Transcaucasiae ad Atakur et Usurgeti, Wittmann (LE - n.v., G).


Probably endemic to S. Caucasus, Lazistan, & N. E. Armenia growing in mountain steppe and rocky ledges.

E. wittmannii is perhaps allied to a Cyprian endemic, E. cypria Boiss. but is easily recognised by its larger, broader, spreading leaves, larger involucral leaves, and smooth seeds.


*E. troodii* Post in *Mem. Herb.* *Boiss.* 18, 100 (1900).


Glabrous caespitose perennial. Stems up to 45 cm. long, many, rigid, slender, erect or decumbent. Cauline leaves 1.5-2.5 cm. x 0.2-0.5 cm., sessile, oblong-spathulate, obtuse (the upper one linear-lanceolate and acute), strict or spreading, remotely serrulate towards apex. Involucral leaves similar to upper cauline leaves. Umbellate radii 1-6 cm. long, unequal. Involucellar leaves elliptic, mucronate. Capsules c. 3.5 mm. long, deeply trilobed; coccæ subcarinate, glabrous, smooth. Seeds 2.0-2.2 mm. x c. 1.5 mm., ovoid-oblong, with scattered shallow pits; caruncle obscure or absent. Fl. May - June. Chamaephyte.

Type: [Turkey (D5)]: in jugis umbrosis *Cassii in regione inferiori secus viam qua a Laodicea ad Suidieh itur circa pagum *Cassab* [Kasab, S. of Antakya], Boissier (holo. C; iso. K).

06: prov. Hatay, Mt. Amanus, a. 1906, Haradjian 293, *ibid.*, 900 m., a. 1906, Haradjian 487, prope Beilan [Belen], 1050 m., May - June 1862; Kotschhy 173

On mountains and in valleys up to 1050 m.

*E. rigoi* Boiss. ex Freyn was distinguished from the typical plants of *E. cassia* by its decumbent or ascending habit and the stunted umbellate radii (not longer than the involucral leaves). Holmboe, who regards *E. rigoi* as a subspecies, claims that these characters described
by Freyn are preserved in cultivation and that these plants are confined to Cyprus. Post differentiated his E. troodi chiefly on its obovate-rotund and microporate involucellar leaves. However, material from Amanus also shows the decumbent habit, and the length of umbellate radii varies independently of habit and the shape of the involucellar leaves which themselves show considerable variation in their length/breadth ratio.

E. cassia resembles a Cyprian endemic, E. cypria Boiss. in habit and seed characters, but is distinguished by its oblong-spathulate (instead of linear) leaves and by the stems which are branched below. It is confined to Cyprus, Amanus, W. Syria and Lebanon.

E. cassia is allied to E. austroanatolica Huber-Morath & M. S. Khan; for differences see under the latter.
Affinis *E. cassiae* Poiss. sed capsulis molliter verrucosis, seminitus laevibus, foliis caulinis membraneis et pellucido-punctatis differt.

Perennis, herbacea, glabra, et glaucescentia vel pilosa. Caules ex rhizomate plures, ad 30 cm. longi, ad basin 1-2 mm. crassi et caudiculosi, graciles, fragiles, flexuosi, ascendentes, plerumque simplices, raro ramosi, sparse foliosi, inferne demum denudati. *Folia caulina* mediana 15-25 mm. x 3-6 mm., breviter petiolata (petiolus c. 0.5 mm. longus), anguste elliptica vel oblongolata, membraneae, pellucido-punctata, anguste cartilagineo-marginata, folia juvenilia saepe induplicata et falcata, purpureo-et serrulato-marginata. *Folia involucrata* 4-5, elliptica vel lanceolata, 10-20 mm. x (-2) 5-8 mm., minute serrulata, mucronata, pellucido-punctata. *Radii primariorum umbellae* 4-5, 1-4 cm. longi, semel vel bis bifidi. *Folia involucellae* (primariae) 8-13 mm. x 4-8 mm., elliptica, mucronata, pellucido-punctata. *Cyathia* 2-3 mm. longa, campanulata, lobis oblongis, truncatis vel retuis utrinque glabris sed ciliato-marginatis, glandulis (in sicco) flavescentibus, breviter stipitatis, transverse late oblongis vel subreniformis, marginibus rotundatis, ecorumitis. Bracteolae inter flores masculos paucae, ciliatae. *Capsula* 3.0-4.5 mm. longa, coccis glabris verrucis conico-cylindricis purpureis mollibus provisis. *Semen* 2.5-2.7 mm. x 1.7-1.9 mm., ovoideo-oblongum laeve, fuscescens, caruncula c. 0.5 mm. longa, globosa. *Fl.* Apr. - June.
C2: prov. Muğla dist. Köyceğiz, Muğla - Fethiye, Macchie
141 km. südöstlich Muğla, 7. Juni 1938, Huber-Morath 5281
(Holotypus, Hub.-Mor.; iso. E), dist. Fethiye, Kizildere, between
Fethiye & Köyceğiz, 50 m., 1 Apr. 1956, Davis 25540(K), Muğla -
Fethiye, 37 miles from Muğla, 70 m., May 29, 1962, Dudley
(D. 35141-E).

E. austroanatolica is probably related to an eastern Mediterranean
species, E. cassia Boiss. (Cyprus, Amanus, W. Syria, and Lebanon)
which it resembles in general facies and in the characters of the
cyathial glands, but it is readily distinguished by its verrucose
capsules, smooth seeds, and membranous, pellucid-punctate leaves.

This slender, tufted species has been collected only from the
province of Muğla where it grows near sea level in Pinus brutia
forest on serpentine and maquis; it is probably endemic to
S. W. Anatolia (Caria).
Fig. 2. Holotype of *E. austroanatolica* Hub.-Mor. et M.S. Khan.
E. schottiana Boiss., Diagn. 2 (4), 85 (1859).

Syn. E. dense Schott et Ky. in Kotschy, Reise Cilic. Taur., 396; 1859, nomen solum, non Schrenk (1845).

Tithymalus schottii (Boiss.) Klotzsch & Gr. in Abh. Akad. Wissen. (Physik.) Berlin 37, 70 (1860).

Glabrous, rhizomatous, caespitose perennial. Rhizome vertical, woody, up to 20 cm. deep, branched at the top. Stems several, tufted, up to 20 cm. long, filiform (c. 1 mm. thick), decumbent, flexuose, bases with scale leaves. Cauline leaves 7-13 mm. x 4-8 mm., shortly petiolate, sparsely arranged, ovate, obtuse or mucronate, minutely serrulate. Petioles 1-2 mm. long. Involucral leaves similar to cauline leaves. Umbellate radii 2-3, very much abbreviated. Capsule globose, long-stalked; cocci with hemisphaerical warts. Seeds not known. Fl. July - Aug. Hemicryptophyte. 

Type: [Turkey (C5)]: in summa valle Metdesis [Mededsiz, prov. Mersin] Tauri Cilici alt. 3080 m., floret Julio, Aug., [a. ?], Kotschy 147 (C; K; BM).

C5: Karli Boghas [Küle boğhas?] 1800 m., and Kisl Deps, [Kisl tepe near Bulgar maden], 2800 m., a. 1896, Siehe 299.

E. schottiana, an endemic to Cilician Taurus, apparently has no near relatives. The only species which it approaches in general appearance is E. capitulata Reichenb. (from Greece, Dalmatia, and Balkan peninsula), but can be easily separated by its laxly leaved stems, thick woody vertical rhizome and long-stalked capsules.
Group 'Apios' including E. dimorphocaulon, E. apios, E. cardiophylla, and E. condylocarpa forms a distinct natural unit. All the 4 members have tuberous roots and are scarcely distinguishable by the characters of capsules and seeds. However, they are geographically separate and show differences in their vegetative characters and flowering habit.

The following table summarises the distinctive features of the four species. A distribution map is appended.

<table>
<thead>
<tr>
<th>dimorphocaulon</th>
<th>apios</th>
<th>cardiophylla</th>
<th>condylocarpa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Root</td>
<td>napiform, rarely bifurcate</td>
<td>napiform, occasionally fusiform</td>
<td>cylindrical, vertical</td>
</tr>
<tr>
<td>Stems</td>
<td>dimorphic; sterile decumbent, branched from the base, densely leafy; floriferous erect, sparsely leafy</td>
<td>monomorphic; 1-many, prostrate to erect, branched below</td>
<td>monomorphic; many, sub-erect, often branched below</td>
</tr>
<tr>
<td>Leaves</td>
<td>sparsely hirtulous; on sterile branches up to 6 mm. x 4 mm. and shortly petiolate; on floriferous branches not more than 3 mm. long and subsessile; leaf-base subattenuate or round</td>
<td>sparsely or densely pilose; (-5)10-17 mm. x (-2)3-7 mm. sessile; leaf-base subattenuate or round</td>
<td>glabrous, 18-35 mm. x 6-20 mm., sessile; leaf-base deeply cordate-auriculate</td>
</tr>
<tr>
<td>Autumn flowering</td>
<td>spring flowering</td>
<td>spring flowering</td>
<td>spring flowering</td>
</tr>
<tr>
<td>Crete, Cyprus, and Isauria in S. Turkey</td>
<td>S. Italy, Greece, Balkan Peninsula, Anatolia (chiefly in the Medit. region), Anti-Lebanon and Syria.</td>
<td>Turkey (Bithynia, Ionia, N. Isauria) and N. Iraq.</td>
<td>Armenia, Transcaucasia, Caucasus, and N. Iran.</td>
</tr>
</tbody>
</table>

Syn. E. apios Sensu Sieber, Reise nach Creta 2, 321, t. 9 (1823), non Linn. (1753).

Perennial with napiform, rarely bifurcate tubercous root. Stems branched from the base, dimorphic, the sterile ones decumbent up to 8 cm. long, densely leafy. Leaves shortly petiolate, obovate, up to 6 mm. x 4 mm., serrulate, sparsely hirtulous; the floriferous ones erect, 5-20 cm. tall, sparsely leafy, leaves scarcely more than 3 mm. long, obovate-oblong, subsessile. Involucral leaves similar to cauline leaves of the floriferous branches. Umbellate radii 3-4.


Holotype: Crete: Hierapetra, Aphendi Kavusi, in Phrygana von 0 bis 800 m., Davis 1065 (K).


From sea level to 750 m., especially growing on metamorphic slopes among Quercus coccifera and Poterium spinosum.

E. dimorphocaulon is very closely related to E. apios L., with which it has been confused before. The Turkish gathering is sterile (being collected in the spring) but its petiolate leaves distinguish it from E. apios.

E. dimorphocaulon is apparently confined to Crete, Cyprus and Isauria in S. Turkey where it is the only autumn flowering species of Euphorbia, a habit made possible by its tubercous root. In Crete and Cyprus, it replaces E. apios L.


E. apios L. var. lamprocarpa Boiss., in DC. Prodr. 15 (2), 126 (1862).

Perennial with napiform or occasionally more or less fusiform, rarely bifurcate tuberous root. Stems one to many, up to 30 cm. long, prostrate to erect, often branched below, monomorphic, every stem when mature producing terminal flowering umbels and several axillary floriferous branches, pilose or hirtellous, sometimes glabrescent, the subterranean part of the stem with scale leaves. Cauline leaves (-5) 10-17 mm. x (-2) 3-7 mm., sessile, elliptic-oblong or oblong, rounded or subattenuate at base, margin serrulate at least towards apex, obtuse or retuse, sometimes acute, sparsely or densely pilose. Involucral leaves similar to cauline leaves. Umbellate radii 4-7, once or twice divided. Involucellar leaves broadly rhomboid to transversely ovate, often suborbicular. Capsules 3.0-3.5 mm. x 3.0-4.5 mm., seated on stalks not more than 1.5 mm. long, coccas with short cylindrical or subsphaerical often purplish warts. Seeds 2.0-3.0 mm. x 1.5-2.0 mm., ovate-subcompressed, dark-brown, smooth; caruncle subglobose. Fl. Mar. - June. Geophyte.

Type: Clusius's illustration (Rar. Plant. Hist., Lib. 6, 190: 1601)

A4: prov. Ankara, Çubuk baraj, 1000 m., May 1958, F. Markgraf;
A5: Amasya, 16 May 1889, 4-600 m., J. Bornmüller 814 - as var. lamprocarpa. A7: Gümüşane, 1100 m., 10 May 1960, Stainton 8381.

On rocky slopes and screes of limestone, schist or metamorphic substrate, mountain steppe, amongst maquis on serpentine and in pine and oak forests, reaching 1650 m., mainly in the Mediterranean region.

E. apios is very closely related to E. dimorphocaulon P. H. Davis, which, however, can be distinguished by its dimorphic stems, short-petioled leaves and autumn-flowering habit. Whereas E. dimorphocaulon is known, so far, only from Crete, Cyprus and Issoria, E. apios extends from S. Italy and Greece through the Balkan peninsula and Anatolia (mainly in the Mediterranean region) into the Anti-Lebanon and Syria, but is absent from Crete and Cyprus where it is replaced by E. dimorphocaulon.
The diagnosis of *E. apios* L. in *Species Plantarum* can be traced back to the figure in Clusius's *Rar. Plant. Hist.*, Lib. 6, 190 (1601), a work which Linnaeus cites in synonymy. Clusius mentions Apulia (S. Italy) and the kingdom of Naples as localities for this plant. Both the provenance cited and the illustration are quite consistent with *E. apios* in the generally accepted sense, but are not applicable to *E. dimorphocaulon* which is not recorded west of Crete. The habitat "in Creta" cited by Linnaeus for *E. apios* appears to be erroneous, apparently based on Clusius's information that the plant in question was seen by Bellonius in Crete - a record that probably refers to *E. dimorphocaulon*. One of the two specimens labelled as *E. apios* in Linnaeus's Herbarium has since been identified as *E. tuberosa* L.; the other might represent *E. barellieri* Savi (*E. baselici* Ten.). Neither specimen fits Linnaeus's diagnosis of *E. apios* and it therefore seems necessary to typify the name by the illustration in Clusius.

Var. *lamprocarpa* was based on subentire leaves, larger, sparser hemispherical warts on capsules, and slightly larger seeds. These characters vary independent of each other and throughout the whole range of the species so greatly that 'lamprocarpa' does not deserve a varietal rank.
Syn. 


Root cylindrical, thick and lignified, vertically descending.

Stems many, up to 40 cm. long, erect or suberect, often branched below, and with many axillary floriferous branches above. **Cauline leaves** 1.8-3.5 cm. x 0.6-2.0 cm., glabrous, usually ovate-oblong, deeply cordate-auriculate at base, margin usually entire rarely obscurely denticulate, apex obtuse or acutish. **Involucral leaves** similar to cauline leaves but smaller. **Umbellate radii** 3-5, once or twice divided. **Involucellar leaves** broadly ovate to semi-orbicular. **Capsule** 4.5-5.5 mm. x 5.0-6.5 mm. seated on stalks up to 4 mm. long, coccæ with hemispherical warts. **Seeds** 3.5-3.8 mm. x 2.7-2.8 mm., ovate, brown, smooth; caruncle subglobose. **Fl.** May - June. Geophyte.

**Holotype:** [Turkey (C3)]: In fruticetis regionis inferioris montis Solyme [Tahtali daği] Lyciae infra Kartsibahir, Heldreich (G).

A2: Bithynia, pr. Brussam [Bursa], May 1874, Pichler.


Often on calcareous rock up to 1300 m.

Described from Lycia and recorded from Bithynia and northern Isauria, *E. cardiophylla* has also been collected from N. Iraq (e.g. Rowandus gorge, Guest - as *E. condylarca*, EJ; Sulaimaniya, Rechinger fil. 10380, W?). Further collecting may show this little known species to have a less disjunct distribution than it appears to have on present evidence.

*E. cardiophylla* is related to *E. condylarca* M.B.; for differences, see the discussion under the latter.


Perennial with a tuberous, ovate-globose or sometimes fusiform root. Stem solitary, up to 50 cm. tall, slender, erect, unbranched below, but with occasional axillary floriferous branches above. Cauline leaves 15-20 mm. x 3-6 (15) mm., oblong or oblong-lanceolate, glabrous, sessile, cordate-amplexicaul at base, margin serrulate, apex obtuse or acute. Involution leaves similar to cauline leaves but smaller.

Umbellate radii 3-5 (-8), filiform, short, not more than once bifid. Involutional leaves broadly ovate to ovate-deltoid, sometimes semi-orbicular. Capsules ovate-sphaerical, trilobed, coccæ with hemisphaerical warts. Seeds ovate, brown, smooth; caruncle ovate-triangular.

Fl. May. Geophyte.

Holotype: in Montosis Caucasi, circa acidulam Narzana, Marschall von Bieberstein (LE - n.v.).

Armenia, Gurdels. in Berlin (fide Boiss. Fl. Gr., n.v.).

E. condylocarpa is allied to E. cardiphylla Boiss. et Heldr. but is distinguished by its ovate-globose or fusiform root (instead of cylindrical), solitary stem unbranched below, and by its much slenderer stem and umbellate radii.

Probably endemic to Armenia, Transcaucasia, Caucasus and N. Iran. Its reported occurrence in Ankara province by Krause (Ankaran in Flora, 101: 1937) appears to be erroneous; one of the two specimens cited in his work, (i.e. Çankaya, Lindsay) examined at Kew is E. apios L.


Sparsely or densely villose or hirtellous perennial with a persisting deep root. Stems one to many up to 70 cm. tall, branched above, erect, sometimes ascending, naked below and densely leafy above. Cauline leaves sessile, oblong-lanceolate, subcordate at base, margin serrulate, acute or acuminate. Involucral leaves similar to cauline leaves. Umbellate radii 4-5, usually unequal, 2 or more times divided. Involucellar leaves broadly ovate to ovate-rhomboid, rounded or subcordate at base. Cyathial glands with rounded margin, hirsute on the ventral surface. Capsule 3-4 mm. across, globose-trilobed; cocci with crowded shortly cylindrical warts and hirsute. Seeds 2.0-2.5 mm. x 1.8-2.0 mm., broadly ovate, dark brown with more or less longitudinally arranged minute tuberces, sometimes the tuberces obscure; caruncle minute, transversely ovate. Fl. June. Geophyte

Described from S. France and Switzerland. (Herb. Linn. No. 51; in Herb. Cliff. the specimen labelled as "Tithymalus sylvaticus flore lunato" could be referred to E. verrucosa L.).
In fields in plains, and on the mountains up to 1400 m., often in moist places and near salt marshes.

The two specimens labelled as *E. verrucosa* in Herb. Linn. represent the species later described as *E. pubescens* Vahl and *E. cybirensis* Boiss. The Linnaean phrase name and the synonymy, however, evidently refer to the former species, so that there seems no reason for adopting *E. verrucosa* L. (1753) as the correct name for *E. pubescens* Vahl. The plant described by Lamarck as *E. verrucosa* (Encyc. Bot. 2, 434: 1788) is a different species, but as he cites *E. verrucosa* L. as a synonym, "*E. verrucosa* Lam." is nomenclaturally synonymous with *E. verrucosa* L. The correct name for Lamarck's species may be *E. brittangeri* Opiz. (fide A. R. Smith, in litt.).

*E. verrucosa* L. resembles, in general facies, *E. platyphylllos* L., but can be readily separated by its cyathial glands which are hirsute on the undersurface, by perennial habit and usually tuberculate seeds.
E. verrucosa L. is distributed throughout the Mediterranean and N. Africa, extending westwards up to Canaries. It reaches the Caucasus through Turkey where it has been recorded from scattered localities in all the three phytogeographical regions.


Robust annual up to 75 cm. tall, usually with several floriferous branches above. *Cauline leaves* glabrous or more or less pilose, sessile, oblong-lanceolate, base narrower, margin serrulate above the middle, apex acute, usually yellowish green. *Involucral leaves* similar to cauline leaves. *Umbellate radii* 3-5, several times dichotomously divided. *Involucellar leaves* broadly ovate, ovate-deltoid or elliptic. *Cyathial glands* transversely oblong, eornate, margin rounded. *Capsules* 2.3-5.0 mm. x 2.7-4.0 mm., obscurely trilobed, subglobose, coccae with small hemispherical warts. *Seeds* 1.7-2.2 mm. x 1.5-1.7 mm. broadly ovoid, dark brown, smooth, shining; caruncle 0.7-0.8 mm. across, sessile, subreniform. *Fl.* June - Oct. *Therophyte.*


Described from France, British Isles and Germany (Herb. Linn. No. 55).

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In damp places.

Differs from its most nearly related *E. stricta* L. in its larger capsules which are obscurely trilobed, and in its larger seeds which are globose-ovate. *E. platyphylllos* is further distinguished by its longer thicker leaves and more robust habit. *E. platyphylllos* also resembles *E. verrucosa* L. and *E. microsphaera* Boiss. For the distinguishing features from the former, see the description under that species; from the latter, it is easily recognizable by its more or less trilobed capsules with hemisphaerical warts (instead of globose and smooth or with soft scattered papillae) and slightly smaller seeds.

*E. platyphylllos* is mainly a European species with a rather wide distribution from the British Isles extending through South and Middle Europe to N. Africa, the Balkan Peninsula and Middle and South Russia. In N. America it is probably an established weed. In Turkey, it is so far known only from the western part (mainly in the Mediterranean region) and Lazistan.


Tithymalus strictus (L.) Klotzsch & Gr. ex Gareke, Fl. Deutschl. ed. 4, 290 (1849).

Annual up to 60 cm. tall, glabrous or pilose with several axillary floriferous branches below the terminal umbel. Stems erect, occasionally branched below. Cauline leaves spathulate-lanceolate or elliptic-lanceolate, sessile, serrulate above the middle, acute, membranaceous, usually pure green. Involucral leaves similar to cauline leaves. Umbellate radii 3-6, long and slender, several times dichotomously divided. Involucellar leaves ovate or elliptic rarely ovate-deltoid, base narrow or broad, rounded, rarely truncate. Cyathial glands transversely oblong, margin rounded, ecornate. Capsules 1.6-2.0 mm. x 1.7-2.2 mm. deeply trilobed, cocciae rounded and covered on the backs with several + cylindrical warts. Seeds 1.2-1.7 mm. x 0.8-1.2 mm., ovoid-oblong, dark brown, smooth and shining; caruncle 0.5-0.6 mm. across, reniform or subrotund. Fl. Mar. - Aug. Therophyte. 2n = 28 (Perry: 1943 in Löwe & Löve: 1961)

Type locality not given by Linnæus (Herb. Linn. No. 54).

Al(E): prov. Tekirdağ, dist. Malkara, Sariyar, 22 June 1891,
B. stricta prefers shady wet places by streams, springs, ditches on road sides, salt marshes and among rocks in forest, reaching 1800 m. Although *B. stricta* looks very much like its closest ally *B. platyphyllos* L. in general facies, it can be readily separated by its smaller capsules which are deeply trilobed and by its smaller seeds.
which are narrower and ovoid-oblong. The habit of *E. stricta* is also much more slender and the leaves thinner than in *E. platyphylllos*.

Like *E. platyphylllos*, *E. stricta* is also mainly a European species extending as far west as the British Isles, but more northerly in its distribution, viz. in Central Europe, Balkan Peninsula, Caucasus and Transcaucasia, Russian Armenia, Turcomania and N. Iran; and it is absent from Greece. In Turkey, it occurs in all three phyto-geographical regions.

That *E. platyphylllos* L. and *E. stricta* L. are specifically quite distinct is evident from the accompanying pictorial scatter diagram and histograms. The scatter diagram (Fig. 5) illustrates the combined variation in capsule length (horizontal axis) and seed length (vertical axis), and in width and shape of capsule and seed. Open circles indicate more or less globose capsules with only slight lobing and the dots deeply lobed capsules. A short line pointed vertically upwards denotes the ovoid shape and the lack of it ovoid-oblong shape of seeds.

The two histograms drawn to show the variation ranges for capsule breadth (Fig. 3) and seed breadth (Fig. 4) in the material investigated, indicate that the capsule and seed measurements fall into two categories, viz. those with capsules 1.6-2.5 mm. and 2.6-3.9 mm. broad (the first category being represented on the scatter diagram as a circle or dot without a short horizontal line pointing towards the right, and the second with such a line); and those with seeds 0.8-1.29 mm. and 1.4-1.89 mm. broad (the first category being indicated on the scatter diagram as a circle or dot without a vertical line pointing downwards, and the other with such a line).
Each circle or dot stands for one collection, and every value used represents a mean from three different measurements. All measurements were made on forty fruiting samples of dry herbarium specimens of both European and Orient material present at Edinburgh.
Fig. 3. Histogram showing the variation range for capsule breadth in *E. platyphylllos* L. and *E. stricta* L.
Fig. 4. Histogram showing the variation range for seed breadth in *E. platyphylllos* L. and *E. stricta* L.
Fig. 5. Pictorial scatter diagram illustrating the combined variation in capsule length and seed length, and in width and shape of capsule and seed in *E. platyphylllos* L. and *E. stricta* L. (See page 118).
Fig. 5. Pictorial scatter diagram illustrating the combined variation in capsule length and seed length, and in width and shape of capsule and seed in *E. platyphyllos* L. and *E. stricta* L. (See page 118).


Annual up to 35 cm. tall. *Cauline leaves* 2.0-3.5 cm. x 5-10 mm. lanceolate-spathulate, acute, rarely obtuse or retuse.

*Involucral leaves* similar to cauline leaves. *Umbellate radii* 4-5, repeatedly dichotomously divided, yellowish green.

*Involucellar leaves* 1.0-2.5 cm. x 8-16 mm., elliptic to ovate-orbicular, usually longer than broad, base rounded. *Cyathial glands* transversely obovoid or trapezoid. *Capsule* c. 2 mm. x c. 2 mm., trilobed, oocoeae rounded. *Seeds* c. 1.5 mm. long, ellipsoidal, sub-quadrangular, greyish, with darker irregular furrows; caruncle inconspicuous, deciduous. *Fl.* June - Sept. *Therophyte.*

*Holotype:* Iraq: Mosul-Ain Sifni, 360 m., fields, 11 July 1933, E. R. Guest 4034 (K).


A weed of fallow fields and steppe up to 750 m.

*E. guestii* is closely related to *E. gaillardotii* Boiss. & Blanche emend. Blakelock with which it was confused by Boissier due to its close resemblance in habit, but can be easily separated by its seeds which are grey and irregularly furrowed (instead of brown and smooth). The involucellar leaves, which in *E. guestii* are
are usually longer than broad, and the usually corymbose appearance of the umbels might form additional specific criteria though the constancy of these characters is not beyond doubt. Plants evidently belonging to *E. gaillardotii* (e.g. Diyarbakir, Davis 22143) with brown, smooth seeds show the involucellar leaves longer than broad.

Confined to Turkish and Iraqi Mesopotamia, Amanus, Syria, Anti-Lebanon and Palestine.

Glabrous annual up to 35 cm. tall, occasionally branched above. Cauline leaves 2.5-5.0 cm. x 6-9 mm., lanceolate-spathulate, acute, entire or minutely denticulate towards apex. Involucral leaves similar to cauline leaves, sometimes slightly broader. Umbellate radii usually 5, 2 or more times dichotomously divided. Involucellar leaves broadly ovate or ovate-orbicular with rounded or truncate base, more or less as long as broad, rarely elliptic and longer than broad. Cymathial glands transversely oblong, ecornate, margin rounded. Capsules 2.0-2.2 mm. x 2.0-2.5 mm., trilobed, cocciae rounded. Seeds c. 1.5 mm. x 1.0 mm., subquadrangular, yellowish when young, brown when mature, smooth; caruncle minute, deciduous. Fl. May - Sept. Therophyte.

Lectotype: [Syria]: prope Rascheya, alt. 1550 m., Kotschy (G, W, K).


A weed, often in fallow fields, reaching an altitude of 1350 m. In the absence of seeds E. gaillardotii can be easily mistaken for E. guestii Blakelock which it greatly resembles in general habit and capsule characters (cf. the description of the latter for the distinguishing features). Kotschy's plant with seeds has to
be chosen as a *Lectotype*; the other syntype viz "in agris versus Ouadi Barrada Antilibani, Gaillardot" lacks the capsules. The third syntype of *E. gaillardotii* cited by Boissier (prope trajectum Tigridia, Kotschy) represents *E. questii* Blakelock.

*E. gaillardotii* is endemic to Turkish Mesopotamia, Syria, Anti-Lebanon, and Transjordan; it is also reported from Isfahan and near Teheran (cf. Parsa, Fl. Iran).
(27) E. ancyrensis Aznavour ex M. S. Khan, spec. nov. Fig. 6.

Affinis E. cybirensi Boiss. sed statura valde humiliore, capsulis trilobatis, basibus aculeorum laticribus, seminibus minoribus ecarunculatis albo-pulverulentibus distinguitur.

Planta annua, glabra, humilis, 4-10 cm. alta. Radix tenuis ad 12 mm. alta. Caulis inferne non plus 2 mm. crassus, saepe ramis floriferis infra umbellum provisus. Folia caulina oblanceolata, 8-20 mm. x 4-7 mm., uninervia, ultra medium serrulata, acuta vel breviter acuminata, raro obtusa, basi in petiolum 2-4 mm. longum attenuata. Folia involucra 3-4, oblongo-oblanceolata vel oblonga, 10-16 mm. x 4-6 mm., apicem versus serrulata, acuta. Radii primarii umbellae 3-4, 10-20 mm. longae, 2- vel 3-fidi, ad ter divisi. Folia involucellae 5-10 mm. x 5-8 mm., ovata vel rhomboide-ovata, vel late vel valde late ovata, ultra medium serrulata, mucronata vel breviter acuminata, basi rotunda vel subcordata. Cyathia campanulata, 1.5-2.0 mm. longa, lobis breviter oblongis, truncatis vel bifidis ciliatis, glandulis transverse ellipticis vel depressae transverse ovatis ecorruitis flavescento-brunneis (in sicco). Bracteolae inter flores masculos latae, hirsutae. Capsula 2.0-2.5 mm. x 2.5-3.0 mm., trilobata, glabra, coccis subacutis, dorso aculeis plus minus rigidis 0.4-0.7 mm. longis saepe basi latis provis. Styli 1.5-2.0 mm. longi, basi coaliui, ad apicem bifidi. Semen c. 1.6 mm. x c. 1.5 mm., ovoideum, bruneum vel nigrum, saepe sublente albo-pulverulentum, ecarunculatum.

Kastamonu, Koesen [Kösen], 5 km. E-SE of Tosya, 10 May 1892, Sintenis 3700 (G).

The fruiting specimens of this plant simulate a much dwarfed *E. cybirensis* but the trilobed capsules provided with conical emergences usually with broader bases, and ecarunculate seeds with fine sticky granular covering characterise this very distinct species. As Aznavour named this plant on the herbarium sheet as *E. ancyrensis*, the type gathering presumably came not far from Ankara. It is probably a rare species restricted to the central part of N. Anatolia.
Fig. 6. Holotype of *E. ancyrensis* Azn. ex M.S. Khan.


Robust annual up to 60 cm. tall, glabrous or pilose, sometimes branched below. **Cauline leaves** spatulate, elliptic or elliptic-lanceolate, sessile, obtuse or acute, rarely mucronate, serrulate at least above the middle. **Involucral leaves** + similar to cauline leaves, sometimes broader. **Umbellate radii** 4–5, repeatedly dichotomously divided. **Involucellar leaves** ovate, broadly-ovate or ovate-deltoid, base truncate or subcordate rarely rounded. **Cyathial glands** broadly transversely oblong, ecornate. **Capsules** 2.5–4.5 mm. across, globular, thick or thin walled, indehiscent or dehiscent, covered with rigid and pointed or softer bristles; fruiting pedicel 2–3 mm. long; styles (−1.5) 2.0–3.5 mm. long, united up to half of their length. **Seeds** (−1.5) 2.0–2.5 mm. long, ovoid, dark brown, shining, caruncle c. 0.5 mm. long, subgbose, subsessile. *Fl. Apr.* – *June.*

**Therophyte.**

**Key to varieties**

1. **Capsules** dehiscent, capsule-wall thin with slender, softer bristles. — — — — — — — — — — b. var. *dehiscens*

1. **Capsules** indehiscent, capsule-wall thick, with + stiff, pointed bristles.

2. **Capsules** 2.5–3.5 mm. across — — — — — — — — c. var. *microcarpa*

2. **Capsules** 3.6–4.5 mm. across — — — — — — — — a. var. *cybirensis*
(a) Var. cybirensis

Holotype: [Turkey(C2)]: In planitie Cybirensi near Cameli Cariae, June 1842, Boissier (G). In monte Teuro, a. 1836, Kotschy 481.

AEG. IS., Rhodes: Bastida, 21 May 1870, Bourgeau 289.

(b) Var. dehiscens Boiss., in DC. Prodr. 15 (2), 119 (1862).

Syntypes: [Greece]: in Zacyntho, Margot (G ?); [Turkey (C5)]: Pamphilia ad Kourmalu, Haldreich (G, K); Creta, Sieber (G, K).


(c) Var. microcarpa Boiss., in DC. Prodr. 15 (2), 119 (1862).

Holotype: [Turkey(C5)]: in Cilicia ad Mersina, a. 1855, Balansa 738 (G).


C2: prov. Denizli, Aker Tavas - Kale Tavas, 13 km. from Tavas, 950 m., 5 June 1938, Huber-Morath 5289.

A weed on rocky limestone slopes, clayey soils, in cultivated fields and among maquis, ascending to 900 m.

E. cybirensis var. acutifolia Boiss., Diagn. 1 (12), 109 (1855) mainly distinguished by its oblong-lanceolate cauline and involucral leaves with attenuate and acute apex and by its taller habit has been seen only from Cyprus (Sintenis & Rigo 662) and Syria (plants raised from seed collected by Colin - examined in Herb. Boiss.).
E. cybirensis shows affinities with a western Mediterranean species, E. akenocarpa Guss. and with the mainly eastern Mediterranean E. microsphaera Boiss. From the former it is distinguished chiefly by its echinate (instead of smooth) capsules with longer stalks (2-3 mm. instead of 0.5 mm.). The distinctions from E. microsphaera are given under that species. E. cybirensis is also allied to E. ancyrensis Azn. ex M. S. Khan which has been known so far only from near Ankara and prov. Kastamonu. The former, however, is recognised by its taller stature, sphaerical capsules provided with emergences narrower at base, and larger, carunculate seeds.

E. zabnii Heldr., described from the Peleponnese is a doubtful taxon which may not be specifically distinct from E. cybirensis; it resembles var. dehiscens in the filiform outgrowths on its capsules. A specimen labelled as E. zabnii has been seen from Chios (Guiol 1814 and Fr. Denis 82 in Herb. E. V. D. Post).

E. cybirensis is mainly eastern Mediterranean in its distribution with its western limit in Crete. In Turkey it reaches the Bosphorus in the north. It might be an introduced weed in S. W. Iran (cf. Parsa, Fl. Iran 4, 1254: 1949).

Syn. **E. mohamarensis** Boiss. in Fl. Nöe exs. No. 39 (1850)!

**E. unilateralis** Blakelock in Kew Bull. 3, 453 (1950)!

Robust annual up to 90 cm. tall, glabrous or only rarely pilose on cyathia, involucellar leaves and capsules. **Cauline leaves** 3-6 cm. x 8-13 mm., sessile, spathulate-lanceolate or oblong-lanceolate, acute, serrulate towards apex. **Involucral leaves** + similar to cauline leaves. Umbellate radii 4-5, repeatedly dichotomously divided, the branches being unequal in length. **Involucellar leaves** elliptic, ovate or broadly ovate, base rounded or truncate. **Cyathial glands** ecornate, margin rounded. **Capsules** 2.5-3.0 mm. across, + globose, smooth, sometimes with scattered soft papillae; styles 1-2 mm. long. **Seeds** 2.2-2.5 mm. x 1.6-1.8 mm., subcompressed-ovate, dark brown, shining; caruncle transversely ovoid, whitish, persistent. Fl. May - Sept.

**Therophyte.**

**Type:** [Iran]: In humidis ad radices montis Sabst Buschom prope Schiras, 31. Maj. 1842, Kotschy 449 (G; K; E; BM).


A weed of plains, cultivated fields and vineyards, often occurring near rivers and marshy places, ascending up to 600 m.

*E. unilateralis* Blakelock, which was based mainly on the unilateral branching of umbels, was further distinguished from *E. gaillardoti* by its globose capsules and larger shining seeds with persistent caruncles. However, the description and type of *E. unilateralis* agree in every detail, including the mode of umbel branching, so closely with *E. microsphaera* Boiss. that one is bound to regard Blakelock's species as synonymous with the latter.

*E. microsphaera* stands between *E. gaillardoti* and *E. cybirensis* Boiss., resembling the former in its habit, and the latter in capsule shape and seed characters. From the former it can be separated by its globose capsules (not 3-lobed), and by its larger, shining subcompressed seed with a persistent caruncle (not c. 1.5 mm. long, subquadrangular with deciduous caruncle); from the latter it is easily distinguished by its shorter styles (1-2 mm.; not 2-3.5 mm.), and by its usually smooth or papillose capsule (not bristly).

Out of fruit, *E. microsphaera* can be easily mistaken for a predominantly European species, *E. platyphyllos* L. which in the Orient, however, is confined to the Caucasus and N. & W. Turkey; see the discussion under the latter for differences.
**E. subtuberculata** C.A.M. ex Boiss. (in DC. Prodr. 15 (2), 118: 1862) described from Azerbaidjan (?) and reported from Taschkent, Central Asia (Herb. Fl. As. Med. No. 305) may not be specifically distinct from *E. microsphaera*; it is impossible to separate the two except by the minutely tuberculate capsules of the former.

*E. microsphaera*, which occurs in Iraq and Syria, and in Iran as far south as Shiraz, has a rather disjunct distribution in Anatolia. Although its occurrence in the Southern Provinces is more or less a continuation of its main geographical area, it has also been recorded from the central part of N. Anatolia, and the Mediterranean coast of European Turkey (prov. Tekirdağ).


Glabrous or pilose annual, usually single stemmed and erect up to 40 cm. tall, sometimes stems several and ascending. cauline leaves sessile, obovate to spatulate, rarely oblong, obtuse, serrulate. involucral leaves similar to cauline leaves. umbellate radii usually 5, one or more times divided. involucral leaves obovate to oblong, always obtuse, serrulate, serrations shallow and many (40-60 per involucral leaf). capsules 2.5-4.0 mm. across, globos-trilobed, glabrous, smooth; cocciæ rounded. seeds 2.0-2.5 mm. x 1.5-1.7 mm., ovoid, brown, with honey-comb like elevated reticulations, apex flattened dorsiventrally into a sharp edge; caruncle 0.5-1.0 mm. across, transversely ovate or semi-orbicular.


A common weed of cultivated fields and in steppe; occasionally also found on rocky limestone slopes on terra-rossa, amongst Quercus maquis and by streams and marshes, reaching up to 1300 m.

E. helioscopia is nearly related to E. oxyodonta Boiss. et Hausskn. and E. haussknechtii Boiss., but is always readily recognized by its very characteristic transversely ovate or semi-orbicular caruncle (instead of a vertical one as in the former, or obsolete or none as in the latter.) The habit of the plant and leaf measurements show a considerable variation throughout its range of distribution,
but the seed characters are always consistent and dependable as specific criteria.

First described from Europe, _E. helioscopia_ shows a very wide distribution. In Europe it extends from the Arctic in the North to Spain and Greece in the South. In N. and E. Africa, in Asia up to Japan, in Australia, New Zealand and N. America, it is probably an introduced weed.
E. haussknechtii Boiss. in DC. Prodr. 15 (2), 1267 (1866).

Syn. E. helioscopia L. var. haussknechtii Boiss., Fl. Cr. 4, 1107 (1870), pro parte excl. pl. Aleppica.

Glabrous, erect, annual up to 35 cm. tall. Stem up to the base of umbel 2-15 cm. tall and up to 1 cm. thick, with only a few leaf scars at base. Cauline leaves not seen. Involucral leaves spatulate, serrate towards the apex. Umbellate radius usually 5, several times branched. Involucellar leaves oblong, ovate-oblong or obovate, rarely subrotund, deeply serrate, serrations few (10-30 per involucellar leaf), apex acutish or obtuse. Capsules 3.2-3.5 mm. across; globose-trilobed, glabrous, smooth; cocciae rounded. Seeds c. 2.0 mm. x c. 1.5 mm., ovoid, brown, with honey-comb like elevated reticulations, apex acute; caruncle obscure or absent.

Fl. May. Therophyte.

Lectotype: [Turkey(C6)]: inter Aintab [Gaziantep] et Misib [Nizip], Haussknecht (G, photo. E).

C7: prov. Urfa, Akçakale - Urfa, about ½ way, 17 May 1957, Davis 28115.

Out of the two syntypes cited by Boissier for this species, only the Turkish gathering of Haussknecht matches the seed characters described by him. The other syntype (pr. Aleppo, Kotschy 115) represents a distinct species differing from E. haussknechtii in several characters including the smooth seeds, and has been described in the present work as a new species, E. fistulosa M.S. Khan allied to E. armata Boiss. In the type description of E. haussknechtii (the
lectotype of which lacks cauline leaves), Boissier obviously included the leaf characters of the Aleppo plant ("foliis oblongis basi attenuatis acutiusculis serrulatis") and the seed characters of Haussknecht's plant.

_E. haussknechtii_ differs from _E. helioscopia_ L., to which it is very closely related, chiefly in its seeds which are shorter (only c. 2.0 mm. long; not 2.0-2.5 mm.) and ecarunculate (or seeds with only an obsolescent caruncle), and usually in its comparatively narrower, oblong, acutish involucellar leaves with deeper and fewer serrations (10-30; in _E. helioscopia_ 40-60 serrations per involucellar leaf).

The nearly related species _E. helioscopia_, which has a very extensive geographical distribution, shows a strikingly uniform constancy in its seed characters (with a persistent, transversely ovoid or sub-orbicular caruncle) although a certain degree of variation is seen in habit, leaf-shape, length of umbellate radii and the shape of the involucellar leaves. The correlation of the seed characters with the number and depth of serrations of the involucellar leaves seems to justify provisionally maintaining _E. haussknechtii_ Boiss. as a separate species.

_E. haussknechtii_ is probably endemic to N.W. Mesopotamia, in the Irano-Turanian region.
Sparingly pilose annual with many dwarfish stems, 4-10 cm.
long, c. 1 mm. thick, prostrate to ascending. Cauline leaves
10-20 mm. x 4-11 mm., elliptic or obovate, acutish, deeply serrate,
the lower leaves with base attenuate into a short petiole up to
5 mm. long, the upper ones sessile. Involucral leaves more or
less similar to cauline ones. Umbellate radii abbreviated.
Involucellar leaves ovate, deeply serrate. Capsules c. 3 mm. x
c. 4 mm., glabrous, deeply trilobed; cocoes smooth. Seeds 2.0-
2.2 mm. x 1.5-1.7 mm., ovoid, mature seeds dark with elevated
irregular reticulations, apex obtuse; caruncle c. 7 mm. across,
subsphaerical, vertical, retuse on the inner side. Young seeds

Holotype: [Syria]: in fissuris ruptus et calcareis Djebel Muhassan
et Turmanin prope Aleppum, Haussknecht (3).

Col.: prov. Adiyaman, Urfa, Nimrudag supra Orfam [a hill near
Kahta] et in Djebel Taktak, [between Urfa and Viransehir] 600 m.,
Mar. 1865, Haussknecht - sterile.

Usually found on calcareous rock up to 600 m.

_E. oxyodonta_ is apparently allied to _E. sintenisii_ Boiss. ex
Freyh which it resembles in leaf and seed characters, but is distin-
guished by its dwarfier, prostrate or ascending instead of erect stems
and smaller seeds (2.0-2.2 mm. x 1.5-1.7 mm. instead of 2.5-3.3 mm. x
2.0-2.6 mm.). While _E. oxyodonta_ is confined to Mesopotamia, Syria,
Transjordan, and probably Palestine, _E. sintenisii_ extends from N.Africa
to E. Mediterranean, reaching its eastern limit in Mesopotamia.
(33) *E. arguta* Banks & Solander in Russell, Nat. Hist. Aleppo, ed. 2


Annual, 25-50 cm. tall, softly pilose. Cauline leaves 1.5-2.5 (6.0) cm. x 6-9 (-22) mm., sessile, oblong or oblong-lanceolate, sometimes elliptic, deeply serrate, acute or obtuse. Involucral leaves more or less similar to cauline leaves but smaller.

Umbellate radii 4-5, 2.5-5.0 cm. long. Involucellar leaves ovate-rhomboid to ovate-deltoid, serrate. Cyathial glands with rounded margin, ecornate. Capsules 2.5-3.5 mm. x 3.5-5.0 mm., deeply trilobed; coccceae rounded, smooth, glabrous. Seeds 1.5-2.5 mm. x 1.5-2.5 mm., broadly ovate, smooth, brown; caruncle 0.4-0.6 mm., globose, shortly stipitate. Fl. Apr. Therophyte.

Holotype: [Syria]: Aleppo, Russell (BM).

Col. prov. Mersin, Kuyuk, 10 km. W. of Mersin, alt. 2 m., 7 Apr. 1957; Davis 26511; Mersina (Cilicia), 19 May 1855, Palansa (as *E. calendulaefolia*). AEG. Is.: Chio, 9 May 1912, Frere Denis 17 (Herb. B.V.D. Post).

*E. arguta* is allied to *E. fistulosu* M.S. Khan; see the description of the latter for differences.

*E. arguta* also bears a remarkable resemblance in habit to *E. sintonisii* Boiss. ex Freyn which belongs to the group of reticulate-rugose seeds, and it is not easy to distinguish one from the other in the absence of fruiting material. The former has smaller capsules and smaller seeds which are always smooth when mature with smaller
depressed orbicular caruncles. The latter species, on the other hand, has larger capsules (3-4 mm. x 4.0-5.5 mm.) and larger seeds (2.5-3.3 mm. x 2.0-2.6 mm.) which are distinctly wrinkled in an irregularly reticulate manner (even the immature ones showing faint whitish reticulations), with larger whitish hemisphaerical caruncles (0.5-0.8 mm. across). There is considerable overlapping of the two species in their range of distribution, viz. in Egypt, Cyprus, Syria and Palestine.

Another species which is more or less similar in general facies to *E. arguta* is *E. oxyodonta* Boiss. (from Mesopotamia, Syria and Transjordan) which can be separated by its dwarf stature, ascending stems, and reticulate seeds.

*E. sintenisii*, which has not so far been collected in Turkey, extends as far west as Libya (cf. Sandwith & Simpson, in Jour. Bot. Mar. 1941, p.41), and through the E. Mediterranean to Mesopotamia, whereas *E. arguta* which is known in Turkey only from Cilicia, occurs throughout the E. Mediterranean and Egypt.
(34) E. fistulosa M.S. Khan, spec. nov.  Fig. 7.


Affinis E. argutae Banks & Sol. sed foliis caulínis minute et remote serrulátis vel denticulátis, capsulis et semínibus majoribus, statura robustióre recédit.

Annum, erecta, molliter et sparse pilosa.  Radix verticalis ad 10 cm. longa vel ultra, superiore ad 5 mm. crassa.  Caulis 15-45 cm. altus et ad basin 2-5 mm. crassus, fistulosus, superne sensim dilatatus, tenuiter striatus, plurumque flaveo-virens, sparse foliosus, saepe ad basin ramis sterilibus et superne ramis floríferis provísus.  Folia cauliná (mediana) 30-60 mm. x 8-25 mm., sessilia, oblongo-lanceolata vel elliptico-lanceolata, integra, a medio plurumque minute et remote serrulata vel denticulata, acuta, membranae, subtilis glaucescentia.  Folia involucrí 4-5, 25-60 mm. x 10-25 mm., oblongo-lanceolata vel late elliptica, apicum versus serrulata, acuta.  Radii primarii umbellae 3-5, 4-9 cm. longi, bis vel ter bi- vel tri-fidi, fistulosi.  Folia involucellae (primariae) in binis vel tres. 10-30 mm. x 12-35 mm., late ovata vel ovato-deltóidea, apicum versus serrulata vel denticulata, acuta, basis plurumque subcordatis saepe obliquis.  Cyathia late campanulata, 2.5-3.0 mm. longa, lobis late ovatis, erosulis, glandulis transversae oblongis, marginibus rotundatis, eornutis, flavescentibus vel fuscis (in sicco).  Bracteolae inter
flores masculos multae, apicem versus longe ciliatae. Capsula
3.0-5.0 mm. x 4.5-6.0 mm., subgloboso-triloba, coccis obtusis,
glabris, laevibus, stylis fere ad basin liberis, apicem versus
bifidis. Semen 3.0-3.5 mm. x 2.5-3.0 mm., ovoideum, laeve,
Type: [Syria]: in agris pr. Aleppum, 17 Apr. 1841, Kotschy 115
(Holo. G; iso. BM, K, photo. E).

G7: prov. Urfa, Urfa - Hilvan, 5 km. from Hilvan, 750 m.,
18 May 1957, Davis 28230, Tel Pinar [between Kahta and Siverek];
23 May 1888, Sintenis 860 - as E. cybirensis Boiss. G8: Diyarbakir -
Erzani, 10 km. from Diyarbakir, 750 m., 1 June 1957, Davis 28806.

The type gathering (Kotschy 115) was confused by Boissier (op.
cit.) with E. haussknechtii Boiss. and cited as a syntype of the
latter. E. fistulosa is, in fact, more nearly related to E. arguta
Banks & Solander which it resembles in its smooth seeds, but is
readily separated by its minutely and remotely serrulate or denticulate
cauline leaves, larger capsules and seeds, and more robust habit. The
stem is almost always swollen and fistular towards the top.

E. fistulosa is an annual weed of cultivated fields, reaching an
altitude of 750 m.; it is probably restricted to S.E. Anatolia and
Syria and belongs to the Irano-Turanian element.
Fig. 7. Holotype of E. fistulosa M.S. Khan.

Syn. E. lasiocarpa C. Koch in Linnaea 21, 721 (1848), non Klotzsch (1843) - fide Boiss. in DC. Prodr. & Prokh. in Komarov, URSS, vix descr.

Tithymalus eriophorus (Boiss.) Klotzsch & Gr. in Abh. Akad. Wiss. (Physik.) Berlin 57, 65 (1860).

Annual, 15-50 cm. tall, sparsely to densely pilose, branched above. Cauline leaves 2.0-6.5 (-8.0) cm. x 1.0-1.5 (-2.0) cm., sessile, oblanceolate, acute, denticulate or serrulate towards the apex. Umbellate radii usually 3, 2 or more times dichotomously divided. Involucellar leaves ovate or ovate-oblong, serrate, acuminate or mucronate. Cyathial glands stipitate, transversely reniform-oblong, outer margin rounded. Capsule 3.5-5.0 (-6.0) mm. x 4.5-5.5 mm., stipitate, depressed at both ends; coccaae rounded, minutely granular, pilose. Seeds 2.0-3.0 mm. x 1.5-2.5 mm., ovate-sphaerical, smooth, brown or greyish with brown specks, ecarunculate.

Fl. May - July. Therophyte.

Holotype: [Turkey (C2)]: In agris Cariae interioris segetes, specimen unicum, Jun. 1842, in planitie ad meridiem Cadmi [Honaz dag] Boissier (G ? - type missing).


A weed of cultivated fields and steppe from 650 m. - 1800 m.

E. eriophora is nearly related to a W. Mediterranean species, E. lagascae Spreng. from which, however, it is recognizable by its indumentum (instead of glabrous), hairy globose capsule with rounded coccæ (instead of glabrous and oblong with carinate coccæ), and by its ovate-sphaerical, scarunculate seeds (instead of oblong and carunculate).

E. eriophora is rare in W. Anatolia. Outside Turkey, it occurs in Russian Armenia, S. Transcaucasia, N.W. Iran and probably in Iraq and N. Syria.

Erect, glabrous annual, (-4) 8-15 cm. tall, stems 1-2 mm. thick. Cauline leaves sessile, oblong or oblong-lanceolate, entire, obtuse or acutish. Involucral leaves oblong-lanceolate, slightly longer than cauline leaves. Umbellate radii 2-4, two or more times divided. Involucellar leaves deltoid to broadly lanceolate, sometimes ovate-rhomboid. Cyathial glands transversely oblong, coornate. Capsules 3-5 mm. x 3-4 mm., ovoid-trilobed, more or less truncate at both ends; cocaee rounded, smooth. Seeds 2.0-3.0 mm. 1.5-2.0 mm., obtusely tetragonous, subcompressed, brown, covered on all faces with minute, crowded, white tubercles and with 3-4 narrow, transverse furrows; caruncle hemisphaerical, shortly stipitate. Fl. Mar. - May. Therophyte.

Holotype: [Syria]: In monte Djebel Khailoun ad septentrionem Damasci, medio Aprili, Caillardot (G).

B7: [prov. Erzincan], Egin [Kemaliye], 20 May 1890, Sintenis 2378.

In disturbed steppe and on calcareous rock, often mixed with oak-scrub, reaching up to 1000 m.

*E. phymatosperma* has a superficial resemblance to *E. taurinensis* All.
in the general appearance of its umbels and in the shape of the involucellar leaves, but is easily separated by its very characteristic tuberculate and transversely sulcate seeds, and ecornate cyathial glands.

Probably confined to E. Anatolia, N. Iraq, W. Iran, Syria and Lebanon.
Subsect. Esulae (Haworth) Boiss. in DC. Prodr. 15 (2), 158 (1862).

Herbs or shrubs. Cauline leaves alternate, rarely the upper
ones verticillate. Cyathia in ‘umbels’, rarely on much branched
pseudo-dichotomous stems. Cythial glands with margin truncate,
retuse or more or less 2 or more horned. Bracteoles in between
the flowers hirsute or plumose. Seeds chiefly carunculate.

About 170 species, chiefly in the temperate regions of the
Old World, comparatively fewer in the Americas. Very closely allied
to Subsect. Galarrhae.

Reichenb., Icon. Pl. Crit., t. 251 (1825); Komarov, *Pl. URSS 14*,
t. 22, f. 2 (1949).

*Syn. E. thyrsiflora* Griseb., *Spicil. Rumel. 1* (1), 143 (1843) !

*E. transsylvanica* Schur in *Verh. Siebenb. Ver. Naturw. 3*,
124 (1852).


Glabrous, glaucous, erect perennial with a horizontal rhizome.

Stems usually simple, occasionally with a few young sterile ones at base. Cauline leaves sessile, ovate or ovate-oblong, subcoriaceous, base cordate, mid-vein usually prominent, margin scabrid, apex obtuse or acutish. Involucral leaves similar to cauline leaves. Umbellate radii 8-10, slender, usually twice bifid; several infra-umbellary floriferous branches present. Involucellar leaves broadly cordate-ovate. Cyathial glands semicircular to semilunar with 2 usually very short horns. Capsule ovoid, deeply trilobed; coccas granulate on the back. Seeds ovoid, smooth; caruncle conical. *Fl. Apr. - June.

Geophyte.

**Holotype:** [The Crimea]: In Tauriae meridionalis declivibus siccis mari nigro imminentibus, *Marchall von Bieberstein* (*LE* - n.v.).

prov. Istanbul, San Stefans - Florya, 21 May 1900, Aznavour. C2:
Mesogis [Aydindağ], June 1842, Boissier.

E. agraria has a distributional range from Romania and the Balkan Peninsula to W. Anatolia, the Crimea and probably Transcaucasia, but has not been reported so far from the central part of N. Anatolia (i.e. opposite the Crimea).
E. lucida Waldst. & Kit., Fl. Rar. Hung. 1, 54, t. 54 (1802).
Boiss., Fl. Cr. 4, 1127 (1879); Hegi, Ill. Fl. Mitt.-Europ. 5, (1),
172, f. 1780 (1924).

Syn. E. pallida Willd., Sp. Fl. ed. 4, 2 (2), 923 (1800), pro parte -
Tithymalus lucidus (Waldst. & Kit.) Kl. & Gr. in Garcke, Fl.

Glabrous perennial with a creeping rhizome. Stems erect up to
130 cm. tall, branched above. Cauline leaves sessile, 10-25 mm. broad
in the middle, 5 or more times longer than broad, lanceolate, thick,
gradually tapering from the middle into an acuminate apex. Involucral
leaves similar to cauline leaves but shorter. Umbellate radii up to
10, at least twice divided. Involucellar leaves broadly ovate or
ovate-rhomboid, mucronate. Cyathial glands 2-horned, horns usually as
long as the breadth of gland. Capsule 5.0-6.0 mm. x 6.0-7.0 mm.,
broadly ovoid-trilobed; coccas rounded and punctate-scabrid on the
backs. Seeds 3.0-3.5 mm. x 2.7-3.0 mm., broadly ovoid to broadly
ovoid-oblong, greyish, smooth, obtuse at apex; caruncle depressed,


Type: [Hungary]: in fossis aliiisque locis humidis Comitatus pesthin-
enensis, Albensis, Tolnensis, Bekensiensis & Bihariensis, nec non in
Banatu inter Orsonam & Ogradinum ad Danubium, Waldstein (FR, photo. E).

A2 (E): prov. Istanbul, near the river Kila, 2 July 1901 and
21 July 1901, Aznavour. Asia minor, a. 1858, Tchihatcheff.
E. lucida is similar to E. virgata Waldst. & Kit. differing, however, in its thicker shining leaves, larger capsules and seeds, and in its creeping rhizome. It is mainly a central and eastern European species extending through the Balkan peninsula into N. Anatolia.

This species is known to interbreed with E. virgata Waldst. & Kit. and E. esula L. in Austria and Transylvania; the hybrid with the former has been described under the name E. pseudo-lucida Schur (in Verh. Sieb. Ver. Naturw. 3, 124 : 1852), and the one with the latter has been mentioned as E. wagneri Soo by its author in Bot. Közl. 22, 67 (1924/25).
E. salicifolia Host var. latifolia Ledeb., Fl. Ross. 3, 578 (1850).
Tithymalus ibericus (Boiss.) Prokh. in Komarov, Fl. URSS. 14, 435 (1949).

Many stemmed perennial with creeping rhizome. Stems erect, up to 85 cm. tall, at base 4-9 mm. thick, usually with scale leaves, and with several axillary sterile branches above, rarely simple. Cauline leaves ovate-oblong or oblong-lanceolate usually not more than 3 times longer than broad, usually glabrous and glaucescent, rarely puberulous, subcoriaceous; leaves on axillary branches linear to linear-oblong.
Involucral leaves similar to cauline leaves but smaller. Umbellate radii (-5) 8-18 (-21), slender, one or more times divided.
Involucellar leaves broadly ovate to broadly ovate-deltoid, base usually subcordate, rarely truncate. Cyathial glands semilunar, 2-horned, horns not longer than the width of glands. Capsules 3.0-4.0 mm. x 3.0-4.5 mm., broadly oblong, trilobed, depressed at both ends, cocciæ rounded, usually elevate-punctate to scabrid, rarely smooth.
Seeds 2.5-3.0 mm. x 1.7-2.0 mm., ovoid-oblong, usually greyish, smooth, caruncle 0.4-1.0 mm. across, almost discoid, slightly retuse on the ventral side. Fl. June - Sept. Chamaephyte 2n = 56 (Perry : 1943 in Darlington & Wylie : 1955).

Syntypes: in herbidis humidiusculis Georgiae Caucasicae circa
Helendorf, Hohentacker (LE – n.v., K, G); Persia bor., Buhse
(LE – n.v., G).

A8: Rize, July 1866, Balansa 387 – as E. iberica var. intermedia.
A9: prov. Kars, Sarikanis – Selim, 1900 m., 15 June 1957, Davis 29545;
Maras, dist. Çardak, Kandil dag, 1700-1900 m., 24 July 1952, Davis
20233. B7: prov. Tunceli, Ovacık – Hozat, 2050 m., 22 July 1957,
Davis 31075 and 2000 m., 14 July 1957, Davis 31075. B8: prov. Bitlis,
Kambos dag, above Rumus [dist. Setek], 2100 m., 31 June 1954, Davis
23455. B9: prov. Karakose (Agri), 54 km E Horassan, between
Zidikan [Eleskirt] and Velibaba, c. 2500 m., 4-5 Sept. 1957, K.H.Rechinger
15058 (as E. orientalis L.). C9: prov. Hakari, Kara dag, 3450 m.,
16 Aug. 1954, Davis 20497 – plants dwarf, young leaves puberulous.
C10: prov. Hakari, Cilo tepe, 3060 m., 8 Aug. 1954, Davis 24061 –
rather untypical, sterile branches some times absent, umbels condensed.

On rocky slopes, earthy igneous scree, and in deciduous Oak
scrub from 1700-3450 m.

E. iberica is probably allied to E. latifolia C.A. Meyer ex
Ledeb. (Siberia and Central Asia) from which it differs chiefly by
its firm subcoriaceous leaves (not thin and membranous) and smaller
umbels.

Boissier described a var. intermedia with narrower, oblong-
lanceolate leaves (in DC. Prodr. 15 (2), 163 : 1862) from Caucasus.
I have seen only one of the two syntypes (Chaschmi, Hohentacker) but
not enough material referable to this variety to decide the status of this taxon. Balansa's plant from Rise and Davis 31075 from prov. Tunceli have leaves up to 4 times longer than broad.

_E. iberica_ is restricted to Caucasus, E. Anatolia, N. Iraq and N. Iran.
Reichenb., in Fl. Germ. Helv. 5, t. 147, f. 4792 (1841); Hegi, Ill.
Fl. Mittel-Europ. 5 (1), 174 & 175, f. 1782 & 1783 (1924).

Syn. Tithymalus virgatus (Waldst. & Kit.) Kl. & Gr. ex Garcke, Fl.
Deutschl. ed. 4, 292 (1849).
E. virgata Waldst. et Kit. var. orientalis Boiss. in DC. Prodr.
15 (2), 160 (1862).
E. virgata Waldst. et Kit. var. Uralensis (Fisch. ex Link) Boiss.
in DC. Prodr. 15 (2), 160 (1862), pro parte.
E. virgata Waldst. et Kit. subsp. orientalis (Boiss.) Valenovsky
in Fl. Bulg., 507 (1891).

Tithymalus boissieriannus Woronow, Herb. Fl. Cauc. no. 479 (1931,
in sched).
E. boissieriana (Woronow) Prokh. in Komarov, Fl. URSS 14, 445
(1949).

Glabrous erect perennial up to 95 cm. tall. Stems many from a
woody vertical root, virgate, striate, often with many secondary
axillary sterile branches above. Cauline leaves on main stems, 35-
95 mm. x 4-15 mm., sessile, linear-lanceolate or elliptic-oblong, base
scarceiy attenuate, margin sometimes sinuous, acute or mucronate, strict
or spreading, usually rigid. Involucral leaves similar to upper
cauline leaves, usually shorter. Umbellate radii 4-16, one or more
times divided; several secondary infra-umbellar floriferous branches
present. Involucellar leaves broadly ovate or ovate-deltoid, base
truncate or subcordate, mucronate, usually yellowish. Cyathial glands
bicornate, horns shorter or longer than the breadth of glands, simple or divided at the tips. Capsule 3.5-4.0 mm. x 4.0-5.0 mm., deeply trilobed; coccae laterally subcompressed, distinctly elevated-punctate to rugose on the back. Seeds c. 2.5 x c. 2.0 mm., ovoid, smooth, mature ones brown or greyish; caruncle discoid, suborbicular, + projected towards the ventral side of seed. Fl. May - Aug.

Chamaephyte

In meadows and arable land usually near rivers and ditches and on igneous N. slopes, reaching 2300m.

E. virgata W. & K. var. orientalis Boiss. which was later raised to
the rank of a subspecies by Velenovsky and treated as a distinct species by Prokhanov, was chiefly based on the longer and broader cauline leaves, slightly bigger capsules and more branched habit. Considerable variation in leaf size and capsule size has been seen from the material examined from Europe and the Orient, and plants with broader leaves and many sterile branches occur in Swedish, Serbian and Austrian localities. The Turkish material shows every transition in the length and breadth of the cauline leaves and in the number of infra-umbellar sterile branches, so that there seems no justification for recognizing this taxon even at varietal rank.

_E. uralensis_ Fisch. ex Link, which according to Prokhanov (Fl. URSS) is endemic to regions near the Volga-Don, Altai mountains, Urals and Russian Black sea coast, is said to differ from _E. virgata_ mainly in its narrower linear cauline leaves and more branched habit. I have not examined sufficient material of this taxon to assess its value, but all the specimens from Caucasus and Asia Minor under this name at Kew are referable to _E. virgata_.

_E. virgata_ is closely allied to another widespread species, _E. esula_ L. (Europe and temperate Asia), from which it is chiefly distinguished by its vertical descending root (instead of horizontal and stoloniferous) and by its oblong subsessile leaves with a rounded or cuneate base (instead of linear-oblanceolate, gradually tapering from the middle towards the base into a short narrow petiole). _E. virgata_ is also related to _E. sanasunitensis_ Hand.-Mazz.; see the discussion under the latter for differences. The Iranian _E._
hebecarpa Boiss. resembles E. virgata very closely in general facies but can be separated by its pubescent cyathia and capsules. The unbranched narrow-leaved forms of E. virgata can be easily confused with E. seguieriana Necker, but are readily recognizable by the presence of glandular horns. In fruiting condition, the former is easily distinguished also by its larger capsules.

This species is known to hybridise with at least 3 allied ones, viz. E. lucida, E. cyparissias, and E. salicifolia. The hybrids, all from Austria and Hungary, have been described as E. pseudo-lucida Schur, E. gayeri Boros et Soc ex Soc (in Bot. Közl. 22, 66 : 1924/25), and E. angustata Rochel (Pl. Banat. rar. 43, t. 7 : 1831) respectively.

E. virgata is common in central and eastern Europe but penetrates throughout the Caucasus and Asia Minor (chiefly in Armenia and Kurdistan) into mountains of Elburz and Turkmenistan. In the British Isles and in the Far East it is probably an introduced plant.

A many stemmed perennial with a thick erect lignified rhizome covered with brown scale leaves. Stems erect, 40-60 cm. tall and up to 4.5 cm. thick at base, often with several infra-umbellary sterile branches. Cauline leaves sessile, 5.0-10 cm. x 1.0-2.5 cm., glabrous, subcoriaceous, elliptic-lanceolate to rhomboid-lanceolate, base narrowed, abruptly broadened above and gradually tapering into an acute or acuminate apex, sometimes falcate, margin finely cartilaginous, leaves on sterile branches linear. Involucral leaves 5-10, 15-35 mm. x 4-10 mm., oblong-lanceolate. Umbellate radii usually 10-13, 3-4 cm. long. Involucellar leaves 7-14 mm. x 10-15 mm., deltoid or rhomboid, base truncate or subcordate. Cyathial glands semilunar with 2 horns, much shorter than the width of gland. Capsule c. 3 mm. x c. 3 mm., trilobed, depressed at both ends; coccas rounded, elevate-punctate. Seeds c. 2.0 mm. x c. 1.5 mm., ovoid-subtetragonal, smooth, caruncle stipitate, projected to the inside.


On rocky slopes often on limestone, on humus, and near springs, from 2100 m. - 3140 m.

E. sanasunitensis is very closely related to E. virgata Waldst. & Kit. from which it seems to differ chiefly by its elliptic-lanceolate to rhomboid-lanceolate cauline leaves (instead of narrowly or broadly oblong). It is probably endemic to Kurdistan.
Glabrous glaucous perennial with a vertical woody root.
Stems many from woody stock, slender, up to 65 cm. long, erect to decumbent, usually simple, bases often twiggy, usually mixed with juvenile shoots. Cauline leaves linear or lanceolate-linear, strict or spreading, apex long mucronate. Involucral leaves similar to upper cauline leaves. Umbellate radii 6-26, often with few infra-umbellary secondary radii, slender, sometimes filiform, usually not more than twice divided. Involucellar leaves rhomboid-ovate to triangular-ovate, yellowish, base truncate or subcordate, mucronate to aristate. Cyathial glands with truncate margin, ecoriate. Capsules 2-4 mm. long, broadly ovoid-trilobed; coccas minutely granulose, subcarinate on back. Seeds 1.5-2.5 mm. x 1.0-1.5 mm., ovoid, smooth; caruncle depressed, shortly conical. Fl. Mar. - Sept. Hemicyryptophyte. 2n = 16 (Perry : 1943 in Löve & Löve : 1961); 18 (Harrison : 1931 in Darlington & Wylie : 1955).

Key to subspecies.

Umbellate radii usually 5-14 - - - - - - - a. ssp. seguieriana
Umbellate radii usually 15 or more - - - - - b. ssp. niciciana

a. Subsp. seguieriana

Reichemb., In. Fl. Germ. Helv. 5, t. 147, f. 4794 (1841) - sub E. gerardiana.

Syn. E. linariaefolia Lam., Encyc. 2, 437 (1788 or 1739).

Holotype: in Palatinatu Rheni [Central Europe], a. 1768-1789, Necker (Mannheim - destroyed).


E. niciciana Borbas ex Novak in Preslia 5, 76 (1927).

Syntypes: [Yugoslavia]: Serbia austro-occidentalis, in herbidis et
pratis supra fluminis Ibar ripam dextram apud vicum Matruge (alluvium, arena, 220 m.s.m.), copiose, [19 May 1926], Novák 1223 (FRC - n.v.) et copiose in herbidis ad declivia arenosa apud vicum Cotovac, 325 m.s.m., non procu ab oppido Kraljevo, [20 May 1926], Novák 1229 (FRC - n.v.); Stolovi planina, in serpentinicis, solitarie ad declivia ad septentriones spectantia montis Ostra Ćuka apud vicum Matruge, 250-260 m.s.m. [19 May 1926], Novák 1279 (FRC - n.v.); in herbidis ad declivia ad septentriones spectantia montis Ćava supra vicum Metikos, meridiem versus ab oppido Kraljevo, 520-550 m.s.m. [18 May 1926], Novák 1187 (FRC - n.v.).


In fallow fields, disturbed steppe, oak forests, river valleys and on mountains, often amongst volcanic rock, and on marly or soft loamy substratum, from sea level to 2000 m.

_E. seguieriana_ Necker was distinguished from _E. niciciana_ (Borbas ex Novák) Rech. fil by Hayek and Rechinger on various characters. Hayek (op. cit.) separated them on capsule size (3 mm. in _E. seguieriana_ and 2 mm. in _E. niciciana_), and seed-shape (oblong-prismatic in the
Rechinger (op. cit.: 1939) pointed out that the cauline leaves in the former are upwardly inclined and in the latter, spreading. The distinction on the above mentioned characters, however, breaks down due to the great variability of these and their lack of correlation with the number of umbellate radii; hence, it is impossible to maintain *E. niciciana* at specific rank.

The umbellate radii in this taxon, however, are found usually at a fairly constant range (15-26) - a criterion which serves to separate it from the typical *E. seguieriana* which has usually 5-14 radii. As Rechinger (op. cit. 1948) had already emphasised, *E. niciciana* Necker could be better treated as a geographical subspecies confined mainly to Greece (where it replaces subsp. *seguieriana*), the Balkan peninsula and Turkey where it is recorded from Thracia, Bithynia, and Taphlagonia; in N.W. Turkey, it overlaps with subsp. *seguieriana*.

Two gatherings made near Beyşehir in prov. Konya (vis. 1100 m.; 15 June 1962, Dudley (D. 35828); and a. 1845, Heldreich) show, in the same populations, plants with the number of umbellate radii ranging from 9-21. Rechinger (op. cit. 1929) also mentioned of similar doubtful specimens from the Balkan peninsula with 15-20 umbellate radii, and placed them as transitional forms.

Subsp. *seguieriana* is distributed almost all over Europe extending through the Crimea and Caucasus into Aral-Caspian region. In Turkey, the typical specimens of this have been collected so far only from W. Anatolia and from Armenia and Kurdistan. The plants in the
easterly range usually show longer and much branched umbellate radii. A third subspecies hohenackeri (Hochst. & Steud. ex Boiss.) Rech. fil., distinguished by elongate-lanceolate involucellar leaves, is restricted to Caucasus.

E. seguieriana resembles a European species, E. cyparissias L. in habit and leaf-shape; the latter, however, has many sterile branches and semilunar cyathial glands.
Many stemmed, glabrous, glaucous perennial with thick woody root. Stems erect, up to 60 cm. tall, robust, usually denuded below, often branched. Cauline leaves densely imbricate, oblong or oblong-lanceolate, thickly coriaceous, acute or mucronate. Involucral leaves more or less like cauline leaves, sometimes broadly rhomboid.

Umbellate radii 3-5, two or more times divided. Involucellar leaves broadly ovate to suborbicular, base usually subcordate. Cyathial glands with 2 short divaricate horns. Capsule 4.0-4.5 mm. long, deeply trilobed, depressed at both ends; coccce rounded granulate or wrinkled. Seeds 3.0-3.5 mm. x 2.5-2.8 mm., ovate-globose, subcarinate on the back, greyish, often with darker spots; caruncle minute or obsolete. Fl. May - Oct. Geophyte. 2n = 16 (D'Amato : 1939, Perry : 1943, Rodrigues : 1953 in Löve & Löve : 1961)

Described from sand dunes of Europe (Herb. Linn. Nos. 44 & 45; the specimen labelled in Herb. Cliff. as E. paralias is E. alleppica L.)


Limited chiefly to coastal sandy places, often among maquis.

E. paralias is similar to a W. Mediterranean species, E. pithyusa L. which, however, has narrower lanceolate, more pointed leaves, smaller capsules and smaller, rugulose-pustulose seeds.

E. paralias is distributed from the British isles and western Europe throughout the Mediterranean; in Turkey it also extends along the Black Sea coast and reaches the Crimea and Caucasus.
Many stemmed, pruinose-hirtulous perennial with a usually horizontal woody rhizome. Stems erect, sulcate, greyish to yellowish with several juvenile shoots at base. Cauline leaves (-30) 40-85 mm. x 8-17 mm., lax, elliptic-lanceolate or oblong-lanceolate, sometimes oblanceolate, coriaceous, 3-5 nerved, entire, apex suddenly pointed into a stiff mucro. Involucral leaves elliptic to broadly elliptic, often
elliptic-rhomboid. Umbellate radii 5-10, at least twice bifid; several axillary floriferous branches below the umbel. Involucellar leaves broadly deltoid to suborbicular, base subcordate. Cyathial lobes cibLong, truncate, shortly velutinous on both surfaces. Cyathial glands semilunar to semicircular, truncate, with 2 simple or palmately lobed, broad horns, often with several similar accessory horns on the margin, very rarely horns obscure. Capsule 5-6 mm. long, ovoid; coccae rounded, tomentose or glabrous. Seeds 2.5-3.5 mm. x 2.0-2.3 mm., ovoid-oblong, grey, smooth; caruncle c. 1mm. long, pyramidal, retuse at base on the inner side. Fl. May - Sept.

Chamaephyte.

Holotype: [Turkey (02)]: in collibus argillosos ad orientem urbis Denisleah [Denizli], June 1942, Boissier (o).

A4: near Çankırı, 800 m., 6 June 1929, J. et E. Bornmüller 14606.

In mountain steppe, fallow fields, forestry plantations, on calcareous and metamorphic hill slopes and sandy flats near lakes, reaching 1900 m.

*E. macroclada* is closely related to *E. pannonica*. However, the former is distinguished by its larger capsules and seeds, usually velutinous cyathial lobes, usually more pointed leaves and a horizontal rhizome. Both species are also geographically distinct; *E. macroclada* is easterly in distribution, extending from Lycia to Kurdistan and reaching N.W. Iran, and Caucasus towards the east and Palestine towards the south, while *E. pannonica*, which in Turkey is restricted to W. & N. Anatolia, extends through the Balkan peninsula into C. Europe.

Like *E. cheiradenia* Boiss., *E. macroclada* shows great diversity in the morphology of the glands which, in some species, do not provide
satisfactory taxonomic criteria.

Note:

A unique specimen collected from Keşiş dağı in prov. Erzincan (a. 1834 Orient. Herb. Montbret 2460, W'), though approaching E. macroclada in leaf and seed characters, is distinct in its flexuose decumbent stems arising from caudiculi, trapeziform coernate cyathial glands, much shorter umbellate radii and a vertical rhizome. It may represent an undescribed taxon.
Robust glabrous perennial with thick woody vertical rhizome.

Stems many from the woody stock, erect to suberect up to 60 cm. tall, usually denuded below. Cauline leaves 30-60 mm. x 10-20 mm., lanceolate, elliptic-lanceolate or oblanceolate, 3-5 nerved. Involucral leaves elliptic to broadly elliptic. Umbellate radii 5-15, at least twice bifid; several infra-umbellary floriferous branches present. Involucellar leaves broadly ovate to suborbicular or broadly elliptic, subcordate or rounded at base. Cyathial glands trapeziform to triangular, truncate, usually yellowish, eornate or rarely ends drawn into short simple or bifid horns. Capsules 3.0-4.0 mm. long, ovoid; coccæ rounded, smooth, usually pilose to velutinous, sometimes almost glabrous. Seeds 2.0-2.5 mm. x 1.5-1.7 mm., ovoid to ovoid-oblong, subcompressed, greyish, smooth; caruncle c. 0.5 mm. long, shortly conical, obtuse at base on the inner side. Fl. June - Aug. Chamaephyte.

Holotype: in Hungaria et finitima Austria in pratis, campis, ad agrorum margines; in agro Vindobonensi copiose circa Lanzendorf, Himberg, Host (Herb. Endlicher, W).


In plains or on mountains from sea level to 1150 m.

The nearest ally to _E. pannonica_ is _E. nicaensis_ All. from which the former seems to differ in its smaller capsules with rounded coccae (in the latter, capsules are 4-5 mm. long and the coccae carinate on the back), broader, longer leaves and more robust habit. There is also a geographical separation between the two species; _E. pannonica_ extends from C. Europe through the Balkan peninsula into W. & N. Anatolia, while _E. nicaensis_ All. has its distributional range from Spain to Dalmatia, mostly within the Mediterranean region.

_E. pseudoglareosa_ Klokov (Fl. RSS. Ukr. 7, 630, t. 27 : 1955), described from Ukraine, was distinguished by its author chiefly by the often elliptic, acute leaves with manifestly denticulate margin. But the examination of an authentically determined specimen from Herb. Inst. Bot. Ac. Sc. RRS. Ucr. Kiew, Ukrain, and the description and the illustration of the species in Fl. Ukraine suggests that _E. pseudoglareosa_ may not be specifically different from _E. pannonica_ Host.

_E. pannonica_ could be mistaken for _E. macroclada_ Boiss. whose distributional range it overlaps in the central part of N. Anatolia (cf. Map 2). See the discussion under _E. macroclada_ for differences.


*Tithymalus cheiradenius* (Boiss. et Hohen.) Klotzsch & Gr. in Abh.
Akad. Wissen. (Physik.) Berlin 37, 98 (1860)

Glaucous, rhizomatous perennial. Stems many, decumbent, often
flexuose up to 45 cm. long, with many short juvenile shoots. Cauline
leaves oblanceolate, elliptic-oblong or broadly elliptic, obtuse or
acute, coriaceous, at least the younger ones on juvenile shoots
pruinose-hirtulous. Involucral leaves elliptic to broadly elliptic,
rarely elliptic-rhomboid. Umbellate radii 4-6, one or more times
divided. Involucellar leaves semi-orbicular to very broadly ovate,
base truncate or subcordate, rarely deeply cordate, usually yellowish,
obtuse or mucronate. Cyathial glands bicornate, the horns usually
broader and bifid at the tips; usually one to many accessor horns
present on the glandular margin; young glands with only 2 simple horns.
Capsule 4.5-6.0 mm. x 3.0-4.0 mm., ovoid or ovoid-oblong, apex attenuate;
coccae rounded, smooth or minutely granular. Seeds 2.5-3.0 mm. x 1.5-
2.0 mm., ovate-oblong, subtetragonal, greyish or sometimes greyish-
yellow with crowded deep verruiform anastomosing wrinkles; caruncle c.
1 mm. long, base on the ventral side truncate. Fl. May - Aug.

Chamaephyte.

Syntypes: in monte Elbrus Persiae borealis prope Passgala, Kotschy 182
(G; K; BM); [Turkey (C8)]: in Mesopotamia circa Diarbekir, Kotschy

A6: Sivas, Mt. Yildiz dağ, 1200 m., 6 June 1890, J. Bornmüller 2513.

Among calcareous, igneous, marly or serpentine rocks, in fallow fields and steppe and on gravelly river banks, reaching 3000 m.

E. bothriosperma Boiss. et Kotschy ex Boiss, treated here as a synonym of E. cheiradenia, was based chiefly on the non-pectinate cyathial glands – a character that has been seen to be extremely variable; young glands have only 2 simple horns which later on in development become bifid at the tips, while on the glandular margin itself appear one to several accessory horns.

E. cheiradenia is perhaps allied to E. petrophila C.A. Meyer, but is a much larger plant with the seeds densely irregularly vermiciform-wrinkled instead of shallowly pitted. E. cheiradenia, which is chiefly centred in E. Irano-Turanian region, reaches the Elburz mountains (Iran) towards the east, and southwards extends to Transjordan.

Kotschy 232 from Diyarbakır (a syntype of E. cheiradenia Boiss. et Hohen.) and Kotschy 532 from Anti-Lebanon which also represents this species were mistakenly cited by Boissier (Fl. Cr.) under E. chesneyii (Kl. & Cr.) Boiss. – a species which has not so far been reliably reported from Turkey.

_Syn._ *E. obtusifolia* Lam., Encycl. 2, 430 (1786).

*E. valentina* Ortegae, Hort. Matrit., 127 (1797).

*E. heterophylla* Desf., Fl. Atl. 1, 385, t. 102 (1798).


*E. diversifolia* Persoon, Syn. Pl. 2, 17 (1806).

*E. portlandica* sensu Sibth. & Sm., Fl. Gr. Prodr. 1, 327 (1808), non Linn. (1753).

*E. neapolitana* Ten., Nap. 1, 266 (1811-1815), t. 42 (1811-1838).

*E. seticornis* Poir., Encycl. Suppl. 2, 617 (1812).


*E. leiosperma* Sibth., Fl. Gr. 5, 51, t. 465 (1825).

*E. terracina* L. var. prostrata Boiss., Fl. Gr. 4, 1123 (1879).

Glabrous, glaucous perennial with thick woody root. Stems many, up to 60 cm. tall, erect to prostrate, usually branched from base. Cauline leaves linear-lanceolate or linear-oblong, acute or obtuse; younger ones oblanceolate and truncate or retuse. Involucral leaves lanceolate, elliptic-lanceolate or rarely ovate-elliptic. Umbellate radii 3-5, usually several times divided. Involucellar leaves ovate-deltoid to ovate-rhomboid or semiobticular. Cyathial glands with setaceous horns usually longer than the breadth of gland. Capsule 2.5-4.0 mm. x 3.0-4.0 mm., deeply trilobed, depressed at both ends; cocciæ smooth, subcarinate on the back. Seeds 2.0-2.5 mm. x 1.5-1.8 mm., oblong-cylindrical, grey, smooth; caruncle stipitate, projected and beaked on one side. Fl. May - Sept. 

Described from Alstroemer, Spain (Herb. Linn. No. 33).

In monte Tauro, [a. 1836 ?], Kotschy 484. AEG. IS.: Rodos (Rodhos), Kremasto, 10 May 1935, E.H. & F. Rechinger 7107.

The long list of synonymy of this polymorphic species is by no means an exhaustive one; extreme variability is found in habit and the shape of cauline and involucellar leaves. Although originally described as an annual, *E. terracina* perennates by the help of its thick lignified root.

*E. terracina* has great resemblance to *E. taurinensis* All. in leaf shape and general facies, but is easily separated by its smooth seeds (not pitted) and more robust perennial habit.

*E. terracina* is distributed throughout the Mediterranean. From the mainland of Turkey, it is known so far only from near Istanbul and the Taurus mountains.
E. *pinea* Linn., *Syst. ed. 12, 335* (1767).


Glabrous, glaucous perennial. Stem erect, indurated below, densely leafy, often branched below the umbel. Cauline leaves linear, thick, obtuse, mucronulate, the lower ones densely imbricate. Involucral leaves ovate. Umbellate radii 5-7, once or twice bifid. Involucellar leaves reniform-cordate, obtuse. Cyathia campanulate, lobes ovate, fimbriate, glands 2-horned, horns setaceus, longer than the breadth of gland. Capsule ovoid, trilobed, coccas finely granulose. Seeds whitish, ovoid, subcarinate on the back, irregularly pitted. Therophyte or Hemicryptophyte. 2n = 18 (Harrison : 1931 in *Darlington & Wylie : 1955*).

Boissier (*Fl. Or.*) recorded *E. pinea* from N.W. Anatolia, viz. in rupestris saepius maritimus, Bithynia, Wiedemann in herb. Petrop. (*LE - n.v.*). I have not seen any plant from Turkey that could be referable to this taxon. The European material examined shows great variation in habit and leaf-shape. *E. pinea* has been treated as a subspecies of an annual species *E. segetalis* L. by Hayek (*Prodr. Pl. Pen. Balc. 1, 135 : 1927*) and Vindt. (*Monogr. Eph. Maroc. 1, 140 : 1953*).

*E. pinea* is distributed throughout the C. & W. Mediterranean region.

Io. Euph., t. 101 (1866); ibid. Fl. Cr. 4, 1118 (1879).


E. nicaensis All. var. minor Ledeb., Fl. Ross. 3, 573 (1850).

Perennial with thick woody vertical root up to 10 cm. deep.

Stems many from the woody stock, decumbent, up to 25 cm. long, indurated at base, densely or laxly leafy, mixed with several juvenile shoots; mature stems with bases denuded and marked by leaf-scars.

Cauline leaves elliptic, elliptic-oblong or oblanceolate, pruinose-hirtulous at least when young, subcoriaceous, obtuse or acute.

Involucral leaves broadly elliptic to transversely ovate. Umbellate radii 3-5, usually not more than once bifid. Involucellar leaves semi-orbicular with usually a truncate base. Cyathial glands bicornate, horns shorter or longer than the breadth of gland. Capsule 3-5 mm. long, ovoid-trilobed; coccae rounded, minutely granulose. Seeds 1.7-2.5 mm. x 1.0-1.8 mm., ovoid- or oblong-subtetragonal, subcompressed, greyish, with several irregularly arranged shallow pits; caruncle conical broader than long. Fl. May - July. Chamaephyte.

Key to varieties.

Leaves 6-15 mm. long; primary umbellate radii 5-20 mm. long; stems usually dwarf (3-10 cm.)

Leaves 10-25 mm. long; primary umbellate radii 15-30 mm. long; stems usually long (15-25 cm.)

a. var. petrophila

b. var. armena
a. Var. petrophila

Holotype: [Crimea]: in rupestribus montium Tauriae, e.g. in monte Tschatschyr dagh, C.A. Meyer (LE - n.v.).


A5: prov. Amasya, Akdağ, 15-1900 m. 23 May 1890, J. Bornmüller 1815.

C5: prov. Nigde, Bulgar Maaden, N. Taurus, 1700 m., July 1813, Siehe 444.

b. Var. armeniaca Boiss. in DC. Prodr. 15 (2), 1268 (1866).

Type: [Turkey (A8)]: in rupibus pr. Baiburt [Bayburt], Armeniae, 20 June 1882, Bourgeau 242 (Holo. G; iso. E, K).

A8: prov. Gümüşane, Bayburt, 20 June - 10 July 1882, Bourgeau 636 (as E. armeniaca).

On calcareous or calcareous-marly rock and on dry slopes of mountains often on alpine meadows growing with Juniperus nana, reaching 2050 m.

E. petrophila is closely allied to E. mesopotamica M.S. Khan (being described from N. Iraq and N.E. Syria) but differs chiefly by its ascending instead of procumbent stems, thinner involucellar leaves with entire or eroded margin instead of coriaceous and cartilaginous denticulate, and by its shorter seeds (1.7-2.5 mm. instead of 2.0-2.7 mm.).

Another closely allied W. Caucasian taxon, E. panjutinii Grossheim
(Not. Syst. Herb. Inst. Bot. Ac. Sc. URSS 15, 18 : 1950), was distinguished from E. petrophila by its dwarfer stems which are densely foliate, smaller leaves, and by its greatly abbreviated umbellate radii. I have not seen the type of E. panjutinii but examined a photograph of it at Edinburgh, and by the appearance of the general facies it appears that it might represent not more than a depauperate form of E. petrophila.

E. petrophila is probably confined to S. Russia, the Crimea, Caucasus, Transcaucasia, Armenia, and Anatolia where it occurs mainly in the central-northern part, but also extends to the N. side of the Cilician Taurus. Samuelsson's plant (S. 3392-3') from the central Syria, reported by Rechinger (in Arkiv für Bot. ii. 5 (1), 284 : 1959) as E. petrophila is, in fact, E. cheiradenia Boiss. et Hohen.
(50) E. pisidica Huber-Morath et M.S. Khan, spec. nov. Fig. 8

Affinis E. pestalozzae Boiss. sed indumento breviter tomentoso, foliis caulinis semper linearibus angustioribus, radiis umbellae longioribus plerumque semel bifidis recedit.

Planta perennis. Radix (caudice incluso) indurata verticalis ad 20 cm. longa vel ultra, superne ad 1 cm. crassa caudiculosa. Indumentum caulium (in parte superiore) et foliorum caulinarum et involucri dense et breviter tomentosum. Caules floriferi plures, ad 20 cm. longi et 1-3 mm. lati, fragiles, ascendentes, simplices, raro superne ramis floriferis, inferne demum denudati cicatricosi, surculosus hornotinis sterilibus brevibus commixti. Folia caulina mediana 10-35 mm. x 1-2 mm., sessilia, linearia, integra, late mucronata, crassa, inferiora et ea surculorum sterilium dense imbricata, superior laxa. Folia involucri 4-5, linearia vel oblongo-lanceolata, mucronata, 10-15 mm. x 2-5 mm. Radii primarii umbellae 2-5, 15-40 mm. longis, graciles, glabri, plerumque semel bifidi. Folia involucellae (primariae) 5-8 mm. x 8-12 mm., transverse late elliptica, mucronata, glabra, virenti-flava. Cyathia 2.5-3.5 mm. longa, campanulata, glabra, lobis ovato-oblongis extus glabri intus pubescento-hirti, plerumque retusis, glandulis (in sicco) fuscis, semilunato-deltoides bicornutis, cormibus angustis obtusis glandulae latitudine aequilongis. Bracteolae inter flores masculos multae plumbae. Capsula 3.5-4.0 mm. x 2.5-3.0 mm., ovoidea, trilobata, fuscoscentia, coccis rotundatis, laevibus, obscure punctatis; styli 1.0-1.5 mm. longi, apicem versus semel bifidi, ad basin coalescenti. Semen 2.0-2.2 mm. x 1.5-1.7 mm., ovoideum, subcompressum,
griseum, leviter et irregulariter reticulato-foveolatum, caruncula c. 0.5 mm. longa, conico-pyramidalis, basi intus retusa. Fl. Jun.

C2: prov. Burdur, dist. Tofenni, Passhöhe südlich ob Dirmil, Eruptivgestein, 1500 m. 28 Juni 1948, Huber-Morath 8593 (Holotypus, Hub.-Mor.; iso. H); Triften der Passhöhe 7 km. südlich Dirmil, 1500 m, 9. Juni 1938, Huber-Morath 5667; Katara pass [near Gölhisar, 12 May 1842], Prof. Forbes 563 (K).

E. pisidica is closely allied to E. pestalozzae Boiss. to which it is similar in general habit and in the characters of cyathial glands, capsules and seeds, but is specifically distinct in its shortly tomentose indumentum, always linear cauline and involucral leaves, and longer and usually at least once-divided umbellate radii.

E. pisidica has not been found, so far, out side the Lycian Taurus, and is probably endemic to that region; a chamaephyte on pasture land and volcanic rocks near high mountain passes at an altitude of about 1500 m.
Fig. 8. Holotype of *E. pisidica* Hub.-Mor. et M.S. Khan.
E. pestalozzae Poiss., Diagn. 1 (12), 114 (1853).


Glabrous perennial with a thick vertical ligneous root up to 15 cm. or more deep. Stems many, decumbent, indurated below, up to 20 cm. long, densely leafy, usually denuded at the bases and often purplish, mixed with juvenile branches. Lower cauline leaves linear-oblong or elliptic-oblong, the upper ones larger and laxer, elliptic or elliptic-spathulate, glaucous, subcoriaceous, young leaves with involute margin, apex obtuse or acutish. Involucral leaves elliptic, usually larger than the upper cauline leaves. Umbellate radii 3-5, not more than 2.5 cm. long, slender, abbreviated, usually simple, bearing the cyathia at the apices. Involucellar leaves broadly ovate to broadly ovate-rhomboid. Cyathial glands wax-coloured or brownish, semi-lunar with 2 short horns. Capsules 3.0-4.5 mm. long, ovate, apex pointed; coccas smooth and glabrous. Seeds 2.0-2.5 mm. x 1.5-1.8 mm., broadly ovoid, with several irregularly arranged shallow pits; caruncle small, conical, substipitate. Fl. July. Chamaephyte.

Holotype: [Turkey (C4)]: prov. Konya, in Caramania [Karaman], Pestalozza (C).

C2: prov. Antalya, Akgöl, 17 July 1882, Iuschan (type of E. akiadakensis); ibid., 5 July 1860, Bourgeau 600; dist. Elmali, Beydag. [Citation]
On high plateaus and on mountain screes up to 2500 m.

_E. pestalozzae_ is allied to _E. pisidica_ Huber-Morath & M.S. Khan; the latter, however, has narrower (not more than 2 mm. wide) leaves that are pubescent, and longer (15–40 mm.), divided umbellate radii.

_E. pestalozzae_ is probably endemic to the Lycian Taurus and S. Iycaonia.
(52) **E. erythrodon** Boiss. et Heldr., Boiss. Diagn. 1 (12), 114 (1853).

**Syn.** Tithymalus erythrodon (Boiss. et Heldr.) Klotzsch & Gr. in Abh. Akad. Wissen. (Physik.) Berlin 37, 87 (1860).

A dwarf perennial with a thick lignified vertical descending root up to 15 cm. deep. Stems many, decumbent, up to 8 cm. long, indurated at base, densely leafy, mixed with juvenile branches. **Cauline leaves** elliptic or oblong-elliptic, subcoriaceous, pruinose-hirtulaceous at least when young, acute or acuminate into a short rigid point. **Involucral leaves** similar to cauline leaves. **Umbellate radii** very much condensed to form dense 'heads'. **Involucellular leaves** broadly ovate to suborbicular, macronate. **Cyathial glands** light to dark purplish, borne very small or obsolete. **Capsules** 3.0-3.5 mm. long, ovoid; cocciæ minutely granulate; young capsules velutinous. **Seeds** 2.0-2.5 mm. x 1.3-1.5 mm., ovoid-oblong, greyish, smooth; caruncle small, conical. Fl. May - July. **Chamaephyte.**

**Type:** [Turkey (C3): prov. Isparta], in rupestribus regionis superioris montis Davros Pisidia, alt. 1650 m., May, Heldreich (Holo. G; iso. K, BM).

**B3:** prov. Konya, Akşehir, Sultandag, 1900 m., 21 June 1899, J. Bornmüller 5551, ibid. 1900 m., 3 July 1948, Huber-Morath 8150.

**C3:** prov. Antalya, Bozburundag, 2200-2300 m., 25 July 1949, Davis 15663.

On mountain ridges, often on limestone up to 2300 m.

Boissier who did not observe the seeds of *E. erythrodon*, placed it provisionally with the species with pitted seeds. In fact, it is allied to the smooth-seeded *E. glareosa* Pall ex M.B. (E. glareosa Pall ex M.B. var. minor Boiss.) from which it is recognized by its condensed
'capitulate' umbels and by the densely imbricate cauline leaves.

E. erythrodon is perhaps endemic to Anatolia, being known only from Lycaonia, Pisidia, and Lycia.
(33) *E. glareosa* Pall. ex M.B., *Fl. Taur.-Cauc.* 1, 373 (1808) & 3, 324
(1819). Komarov, *Fl. URSS* 14, t. 21, f. 3 (1949).


*Tithymalus glareosus* (Pall. ex M.B.) Prokh. in Komarov, *Fl.
URSS* 14, 402 (1949).

A dwarfish perennial with a thick woody vertical root. Stems
many from the lignified stock up to 15 cm. long, slender, ascending,
usually with few juvenile shoots at base. Cauline leaves oblanceolate
to oblong, pruinose-hirtulous. Involutural leaves broadly elliptic or
oblong. Umbellate radii 3-5, slender, once or twice bifid. Involu-
cellar leaves very broadly ovate to suborbicular, base truncate or
subcordate. Cyathial glands transversely elongated, margin truncate;
usually ecornate, rarely the ends drawn out into short broad horns.
Capsule 3.5-4.0 mm. long, ovoid, trilobed; coccæ subcarinate and
punctate. Seeds c. 2.5 mm. x 1.3-1.5 mm., ovoid-oblong, subcompressed,
smooth; caruncle 0.5-0.7 mm., conico-pyramidal. *Fl. May.* Chamaephyte.

Holotype: [The Crimea]: provenit in Tauriae et Caucasi sterilibus
lapidosis, [Pallas ?] Floret Majo, Junio (LE - n.v.).

A5: Amasya, Mont. Logman, 500-514 m., 17 May 1889 J. Bornmüller
819. B6: Gürün - Sivas, 20 km. from Gürün, 1400 m., 20 June 1960,
Stainton & Henderson 5740 (with many prostrate stems from a much
branched woody stock). B6: Erzerum, a. 1853, Calvert 990, and a. 1854,
Calvert 111.

*E. glareosa* is allied to *E. erythrodon*, but distinguished by its
longer spreading umbellate radii and laxly arranged cauline leaves.
E. glareosa can also be easily mistaken for E. petrophila C.A. Mey., with which it overlaps in its distribution, due to a striking similarity in habit, but in the fruiting state is easily separated by its smooth seeds.

E. glareosa var. elatior M.B. (Fl. Taur. Cauc. 3, 325 : 1819) has been described as E. stepposa Zoz (in Komarov, Fl. URSS 14, 738 : 1949) from Ukraine. This plant is said to be allied to E. pannonica Host and E. glareosa M.B., differing from the former (fide Zoz) in its taller stems, glabrous leaves and divaricate umbels, and from the latter in its robust stature, glabrous entire leaves and multi-radiate umbels. The type has not been seen, and its status requires confirmation.

E. glareosa is restricted to the Crimea, Caucasus, and the central and eastern part of N. Anatolia.
(54) \textit{E. isaurica} M.S. Khan, spec. nov. Fig. 9

Affinis \textit{E. promecocarphae} P.H. Davis et \textit{E. herniariifolia} Willd. sed ab ambobis indumento tomentoso distinguitur; insuper a priori foliis majoribus crassioribus, statura majore, capsulis et seminibus majoribus rededit; ab altera capsulis oblongis, coccis dorso rotundatis (haud bialatis), caruncula majore subglobosa differt.

Perennis, planta tota breviter tomentosa. \textit{Caules} plures, procumbentes vel penduli, fragiles, basi caudicolosi, iterato acute ramosi, ad 30 cm. longi, inferne 1-4 mm. lati. \textit{Folia caulina} mediana 4-9 mm. x 4-9 mm., breviter petiolata (petiolus 0.5-1.5 mm. longus), orbiculata vel late elliptica, crassa, integra, obtusa raro emarginata, nervis obscuris. \textit{Folia involucr} (-2) 3-4, 4-12 mm. x 4-12 mm., late elliptica vel late elliptico-rhomboida vel orbiculata, obtusa vel acutiuscula, breviter petiolata (petiolus 0.5-1.0 mm. longus). \textit{Radii primarii umbellae} 2-4, 5-30 mm. longi, bis vel iterato bifidi. \textit{Folia involucellae} (primariae) 5-10 mm. x 5-11 m., late elliptica vel late elliptico-rhomboida raro orbiculata, acuta vel obtusa. \textit{Cyathia turbinata}, 1-2 mm. longa, lobis oblongis truncate ciliatis, glandulis transverse oblongis vel semilunatis flavescento-fusceis vel atrofuscis (in sicco), bicornutis, cornibus setaceis, glandulae latitudine aequilongis vel longioribus. \textit{Bracteolae} inter flores masculos ciliatae. \textit{Capsula} 2.5-3.0 mm. x 1.4-1.7 mm., anguste oblongo-trilobata, ad apice et base plus minus depressa, coccis rotundatis, dorso billineatis; \textit{stylis} 0.7-1.0 mm. longi basin versus coalesco, apicem versus bifidi. \textit{Semen} 1.2-2.0 mm. x 0.7-1.0 mm., cylindricum, griseum vel griseo-virens,
foveolis paucis levibus provisum; caruncula 0.7-1.0 mm. longa circa
dimidio semine brevior, oblonga vel subsphaerica, substipitata,

C4: prov. Konya, dist. Ermenek (Isauria), Kandis Dere (between Ermenek & Oyuâlu Dağ), alt. 1400-1500 m., 14 Aug. 1949, hanging from roofs of caverns, Davis 16189 (Holotype E; iso. K); Ermenek - Karaman, 24 km. nach Ermenek, 1550m., 9 Jun. 1948, Huber-Morath 8661

Although very similar to *E. promecocarpa* P.H. Davis (Syria) in its habit and the characters of capsules and seeds, *E. isaurica* is specifically distinct in its larger thicker leaves, larger stature, larger capsules and seeds, and by its short tomentose indumentum. From its other ally, *E. hermariifolia* Willd., it differs by its narrowly oblong capsules, cylindrical seeds with larger, oblong or subsphaerical caruncles, and by its characteristic indumentum.

The type of *E. isaurica* was collected in a relict community found on overhanging rocks at the mouths of limestone caverns in Isauria where it is associated with *Arenaria spelunca* McNeill, *Teucrium cavernarum* P.H. Davis, *Tracheliopsis myrtifolia* (Boiss. & Heldr.) O. Schwarz & P.H. Davis, *Campanula leucosiphon* Boiss. & Heldr., *Erodium pelargoniflorum* Boiss. & Heldr., *Calium dumosum* Boiss. and *Valeriana spelunca* Boiss.; it is probably endemic to Isauria. Huber-Morath 8661 was collected from calcareous rock. The allied *E. promecocarpa* is confined to dry vertical overhanging rocks in the Anti-Lebanon.

A puzzling gathering made by Huber-Morath from near the type
locality (Ermenek - Mut, sendrechte Kalkfelsen 20 km. nach Ermenek, 1340 m., 13 June 1950, Huber-Morath 9962) includes both tomentose plants resembling E. isaurica and glabrous ones which on the first sight might be referred to E. herniariifolia Willd. var. glabrescens Halacsy. The hairy plant has a short ovoid capsule but the glabrous specimens have oblong capsules like E. isaurica. However, neither of the plants have capsules mature enough to show the seed characters. It seems possible that this gathering might represent the result of introgression between E. isaurica and E. herniariifolia var. glabrescens.
Fig. 9. Holotype of *E. isaurica* M.S. Khan.

Glabrous or puberulous perennial with woody deeply descending root. Stems numerous from woody stock, slender, crowded, borne in cauliculi, decumbent or prostrate, often branched above. Cauline leaves petiolate or subpetiolate, obovate, shortly elliptic or sub-rotund, obtuse or acute, usually subcoriaceous, sometimes thin. Involucral leaves similar to upper cauline leaves, usually larger. Umbellate radii 3–5, usually very short, 1 or 2 times divided, rarely simple. Involucelar leaves similar to involucral leaves, becoming gradually smaller towards apex. Cyathial glands with 2, usually setaceous horns, shorter or longer than the breadth of gland, rarely with a central accessory horn. Capsule 3.0–4.0 mm. x 2.5–4.0 mm., ovoid to ovoid-oblong, trisulcate; coccæ glabrous, puberulous or velutinous, usually acute, with 2 parallel, narrow + undulate wings on the back. Seeds 1.7–2.5 mm. x 1.0–1.8 mm., ovoid or oblong, grey to brown, subtetragonous, on the ventral side with 2 parallel grooves, and on the dorsal side with few shallow or deep pits; caruncle small, (0.5–0.7 mm. long) conical. Fl. Apr.– Aug. (–Oct.). Geophyte.

Key to varieties.

Stems, leaves, and capsules, at least when young, puberulous to velutinous

a. var. herniarifolia

Stems, leaves and capsules, always glabrous

b. var. glaberrima
a. Var. herniarifolia


E. herniariaefolia Willd. var. hebearpa Boiss. in DC. Prodr. 15 (2), 155 (1862).

Holotype: in Creta, Willdenow (B - n.v.; photo. E).


Syn. E. pycnophylla C. Koch in Idinnea 19, 17 (1847).

E. herniarifolia sensu Boiss., Fl. Gr. 4, 1125 (1879), pro parte.
Syntypes: Orphanides herb. n. 2388 (W - n.v.); Baldačci, it. alb. a. 1892, n. 163 (K).


E. herniariifolia grows on calcareous, serpentine or metamorphic rocky slopes and ledges, often on North facing screes and overhanging rock crevices, reaching an altitude of 2900 m.

The species shows considerable variation in size, shape and texture of the leaves, length of petioles, the colour of the cyathial glands (from red to yellow), and the size of capsules and seeds; plants growing in shady situations have usually thinner leaves with longer petioles. The two varieties recognized have widely overlapping distributions.
E. herniariifolia is allied to E. isaurica M.S. Khan - probably endemic to Isauria - from which it can be separated by its ovoid to ovoid-oblong capsules (instead of narrowly oblong), seeds with smaller, conical caruncles (instead of larger, globose) and glabrous or puberulous leaves (instead of tomentose). It occurs in all the phytogeographical regions of Turkey, with its western and southern extension through the Balkan peninsula and Greece (including the Aegean islands) up to Crete and Cyprus. Eastwards it does not extend beyond Turkey; in Syria and Lebanon it is replaced by E. caudiculosa Boiss. and E. promacocarpa P.H. Davis both of which resemble it rather closely in the general facies.

Glabrous annual with stem erect up to 35 cm. tall, or decumbent, usually branched from the base. Cauline leaves obovate to sub-orbicular, base long attenuate into a petiole up to 5 mm. long, obtuse rarely retuse, membranous. Involucral leaves similar to cauline leaves. Umbellate radii 3-5, 2 or more times divided. Involucellar leaves ovate, suboblique. Glandular horns setaceous, usually longer than the width of the glands. Capsule 1.5-2.0 mm. long; coccæ laterally subcompressed and with 2 narrow parallel wings on the back. Seeds 1.0-1.6 mm. x 0.7-0.9 mm., oblong-subhexagonal, base truncate, greyish, with 1 longitudinal groove on each of the two inner faces, with a row of 2-4 rarely 5 pits on each of the 4 outer faces; caruncle sessile, conical, deciduous. Fl. Feb. – Aug. Therophyte. 2n = 16 (Perry: 1943 in Darlington & Wylie: 1955).

Key to varieties

Plants tall with erect stems with only few branches at the base; leaves usually longer than broad, obovate; seeds (1.3) 1.4-1.6 mm. long

a. var. peplus

Plants dwarf with many decumbent branches at the base; leaves usually as broad as long, orbicular; seeds 1.0-1.3 (-1.4) mm. long

b. var. peploides
var. peplus

Described from Europe (Herb. Linn. No. 25 - var. peplus; Herb. Cliff. - var. peplus.


var. peploides (Goüan) Visiani, Fl. Dalm. 3, 229 (1852). Reichenb.:


E. peplus L. var. maritima Boiss. in DC. Prodr. 15 (2), 141 (1863).!

E. peplus L. subsp. peploides (Goüan) Rouy, Fl. Fr. 12, 175 (1910).!


Type: Montpellier (S. France), Goüan (? K).

Thymbra [near Troy], in valle Scamandri [K. Menderes], 19 Apr. 1883, Sintenis 294.

**E. peplus** is a weed of cultivated fields and waste places, often on limestone rocks at lower altitudes from sea level to 50 m.

It is with some hesitation that var. *peploides* is provisionally maintained here. Gouan differentiated *E. peploides* from *E. peplus* L. chiefly by its 2-fid umbellate radii (a very variable character), in contrast to the 3-fid umbels of the latter. Boissier maintained *E. peploides* as a distinct species distinguished by its more rounded leaves, obsolete styles and by its twice smaller seeds with fewer pits - characters claimed to have been preserved in cultivation. Careful examination of material from Europe and the Orient revealed that the number of pits in each row on seeds varies a great deal. However, there seems to be a fair degree of correlation between the decumbent habit and the smaller seeds in plants which have their cauline leaves usually suborbicular. The possibility of this taxon being treated as a subspecies can be ruled out as it has no separate geographical area; decumbent plants with orbicular leaves are not confined to the Mediterranean, but also occur in the British Isles and N. Iran. The relationship of *E. peploides* to *E. peplus* cannot be understood without cultivation experiments. To what extent are its diagnostic characters environmentally induced? In the meantime it seems advisable to draw attention to the problem by recognizing *E. peploides* as a variety of *E. peplus*.

*E. peplus* is closely related to *E. chamaepeplus* Boiss. et Gaill. (from Iraq, Syria, Palestine, Arabia and Egypt) from which, however,
it differs by its capsules characterised by bicarinate coccae (instead of a single keel) and by its seeds with 4 distinct rows of longitudinally arranged pits on the outer faces (instead of pits in crowded and irregularly arranged rows). *E. chamaepeplus* is always a dwarf plant with petioles usually not more than 1.5 mm. long.

*E. peplus* is mainly a European species occurring almost throughout the Continent (including the Mediterranean) and the British isles but also extends to N. Africa, E. Mediterranean, Arabia petrea and N. Iran. In Turkey it is distributed mainly in the Mediterranean region and the Buxine province. In other parts of the world, viz. N. America, Canaries, India etc., it is probably an introduced weed.
(57) E. aulacosperma Boiss., Diagn. 1 (12), 117 (1853). Boiss., in Euph. t. 22 (1866).


E. aulacosperma Boiss. var. fossulata (Boiss.) Boiss. in DC. Prodr. 15 (2), 141 (1862).

Tithymalus aulacosperma (Boiss.) Klotzsch & Gr. in Abh. Akad. Wissen. (Physik.) Berlin 37, 82 (1860).

A dwarfish, erect, glabrous annual up to 20 cm. tall. Stems simple or branched below. Cauline leaves 7-15 mm. x 4-7 mm., sessile or with short petioles, obovate to spatulate, obtuse or mucronate, the lower ones usually truncate or retuse. Involucral leaves similar to cauline leaves, slightly larger. Umbellate radii 3-4, one or more times divided. Involucellar leaves ovate-rhomboid, oblique, often transversely elongated, mucronate. Cyathial glands with setaceous horns which are 2 or more times longer than the breadth of gland. Capsules c. 2 mm. x c. 2 mm.; cocciæ rounded.

Seeds 1.5-2.0 mm. x 0.5-0.7 mm., greyish, ovate-oblong, with 6 longitudinal parallel grooves either darker than or of the same colour as the alternating ridges, base truncate; caruncle minute, depressed, deciduous. Fl. Apr. - June. Therophyte.

Holotype: [Palestine]: in cultis prope Hierosolymam, Fl. Apr., Boissier (G).

G4: c. 15 km. S. of Konya, 5 June 1937, H. Reese. G5: prov. Mersin, village d’ Alla-Dagh, à 7 lieues au No. de Mersina, 16 May 1855, Balansa 734, Güzeldere, près de Kecilik (Environs de Mersina),
30 May 1853, Balansa 743; Namrun, 1500 m., June 1895, Siehe 190.

On mountains up to 1500 m.

In the general habit, *E. aulacosperma* resembles very closely the eastern Mediterranean *E. arvalis* Boiss. et Heldr., and in seed characters the western Mediterranean species, *E. sulcata* De Lens ex Loisel. From the former, it is recognised by its longitudinally grooved seeds instead of irregularly reticulate-rugose; from the latter it differs in its obovate to spatulate cauline leaves (instead of linear), and in its usually taller stature.

Probably endemic to Cilicia and Lycaonia, Syria, Anti-Lebanon, Lebanon, and Palestine.
Boiss., Fl. Gr. 4, 1114 (1879).

Syn. E. ruderalis Scheele in Lindmaa 17, 343 (1843)
E. parvula C. Koch in Lindmaa 21, 751 (1848) non Delile (1813) -
Boiss. vix descr.
E. punctata sensu Ledeb., Fl. Ross. 3 (2), 571 (1850); sensu
Boiss. in DC. Prodr. 15 (2), 145 (1862), pro parte - non Delile
E. parvula Koch in
Tithymalus arvalis (Boiss. et Heldr.) Klotzsch et Gr. in Abb.
Akad. Wissen. (Physik.) Berlin 37, 92 (1860)

Erect, glabrous annual up to 20 cm. tall with branches spreading
from the base. Cauline and involucral leaves obovate-oblong, obtuse,
thick. Umbellate radii usually 3, several times divided. Involucral
leaves ovate or ovate-rhomboid, sometimes oblanceolate, base sub-
cordate or narrowed, obtuse or acute. Calathia glabrous or pilose;
glands yellow to rose-coloured, horns not longer than the width of
glands, sometimes obsolete. Capsules 2-3 mm. x 2-3 mm., broadly
ovate-trilobed; cocci smooth, rounded. Seeds 1.4-1.7 mm. x 1.0-1.3 mm.,
ovoid or ovoid-oblong, obsolete tetragonal, with irregularly reticulate
wrinkles which sometimes enclose very small pits; caruncle small,

Holotype: [Turkey (O3)]; in arvis Pisidae inter Isparta [Isparta] et
Egridir, Heldreich (G).

A8: [prov. Rize], Cimil valley (Lazistan), 2000 m., July 1866,

A weed of fields reaching 2,000 m.

E. arvalis had been treated previously by Boissier (in DC. Prodr.) erroneously as conspecific with an allied Egyptian species, E. punctata Del.; the latter, however, is a much dwarfer plant with smaller (1.0-1.2 mm. long), ecarunculate seeds sculptured with irregularly arranged pits instead of wrinkles.

E. arvalis is confined chiefly to S. and E. Anatolia, extending northwards and eastwards to the Caucasus and N. Iran.
E. taurinensis Allioni, Fl. Ped. 1, 287 & 3, t. 83, f. 2 (1785).


Syn. E. terracina sensu Portenschlafs in Host, Fl. Austr. 2, 553 (1831);

Grisebach, Spicil. Fl. Rum. 1, 139 (1843), non Linn. (1762).


E. dalmatica Visiani, Fl. Dalm. 3, 228 (1852).

Tithymalus graeca (Boiss. et Sprun.) Klotzsch & Gr. in Abh. Akad. Wissen. (Physik.) Berlin 37, 84 (1860).


Erect, glabrous, glaucouscent annual up to 40 cm. tall. Stems simple or branched, sometimes purplish below, branches spreading. Cauline leaves oblong-ovate to linear-lanceolate, base attenuate, apex obtuse, truncate, retuse, mucronate or acuminate, the lower leaves smaller, usually obovate or cuneate. Involucral leaves more or less similar to upper cauline leaves, slightly larger. Umbellate radii 2-5, 2 to several times divided. Involucellar leaves shortly or elongated deltoid or deltoid-rhomboid, acute or acuminate. Cyathial glands yellowish to purplish, bicornate, horns setaceous, 2 or more times as long as the breadth of gland. Capsule 2.5-4.0 mm.
long, broadly ovate-trilobed; cocciae rounded, minutely granulate on the back, rarely smooth. **Seeds** 1.7-2.0 (≈3.0) mm. x 1.2-1.4 (≈1.7) mm., ovoid, greyish-white or light brown, irregularly reticulately-pitted; caruncle subglobose to conical, retuse at base. Fl. Mar. - Aug. Therophyte. 2n = 28 (Perry: 1943 in Löve & Löve: 1961).

**Holotype:** [N. Italy]: Montana circa Iusenego non procul ab Augusta Taurinorum, Allioni (TO, photo. E).

A2 (A): prov. Istanbul, Antigoni, 13 May 1893, Astrasour; Pendik, 6 May 1906, Astrasour; Bilecik, 300 m., 2 July 1962, Davis 36506.


On serpentine, igneous and calcareous rock, often in Pine forests, from sea level to 1450 m.
Boissier (Fl. Gr. 4, 1115:1879) differentiated *E. gracca* Boiss. et Sprun. from *E. taurinensis* by its shorter stature, deeply bifid styles and long-horned cyathial glands, but these characters, along with the form and measurements of the cauline leaves and involucellar leaves, show such a degree of variability, sometimes even on the same plant, that it is impossible to separate one species from the other. Rössler-Hüber (op.cit.) regards *E. reuteriana* Boiss. (Syria, Lebanon, and Palestine) - a taxon closely related to *E. taurinensis* - as only a geographical race of the latter.

Although resembling *E. terracina* L. (smooth-seeded) and *E. exigua* L. (tubercular-seeded) in its habit and shape of cauline leaves, *E. taurinensis* is, in fact, closer to *E. segetalis* L. (Europe and N. Africa) in its capsules with warty coccae and reticulately-pitted seeds, but differs in its laxer cauline leaves which are oblong-ovate to linear-lanceolate (instead of crowded and narrowly linear), and by more deeply pitted seeds.

Rössler-Hüber (op.cit.) designated Allioni's figure as the type of *E. taurinensis* without giving reasons for such a choice. An authentic specimen from Allioni's Herbarium, (lacking number, and information about the locality) agrees in all characters with the type description, and might be regarded as the holotype of Allioni's species although not identical with Allioni's figure.

Described from N. Italy, *E. taurinensis* is chiefly a N. Mediterranean species centred in the Balkan peninsula and Greece, but also extends to the Crimea and Caucasus in the north. In Anatolia it is mostly restricted to the Mediterranean region.
Dwarfish glabrous annual normally up to 15 cm. tall. Stems many, erect to ascending, densely leafy. Cauline leaves linear, usually not more than 2 mm. broad, apex acute, truncate, retuse or tricuspidate. Involucral leaves linear-lanceolate, slightly longer than the cauline leaves. Umbellate radii 3-5, filiform, one or more times divided. Involucellar leaves linear-lanceolate. Cyathial glands transversely oblong to semicircular, 2-horned, horns slender, shorter than the width of gland. Capsule c. 1.5 mm. long, ovate-trilobed; cocci smooth or minutely granular, subcarinate. Seeds 1.2-1.4 mm. x 0.7-0.9 mm., ovate-tetragonal, usually greyish with many whitish tubercles; caruncle minute, depressed. Fl. Mar. - July. Therophyte.

The cytological studies of this species investigated on material from different countries yielded conflicting chromosome numbers. They are as follows as given by Darlington and Wylie (1955) and Löve and Löve (1961).

<table>
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<td>28</td>
<td>Perry (1943), Shimoyama (1958).</td>
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<td>64</td>
<td>Reese (1952)</td>
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<tr>
<td>Britain</td>
<td>56</td>
<td>Shimoyama (1958).</td>
</tr>
</tbody>
</table>

Fresh material from Turkey could not be investigated cytologically; the seeds collected from Turkey and sown at Edinburgh did not germinate.
Key to varieties.

All the cauline leaves acute — — — — — — — — — — — a. var. *exigua*

At least the lower cauline leaves with truncate, retuse or tricuspidate apex — — — — — — b. var. *retusa*

a. var. *exigua*


Described from Spain, N. E. Germany, France and Switzerland (Herb. Linn. Nos. 28 & 30).


*E. rubra* sensu DC., Fl. Fr. 5, 359 (1815), non Cavan. (1791).


*E. exigua* L. var. *tricuspidata* (La Peyr) D.J. Koch, loc. cit., 731 (1843).

*E. diffusa* Jacq., Misc. 2, 311 (1781); Icon. Rar., t. 88 (1783) – non Hook. f. (1851), non Dufour (1860).
Described from Montpellier S. France – (Herb. Linn. Nos. 27 &
29; No. 28 from "Monsp." has all leaves acute); (Herb. Cliff.).

Al (A): prov. Canakkale, Dardanelles near Nagram, 24 May 1883,
1904, Aznavour. A2 (E): prov. Istanbul, Safra köy - Nakace farm,
10 May 1903, Aznavour. A6: Samsun, Tchihatcheff. C5: Mersin,
19 May 1855, Balansa 741.

A common weed of arable land.

*E. exigua* is related to *E. parvula* Delile described from Egypt,
but distinct by its linear instead of obovate-spathulate cauline
leaves, and by its seeds which are longer (1.2-1.4 mm. long, instead
of c. 1 mm.), and ovate-tetragonal (instead of ovate-globose). Out
of seed, the larger forms of *E. exigua* can be easily mistaken for the
smaller versions of *E. taurinensis* All. due to the close resemblance
in habit. However, the latter can be separated by its much longer
glandular horns (2 or more times longer than the width of the gland)
and usually broader cauline leaves (more than 2 mm.).

*E. exigua* is a widely distributed species extending from the
British isles towards the east through almost all Europe, Canaries,
N. Africa, and E. Mediterranean up to Caucasus. It was also reported
from N. Iran (Rudbar de Hamadan, Polak & Staf;); cf. Parsa, Flore
de l' Iran 4, 1244 (1949). In Turkey it occurs chiefly in the
Mediterranean region, and in the Duzine.


Annual, single or many-stemmed, glabrous or pruinose-hirtellous.

Stems up to 30 cm. long, erect or ascending, towards the base leafless and covered with leaf-scars. Cauline leaves setaceous near the bases of stems, gradually getting narrowly linear to widely linear towards the top. Involucral leaves linear-lanceolate. Umbellate radii 4-6, several times dichotomously divided. Involucellar leaves elliptic, narrowly elliptic or elliptic-rhomboid, sometimes irregularly lobed, apex cuspidate. Cyathial glands transversely oblong to semicircular, margin truncate, 2-horned. Capsules c. 2.5 mm. across, deeply trilobed; coccæ smooth, subacutely keeled. Seeds c. 1.5 mm. x c. 1.0 mm., ovate-tetragonal, greyish with many minute crowded tubercles, scarunculate. Fl. Apr. – Sept. Therophyte.

Described from Crete and Aleppo (Herb. Linn. No. 461 Herb. Cliff. – as E. paralias).


A common weed of cultivated fields and amongst rocks, reaching 1500 m.

A linear-leaved spurge described by Aiton (Hort. Kew. 2, 142: 1789) as E. juncea from the island of Porto Santo near Madeira, and illustrated under the same name by Jacquin (Schoenbr. 1, t. 107: 1797) has been given as a synonym of E. aleppica L. in Index Kewensis. Although the description of vegetative characters of E. juncea and the
illustration (excepting the cyathia) agree very closely with those of *E. aleppica* L., the occurrence of the reported sexual dimorphism in the cyathia has not been observed either in the European or the Orient material of *E. aleppica* examined so far. None of the Floras of the Atlantic islands include *E. aleppica* L. or *E. juncea* Aiton, nor is a type specimen seen at Kew.

*E. aleppica* has no near relatives, and is unique in its setaceous basal cauline leaves. It is distributed throughout the Mediterranean Europe east of Tyrrhenian islands and in the eastern Mediterranean, N. Iran (chiefly Azerbaidjan) and the Caucasus. In Turkey, it occurs in all the three phytogeographical regions.

Syn. E. mucronata Lam., Encycl. 2, 497 (1788 or 1789).

E. rubra Cav., Ic., t. 34, f. 1 (1791).


E. falcata L. var. rubra (Cav.) Boiss. in DC. Prodr. 15 (2), 140 (1882).

E. caudata Boiss. & Haussk. in DC. Prodr. 15 (2), 1267 (1886).

E. falcata L. var. ecornuta Boiss., Fl. Or. 4, 1111 (1879).


Annual up to 30 cm. tall, glabrous or puberulous, one to many stemmed, simple or repeatedly branched, erect or decumbent, sometimes prostrate. **Cauline leaves** spathulate or oblong-spathulate, acute, acuminate or mucronate, sometimes the lower ones retuse. **Involucral leaves** similar to cauline ones, slightly larger. **Umbellate radii** usually 4-5, repeatedly bifid. **Involucellar leaves** ovate, elliptic, broadly ovate or suborbicular, oblique, mucronate to caudate. **Gyathial glands** yellowish or pinkish, truncate-margined, 2-horned, horns sometimes very short or absent. **Capsules** 2-3 mm. long, ovate, apex pointed; **coccées** smooth, subcarinate. **Seeds** 1-2 mm. x 0.8-1.0 mm.
oblong-tetragonal, dorsiventrally compressed, greyish, with 2 rows of
4 or more transverse grooves on each face, sometimes the grooves
reduced to pits, and crowded in a more or less reticulate pattern;
Therophyte. Cm. 2n = 16 (Pölya: 1950 in Löve & Löve: 1961)

Key to subspecies and varieties.

1. Seeds usually with transverse grooves shorter, crowded,
and often with irregular reticulate pattern;
involute leaves as broad as or broader
than long, suborbicular, always densely
imbricate, micro usually longer, 2-3 mm.,
recurved

subsp. macrostegia

1. Seeds with transverse grooves longer and usually
in regular transverse pattern, rarely shorter
and crowded; involute leaves as long as or
longer than broad, usually ovate or elliptic-
rhomboid, micro shorter, 1.0-1.5 mm., usually
straight, rarely recurved

subsp. falcata

2. Seeds smaller, 1.0-1.5 mm. long, transverse
grooves shallow and obscure, often
reduced to pits, not more than 6 on each
side; upper umbellate radii elongated

var. galilaea

2. Seeds larger, 1.4-2.0 mm. long, transverse
grooves deep and distinct; upper
umbellate radii very short

var. falcata
subsp. macrostegia (Bormm.) O. Schwarz in Fedde, Rep. 36 (4), 129 (1934).


Syntypes: [Turkey (E1)]: Sinus Smyrnaeus in valle supra Hidja (aquis Aganemnonis), 29 May 1899, Bormüller 9961 (B - n.v.; K; BM); [Turkey (C3)]: in monte Taktali dagh, 26 May 1899, Bormüller 9960 (B - n.v.); [Turkey (E3)]: Phrygiae monte Sultan dağ, 26 June 1899, Bormüller 5550 (B - n.v.).


C2: Kale Tavas - Muğla, 35 km. from Kale Tavas, 5 June 1938, Huber-Morath 5238, 40 miles from Muğla, 29 May 1962, Dudley 35155a;


This subspecies is characterized by its much imbricate involucellar leaves which are suborbicular and with long recurved mucros, and by its seeds which have the transverse grooves usually reduced to pits that show transitions to a reticulate pattern. It is confined to western Anatolia and probably the east Aegean islands.
subsp. *falcata*

var. *falcata*

Described from southern Europe (Herb. Linna. No. 26; the other plant (No. 25) named as *E. falcata* is *E. terracina* L.)

var. _galilaea_ (Boiss.) Boiss. in DC. Prodr. 15 (2), 140 (1862).


_E. galilaea_ Boiss., Diagn. 1 (12), 116 (1853).

Holotype: [Jordan] in Planitie Esdraelon [valley of Jezreel], May 1846, Boissier (c).


Var. _galilaea_ is characterised by smaller seeds with shallow obscure grooves almost reduced to pits, and a distinct general facies with lax involucellar leaves and elongated upper umbellate radii.
E. falcata is a common weed of fallow fields, vineyards, stony places in pine forests and often by rivers and amongst calcareous rocky knolls, from sea level to 1600 m.

This species shows considerable variation in habit, colour of foliage and the cyathial glands, and presence or absence of glandular horns; the first two characters in most cases are probably determined by soil conditions. The plant is often infected with an Erysiphe sps. whose external mycelium gives a false impression of arachnoid indumentum.

E. acuminata Lam. (Encycl. 2, 427 : 1788 or 1789), whose type I have not seen, was described from Switzerland and is distinguished from E. falcata chiefly by the dark-green colour of its foliage (in contrast to bluish or pale green). Later, Hegi (Ill. Fl. Mittel-Eur. 5, 185, t. 1706 : 1924) further emphasised its specific difference from E. falcata by its red instead of yellowish cyathial glands and the softly cartilaginous instead of sharply pointed tip of the involucellar leaves. Prokhanov who also maintains E. acuminata as a distinct species (in Komarov, Fl. URSS 14, 465 : 1949) separates it from E. falcata chiefly on the characters of shorter, straight tips of involucellar leaves, laxer foliage, and smaller seeds with only 3-4 transverse grooves - the features diagnostic of E. falcata var. galilaea which was cited by Prokhanov under synonymy. According to Léve & Léve (1961), D'Amato (1939) found the diploid chromosome number of E. acuminata Lam. as 36, while Polya (1950) reported 16 as the somatic number for E. falcata L. I have not seen enough
European material referable to *E. acuminata* to decide its taxonomic status. However, following Boissier, the plants with the characters of *E. acuminata* (sensu Prokhanov) are provisionally recognised here as representing var. *galilaea* (Boiss.) Boiss.

*E. falcata* is related to a Caucasian endemic, *E. normannii* Schmalh. ex Lipsky, but differs in its compressed seeds with transverse grooves or pits (instead of ovate-quadrangular with irregularly arranged pits), and longer capsules (more than 2 mm.). In vegetative characters, *E. falcata* also resembles two Algerian species, *E. hieroglyphica* Coss. et Durien ex Boiss. and *E. bupleuroides* Desf., but is always recognisable by its seed characters.

*E. falcata* has a wide geographical distribution, extending throughout the Mediterranean and C. & E. Europe, and through Turkey, Caucasus, C. Asia, Iraq and N. Iran up to Baluchistan. In Turkey, it is represented in all three phytogeographical regions.
A dwarfish, erect, glabrous, glaucous annual, up to 18 cm. tall. Stems usually simple, slender. Cauline leaves up to 1.5 cm. long and not more than 2 mm. broad, linear-cuneate or obovate-spathulate, apex truncate to obtuse, lower leaves smaller, gradually larger towards the upper part of the stem. Involucral leaves similar to the upper cauline leaves. Umbellate radii 2-5, slender, several times divided into diffusely branched umbels. Involucellar leaves linear-oblong, often falcate or elliptic-rhomboid, sometimes purplish or carmine-red. Cyathial glands with truncate margin, ecorenate or with 2 shorter or longer horns. Capsule 2.0-2.3 mm. x 1.8-2.0 mm., ovate-trisulcate; coccaae acutely keeled. Seeds 1.3-1.7 mm. x 0.6-0.8 mm., oblong-tetragonal, grey, base truncate, apex narrowed, each of the 4 faces concave and with transversely and irregularly arranged wrinkles; caruncle subglobose; stipitate.

Fl. May - Aug. Therophyte.

**Key to varieties.**

Primary involucellar leaves linear-oblong, usually falcate, 6-17 mm. x 1-3 mm., 3 or more times longer than broad — — — — — — — — — a. var. szovitsii

Primary involucellar leaves elliptic-rhomboid, 5-13 mm. x 3-7 mm., usually not more than 3 times longer than broad — — — — — — — — — b. var. kharputensis
a. var. szovitsii
Boiss., Ic. Euph., t. 96 (1866).
Syntypes: In persia boreali, Szovits (LE - n.v.; Photo. E); in Armenia, Szovits (LE - n.v.); [Caucasus] in Montibus Talüsch, Fischer & Meyer (LE - n.v.; G).


b. var. kharputensis Aznavour ex M.S. Khan, var. nov.

A typo foliis involucellae primariae elliptico-rhomboideis pleurumque latitudine non plus longioribus recedit.


_E. szovitsii_ is a weed of fallow fields, vineyards, dried up river beds, and steppe; it also grows on metamorphic and igneous slopes, and schistose screes, reaching 1740 m.

It is related to _E. ledebourii_ F. & M.; see the description of the latter for differences.

_Eszovitsii_ is chiefly an Irano-Turanian species, penetrating into the Mediterranean region of Anatolia. Outside Turkey, var. _szovitsii_ extends from Caucasus to southwards and eastwards up to Afghanistan; var. _kharputensis_ is apparently restricted to Anatolia and Iraq.
(64) **E. ledebourii** Boiss., *Cent. Euph.*, 35 (1860). Boiss., *Ic.*

*Euph.*, t. 95 (1866).


*Tithymalus ledebourii* (Boiss.) Prokh. in *Komarov, Fl. URSS.* 14, 462 (1949).

Glabrous, dwarfish annual. Stem usually simple, erect, slender, up to 15 cm. tall. Cauline leaves linear-spathulate or linear, entire, acute or obtuse, sometimes retuse. Involucral leaves and involucellar leaves similar to cauline leaves, not more than 2 mm. wide. Umbellate radii usually 3, slender, 2 or more times divided. Glandular horns usually as long as the width of the gland. Capsule 2.2-3.0 mm. long, ovate; coccce rounded, minutely granulose.

Seeds 1.8-2.5 mm. x 1.0-1.5 mm., ovate-tetragonal, with several unequal, crowded pits; caruncle minute, conical. *Fl. June.*

Therophyte.


**A4:** Çankiri, 800 m., 5 June 1954, Davis 21517. **A5:** prov. Kastamomu, Tosya, 15 June 1892, *Sintenia* 4227; Amasya, 16-500 m., 16 May 1890, J. Bornmüller 2868. **B4:** Ankara, 2 June 1933, W. Kotte 1057A - as *E. szovitsii*, ibid., a. 1892, J. Bornmüller 3184.

In mountain steppe, often on gypsum rock, up to 800 m.
E. ledebourii is allied to *E. szovitsii* Fisch. & Mey. from which, however, it differs in its narrowly linear involucellar leaves (instead of linear-oblong or elliptic rhomboid and often falcate) and by its irregularly foveolate seeds (instead of transversely and irregularly wrinkled.

*E. ledebourii* which was described from the Crimea and Transcaucasia, is so far known in Turkey only from Galatia and Paphlagonia. Its disjunct distribution might perhaps be explained by Czezott's theory (1937) that the middle part of N. Anatolia, in the Upper Pliocene, was connected by a land bridge with the Crimea.

Candargy described a new var. *insularis* from Mytilene (Lesvos); cf. Bull. Soc. Bot. Fr. 45 (5), 181 (1898). Although the description, in general, agrees with the characters of *E. ledebourii*, the geographical distribution appears rather unlikely. The type gathering could not be examined, nor has any specimen of this taxon been seen from Lesvos; it needs further investigation.


E. *lycia* Boiss. in DC. *Prodr.* 15 (2), 172 (1862).


An erect tomentose perennial, usually forming dense clumps. Stems up to 1 m. tall and 12 mm. thick at the base. Cauline leaves lanceolate-linear, base attenuate, apex acute or mucronate, tomentose or velutinous on both surfaces. Involucral leaves shortly ovate to oblong. Umbels in 1 or more whorls, radii 10-35 in each umbel, 1 to 3 times bifid. Cyathial glands with their truncate margins produced into obsolete and blunt or narrow pointed and divergent horns. Capsule 5-7 mm. x 5-7 mm., velutinous.

Seeds 2.5-3.5 mm. x 1.5-2.5 mm., ovoid-oblong, caruncle up to 1.5 mm. long, shortly conical, stipitate, retuse on the insideside. Fl. Feb. - May. Chamaephyte.

Syntypes: in declivibus montanis et ad ripas rivulorum in Graecia vulgaris, circa Athenas, Spruner (G), Sartori (G); in Peloponnese, Bory (? G - n.v.).

E. lycia Boiss.); ibid., Mar. 1874, N.J. Edwes (as E. characias).

ARG.IS. : Chios, a. 1939-40, J.W.O Platt; Samos, below Zoodochous Pigi monastery, c. 300 m., 4 Apr. 1934, K.H. Rechinger 3727; Rhodos, Mont Akramiti, c. 600 m., 19 May 1935, K.H. & F. Rechinger 7458.

On rocky slopes, often on limestone, reaching 600 m.; also in shady damp places.

Boissier differentiated E. lycia from E. sibthorpii by its less dense, more obtuse cauline leaves which are verticillate above, and by the longer, convergent horns of its cyathial glands. The leaf characters show considerable variation, and the cyathial glands of the two specimens collected from the same area (e.g. Davis 25432 & 25528) show short or obsolete horns on one gathering, and narrow, pointed and divergent on the other. The Anatolian plants could be regarded as representing the eastern limit of one continuous distribution pattern of E. sibthorpii, extending from Greece (mainland) through the Aegean islands to Lycia.

E. sibthorpii is nearly allied to E. veneta Willd. (1809) from which it appears to differ chiefly in its narrower cauline leaves and larger involucellar leaves; the material of the latter species examined is too inadequate to give measurements. Geographically also, E. sibthorpii is separate, being confined to Greece (mainland), Peloponnese, Malta, Aegean islands and Lycia, whereas E. veneta is northerly in its distribution extending from Venice eastwards.
to the Balkan peninsula (W. & S. Yugoslavia, Albania and Greece).

It is possible, however, that E. sibthorpii might be better treated as a subspecies of E. veneta (the earlier name), but sufficient material of the latter has not been seen on which to base a decision.
(66) E. thompsonii Holmboe, Studies on the Vegetation of Cyprus, 121, fig. 36 (1914).

A hirtellous or tomentose perennial. Stems up to 1 mm. tall and up to 7 mm. thick at the base with many infrumbellary flowering branches. Cauline leaves subcoriaceous, usually oblanceolate, upper leaves shorter and narrower than the lower. Involucellar leaves obovate, obtuse. Umbellate radii 5-7, abbreviated. Cyathial glands semilunar, horns short, convergent. Capsule tomentose. Seeds oblong, caruncle conical. Fl. Apr. Chamaephyte.

Type: Cyprus: Pissuri, a. 1905, Jens Holmboe 712 (S).

C4: prov. Mersin, Findik Pinari above Mersin, 1200 m., 7 Apr. 1957, Davis 26498; Cilicia, a. 1895, Siehe 40 (as E. amygdalooides).

This little known species, growing in igneous slopes in Quercus coccifera maquis reaching 1200 m., is related to E. sibthorpiii Boiss. but distinct from it in its cauline leaves which are broader towards the apex and usually obtuse, and (fide Holmboe) by the shape of its cyathial glands which are "protracted into long subulate appendices". The Cilician specimens could be equated with E. thompsonii in all characters excepting the cyathial glands which are semilunar with short converging horns, and hardly agree with the description given by Holmboe; in some allied species (e.g. E. sibthorpiii Boiss.), however, the horns show considerable variation, so that this character may not be diagnostic for E. thompsonii. None of the specimens examined have capsules.

E. thompsonii is probably restricted to Cyprus and Cilicia.
A low shrub about 1 mm. tall. Stems many up to 13 mm. thick at the base, suffruticose, arising from a thick woody stock, branched above into many infra-umbellary flowering branches. Cauline leaves of similar size and shape throughout the length of stem, oblancoolate or elliptic-obl, coriaceous, shining on the upper surface, usually crisply puberulous on the under surface. Involucral leaves similar to cauline leaves, slightly smaller.

Umbellate radii usually 5-8, 2 to 3 times bifid. Cyathial glands convergent or parallel to each other. Capsule 5.0-5.5 mm. x 5.0-6.5 mm., glabrous or hirtellous. Seeds 5.0-5.5 mm. x 2.5-3.0 mm., ovoid, caruncle conical, stipitate or substipitate. Fl. May - Sept. Chamaephyte.

_Type_: [Turkey]: in montosis Tauri occidentalis, Kotschy 480 (G; K; BM).

Bozdağ near Ermenek, July 1872, Peronin 201; prov. Mersin, Selefi
[Silifke], Alaya mts., July 1930, B.A. Byles No. M1 1793.

Common on screes and rocky knolls, often on limestone,
ascending to 2100 m.

*E. kotschyana* is allied to *E. macrostegia* Boiss., but is
easily separated by larger capsules and seeds, thicker stems,
and taller stature. Whereas *E. macrostegia* is easterly in its
distribution, extending from Cilicia to Lebanon and S. Iran,
*E. kotschyana* is restricted to S. and W. Anatolia.

Syn. E. erubescens Boiss., Diagn. 1 (7), 90 (1846), non E. Meyer ex Boiss. (1862).


Suffrutescent perennial. Stems erect, up to 70 cm. tall and 1 cm. thick at base, with sterile branches below and with several infra-umbellary flowering branches above. cauline leaves lax, obovate to oblanceolate. Involucral leaves broadly elliptic to broadly elliptic-oblong. Umbellate radii 3-8, once or twice bifid. Cyathial glands with two broad, divergent horns. Capsules 4.5-5.0 mm. x 4.5-5.5 mm. Seeds 2.3-3.0 mm. x 2.0-2.3 mm., ovoid to ovoid-oblong, greyish or black; caruncle sessile or subsessile, shortly conical, retuse at base on the inner side. Fl. Apr. - July. Chamaephyte.

Syntypes: in declivibus montis Kuh Delu [Kuh-e-Dil] Persiae australis, Kotschy no. 533 (G; K; BM) - type of E. erubescens Boiss.; [C5: near Mersin], in valle Guzeldere Ciliciae, Balansa 730 (G; K; BM); supra Eden [Endem, near Baherri] Libani, Kotschy n. 532 (G).


Maras, Ahir daği, 1800-2100 m., July, 1907, Naradjian 1688; prov. Hatay (Amanus), Soğuk Oluk near Belen, 700 m., 23 Apr. 1957, Davis 27026.

In ravines on limestone, in mixed deciduous oak or Pinus brutia forests, often in Quercus maquis, with an altitudinal range of 700-2100 m.

Var. pauciradiata Borrm. was based on its biradiate umbels—a character seen to be extremely variable. Specimens from the same gathering (Davis 27026) show the number of radii ranging from 2-5, so that this character does not seem to merit varietal status.

The two species closely allied to E. macrostegia are E. kotschyan and E. amygdaloides. From the former, E. macrostegia differs by its smaller capsules and seeds, thinner stems and shorter stature; from the latter, it can be distinguished by the shortly conical caruncles of its seeds, stems woodier and shrubby at the base and by the usually thicker cauline leaves and larger involucellar 'plates' (2.5 mm. - 4.0 mm. across at the broadest point). Geographically also the three species are separate; E. macrostegia is southerly and easterly extending from Cilicia to Lebanon and to S. Iran whereas the other two are chiefly in W. & N. Turkey. E. kotschyan, however, overlaps with E. macrostegia in Cilicia; see distribution map 5.


Euphorbia micans Scheele in Linnaea 17, 343 (1843).

A many stemmed perennial with a woody stock. Stems usually erect, up to 90 cm. tall, terete, indurated and denuded below and with many axillary floriferous branches above. cauline leaves puberulous or glabrous, those of the previous year (lower) petiolate, dense, oblanceolate or elliptic, acute or obtuse, those of the present year (upper) sessile, smaller than the lower ones, remote, obovate to obovate-oblong. involucral leaves broadly oblong to broadly obovate, \(-\) of similar size to the upper cauline leaves.

Umbellate radii 4-8, once or twice divided. involucellar leaves semiorbicular, united into a concave 'plate' with sinuses penetrating to the middle, not more than 2.5 cm. across at the broadest point.

Cytathial glands semilunar, bicornate, horns usually convergent.

Capsule c. 4 mm. long, depressed at both ends. Seeds 2.0-2.8 mm. x 2.0-2.2 mm., ovoid, black when mature, caruncle projected towards the inside. Fl. Mar. - Aug. Chamaephyte. 2n = 18 (in European material) - cf. Löve & Löve (1961).

Described from southern France and Germany (Herb. Linn. No. 71).

Sintenis 84 (or 89 ?) - leaves glabrous and narrower, stature short.


In pine forests, pontic scrub and on woody shady hillsides, from sea level to 2000 m.

_**E. amygdaloides**_ is closely related to _E. robbiae_ Turbull and _E. davisií_ M.S. Khan, and less so to _E. macrostegia_ Boiss.; see under the respective species for differences.

Although the cauline leaves of _E. amygdaloides_ are usually crisply puberulous on the under surface, variants with glabrous leaves have been seen in W. Anatolia (e.g. Ulu dağ, Sintenis 89). Glabrous plants from Aude and Pyrenees Orientales in France have been described as _**E. chaixiana**_ Timb.-Lag. (in Mem. Acad. Toul. Ser. 4 (6), 152 : 1856) - later reduced to a variety of _E. amygdaloides_ by Boissier (in DC. Prodr. 15 (2), 170 : 1862) - and this name has been attached to the glabrous variants from the Balkan peninsula by Hayek (Prodr. Fl. Pen. Balc. 1, 150 : 1934). Another glabrous variety described from Montenegro is var. _pachyphylla_ Pant. in Ver. Ver. Naturk. N.F. 2, 112 (1874). I have not seen enough material of the glabrous plants
to form an opinion about the status of these taxa. It seems likely that glabrous variants are of polytopic origin.

The geographical distribution of *E. amygdaloides* extends from Ireland towards the east through Portugal and France up to Middle and South Europe (as South as Sicily). Northwards and eastwards it extends from the Balkan peninsula through W. and N. Anatolia into the Caucasus, S. Russia, N. Iran, and Turkestan. It is an introduced plant in N. America.
Robust perennial with branched spreading rhizome. Stems up to 80 cm. tall, many arising close together forming a wide bushy habit. Cauline leaves oblanceolate to broadly oblanceolate, obtuse, coriaceous, dark green, when mature glabrous on both surfaces. Involucral leaves obovate. Involucellar leaves connate into a shallow 'plate' with sinuses in the middle. Cyathial glands bicorneate. Capsules c. 4 mm. x 4.0-4.5 mm. Seeds 2.5-3.0 mm. x c. 2.0-2.5 mm., smooth, light grey, caruncle projected towards the inner face. Chamaephyte. 2n = 42 (Janaki Ammal - cf. Turrill, loc. cit.).

Type: in Herb. Kew., cult. Herbarium Experimental ground, Kew, 13 April 1949 - v.s.c.; v.v.c.

_E. robbiae_ differs from its closest ally _E. amygdaloides_ L. in its greener, thicker cauline leaves which are glabrous on both surfaces when mature, larger capsules and seeds and a more robust and bushy habit with several stems arising together. The cytological investigations by Janaki Ammal (as reported by Turrill) on the cultivated plants of _E. robbiae_ revealed a large number of 'pro-chromosomes' in the resting cells, and the somatic chromosome number as 42.

This distinct species, whose seeds are said to have come originally from near Istanbul, has been in cultivation for several years at Kew, where it is claimed by Turrill that the plants retained the characters distinguishing them from _E. amygdaloides_. However, _E. robbiae_ has not been collected again from any wild locality.
Affinis *E. amygdaloidi* Linn. sed indumento crispe pubescenti, statura humilior, caulibus inferne lignosis ramosis, folliis cauliniis minoribus recedit.

*Herba* perennis, suffruticosa, inferne in caudiculós ad 5 mm. crassos lignosos, demum denudatos cicatricosos ramosa. *Indumentum* caulinum et foliorum caulinarum et capsularum crispe pubescens.

*Caules* floriferi plures ad 35 cm. longi, erecti, dense foliosi, infr-umbellum ramis floriferis provisis; caules hornotini steriles, dense foliosi. *Folia caulina* (mediana) 20-30 mm. x 6-10 mm., obovata vel oblanceolata, petiolata (petiolo gracili, 2-7 mm. longo), integra, obtusa vel acutiora saepe breviter mucronata, raro retusa, superiora infra-umbellum minora (7-10 mm. x 3-6 mm.), obovata vel obovato-oblonga, obtusa vel retusa. *Folia involucrī 6-10 mm. x 4-6 mm., obovata vel obovato-oblonga.* *Radii primarii umbellae* 6-10, 2.0-4.5 cm. longi, graciles, plerumque semel bifidi. *Folia involucellae* in patellum plerumque usque medium connata (sinibus angustis separatā), late oblonga vel suborbiculata, 10-20 mm. longa et 10-16 mm. lata. *Cynthia* 1.5-2.0 mm. longa, campanulata, sparse hirtella, lobis ovato-oblongis, ciliatis, truncato-retuis, intus velutinis, glandulis semilunatis flavescentibus vel atrofuscis (in sicco), cornibus glandulae latitudini aequilongis vel longioribus latissimis obtusis. *Fractaeae* inter flores masculos multae apicem versus ciliatae. *Capsula* 4.0-5.0 mm. x 4.5-5.0 mm., trilobata, apici et basi depressa, coccis subcarinatis elevatim punctatis, stylis c. 2 mm. longis, apicem versus semel bifidis, ad basin coaItis. *Semen*
2.5-3.0 mm. x 2.0-2.3 mm., obovato-ellipticum, laeve, nigrum;

caruncula c. 1 mm. longa, substipitata, breviter conica, basi intus

C4: prov. Antalya, Akdağ (S. of Geyik daği), near little
lake, rocky places, 2300 m., 28 Aug. 1947, E.H. Davis 14349
(Holotypus, E) & 14384; prov. Mersin, dist. Anamur (Cilicia Trachea)
near Çamurlu yayla, 2100 m., 15 Aug. 1949, Davis 16256; prov. Konya
Yelibel dağ, Karaman - Ermenek, 2020 m., 10 June 1948, Haber-Morath
9405 (as E. lycia Boiss.)

This rather attractive alpine species is nearly allied to
E. amygdaloides L. - a widely distributed species that occurs in
N. & W. Anatolia but has not been reported so far from Cilicia.
The new species differs in its crisply pubescent inflorescence, smaller
leaves, shorter stature and branched suffruticosus base.

E. davisii is known from an altitudinal range of 2020 m. -
2300 m., growing on calcareous rocky ground, often on north slopes;
it is probably endemic to the central (Isaurian) part of the Taurus
where it has been found growing with E. kotschyanus Fenzl.
Fig. 10. Holotype of *E. davisi*ii M. S. Khan.
A rhizomatous hirtellous perennial. Stems erect, up to 70 cm. tall and 4-8 mm. thick at base, with many infra-umbellary flowering branches above. **Cauline leaves** petiolate, elliptic-oblong, base cuneate, acute, membranous. **Involucral leaves** similar to cauline leaves but smaller. **Umbellate radii** usually 5, 2 or more times divided, slender, lax and spreading. **Involucellar leaves** united into concave more or less orbicular 'plate' with 2 sinuses in the middle. **Calyx glands** bicornate, horns longer than the breadth of gland, convergent. **Capsule** c. 4 mm. x c. 4.5. **Seeds** c. 3 mm. x c. 2 mm., ovoid, caruncle sessile, depressed. Fl. June. Chamaephyte.

**Holotype**: [Caucasus] in montibus sylvaticis Cartiliniae et Karabagh, Fischer and Meyer (LE - n.v.).

**B8**: Erzurum, M. Zohrab 413.

This species is closely allied to *E. oblongifolia* C. Koch with which it is often confused, but the cauline leaves with cuneate bases, and lax, much branched spreading umbellate radii easily distinguish it from the latter. *E. macroceras* also has a superficial resemblance to *E. squamosa* Willd. - another species from the Caucasus and *E. Colchic* area in Anatolia - but is readily distinguished by its connate involucellar leaves and smooth or punctate (instead of warty) capsules.
**E. macroceras** is probably endemic to the Caucasus, Transcaucasia and Armenia. The only specimen seen from Turkey is Zohrab's scrappy gathering at Kew. Huet du Pavillon's plant from Köprübaşı (prov. Trabzon, BM !) labelled as **E. macroceras** is in fact **E. oblongifolia** C. Koch ( **E. rumicifolia** Boiss.).


Syn.: E. amygdaloides L. var. oblongifolia C. Koch in Linnaea 19, 17 (1846).


Tithymalus oblongifolius (C. Koch) Klotzsch & Gr. in Abh. Akad. (Physik.) Berlin 37, 96 (1860).

Perennial with a horizontal creeping rhizome. Stems few, erect, up to 85 cm. tall and up to 13 mm. thick at base, glabrous or pilose, sometimes with infra-umbellary flowering branches above; sterile shoots absent. Cauline leaves shortly petiolate (petiole up to 8 mm.), ovate-lanceolate or ovate-oblong, pilose or glabrous on the under surface, base cordate, rounded or rarely truncate. Involucral leaves elliptic. Umbellate radii 5-9, usually only once bifid, + stunted, not spreading. Cyathial glands with pointed convergent horns usually longer than the breadth of gland. Capsule 3.5-5.0 mm. x 4.0-6.0 mm. Seeds 2.5-3.5 mm. x 1.8-2.5 mm., black, ovoid, base truncate, caruncle beaked towards the inner side. Fl. May – Aug. Geophyte.

Holotype: [A2 (A)]: aus der Umgebung von Brussa [Bursa], Dr. Thirke (B – n.v.).


In rocky clearings in spruce forests (Picea orientalis) and on igneous rocky slopes reaching 2800 m.

Boissier (Fl. Or.) erroneously cites E. oblongifolia (C. Koch) C. Koch as a synonym of E. amygdaloides L. In fact, E. oblongifolia is specifically distinct and has priority over E. rumicifolia Boiss. (1860) which must be treated as a synonym of Koch's species.

E. oblongifolia differs from its nearly allied species, E. macroceras Fisch. et Mey. in its cauline leaves with cordate, rounded or truncate bases (not attenuate) and by the abbreviated, less branched umbellate radii.

Although E. oblongifolia mainly belongs to the Euxine element (including W. Caucasus), it penetrates into Armenia and Kurdistan in one direction and into Bithynia in the other. Aucher-Eloy's plant from Istanbul marks the westernmost point of its Black Sea range.

Glabrous, glaucous, more or less fleshy, many stemmed perennial herbs. Stems simple; one year old stems over winter and flower in next spring. Cauline leaves dense, spiral, sessile. Cyathia in 'umbels'. Cyathial glands 2-horned or with pectinate-margin; horns short, dilated at the apex. Bracteoles in between the male flowers obsolete. Seeds usually tetragonal, carunculate.

About 10 species, in the Mediterranean and the Orient. Closely related to Subsect. "Esulae", but form a distinct natural group characterised by the absence of bracteoles in between the male flowers, and by the habit.

Type species: E. *myrsinites* L.
(74) E. \textit{denticulata} Lam., \textit{Encycl. Bot.} 2, 435 (1788 or 1789 ?). Desfontaine, Choix de Plantes etc., t. 68 (1808); Boiss., \textit{Lox. Ruph.}, t. 119 (1866), \textit{Fl. Or.} 4, 1155 (1879). Map. 6.

Syn.: \textit{E. rotundata} Hochst. in Lorent, \textit{Wander. Morgenl.}, 344 (1845).


Stems 17-55 cm. long and 3-12 mm. thick. Cauline leaves 18-48 mm. x 10-35 mm., obovate, elliptic, rhomboid or orbicular, obtuse or mucronate. Involucral leaves 15-35 mm. x 15-30 mm., broadly ovate, oval or orbicular, obtuse or mucronate. Umbellate radii (-4) 5 (-3), 20-40 mm. long. Involucellar leaves 9-20 mm. x 12-21 mm., suborbicular or transversely ovate. Capsule 8-10 mm. x 7-9 mm., cocciae acutely keeled. Seeds 4.0-4.5 mm. x 2.0-2.8 mm., tetragonal, vermiculate rugose; caruncle stipitate. Fl. Apr. – July. Chamaephyte.

Type: Aubriet's illustration in Paris.

A7: Gumsch-khane [Gümüşhane], 4 June 1862, Bourgeau 241 and 632.


Endemic to Cilicia, eastern Turkey and probably N. Iraq, growing usually on dry limestone slopes and igneous rocks ascending to 2400 m.

E. pectinata Alboff (in Bull. Herb. Boiss. 2, 640 : 1894) has been treated as synonymous with E. denticulata Lam. by Prokhanov (cf.: Fl. URSS, 14, 412 : 1949), but the type material of the former species, "Artwin, a. 1893, Dr. Radde Exs. N. 2", examined in Herb. Delessert at Geneva, shows the cauline leaves elliptic-oblong and the segments of the deeply incised cyathial glands broader and much lobed at the tips. Only more material from Artvin region can decide whether E. pectinata Alboff is a taxon worthy of specific rank or merely an aberrant form of E. denticulata Lam. at the northernmost limit in its geographical range.

E. denticulata is closely allied to E. craspedia Boiss. from which it can be separated by its fewer umbellate radii (not more than 5, rarely up to 8), smaller seeds which are irregularly vermiform wrinkled instead of with more or less longitudinally arranged pustules, and by its fewer or no infra-umbellar radii. The distinction of these
two species on leaf margin - entire in the former and cartilaginous denticulate in the latter - seems to be rather doubtful as far as the Iraqi gatherings (from Mosul, Erbil, Sinjar, and Jarmo) are concerned; these show the leaf margin more or less pectinate but agree in the number of umbellate radii. However, none of these specimens have seeds to confirm the identity. Similar doubtful specimens have also been seen from Iran; see the discussion under E. craspedia.

Syn.: Tithymalus craspedius (Boiss.) Klotzsch & Gr. in Abb. Akad. Wissen. (Physik.) Berlin 37, 87 (1860).

Stems 13-45 cm. long and 4-8 mm. thick. Cauline leaves 1.7 cm. x 0.8-3.5 cm., elliptic-obovate to elliptic-rhomboid, mucronate. Involucral leaves 20-30 mm. x 13-23 mm., obovate. Umbellate radii usually 8-15, sometimes more. Involucellar leaves 8-20 mm. x 10-18 mm. more or less orbicular. Capsule 10-12 mm. x 8-10 mm. Seeds 4.5-5.5 mm. x 3.0-3.5 mm. with more or less longitudinally arranged discontinuous pustules. Fl. probably May. Chamaephyte.

Type: [Turkey (C8)]: inter Mardin et Assuaner in Assyria, Kotschy ex herb. Mus. Vindob. No. 350 (G, K).


Probably endemic to Mesopotamia and Iraqi Kurdistan preferring limestone slopes and reaching up to 1000 m.

The following plants from near Luristan in the W. Iran, (examined at Kew and Edinburgh vis. Luristan, Aug. 1884, Mark Bell; Southern Kurdistan, 11 Mar. 1958, L.F. Merton 3241; 6 m. E. of Khurramabad, 11 Apr. 1929, Cowan & Darlington; Damavar, Bakhtiari, 3600 m., 5 May 1940, Walter Koeltz 15164; 40 km. from Kermanshah, inter Kermanshah et Shahabad, 14 May 1960, A. Bent & H.E. Wright 514-110), are unique in that they have leaves with a distinctly pectinate
margin like *E. craspedia* but as in *E. denticulata*, the umbellate radii are not more than 7 and the infra-umbellar radii are absent. The fruiting material of these specimens is, however, inadequate to decide whether these plants from Luristan - an area rather far from the southern limit of both *E. craspedia* and *E. denticulata* - constitute a new taxon intermediate between these two species.

Stems few to many from a woody stock. Cauline leaves rhomboid, ovate-rhomboid or rhomboid-orbicular. Involucral leaves rotund, base rounded, obtuse, mucronate. Umbellate radii 3-5 (-6), 8-30 cm. long. Involucellar leaves with rounded or subcordate base.

Glandular horns spathulate, 2 or more lobed at the apex. Capsule 5.5-7.0 mm. x 4.5-5.0 mm. Seed 2.5-3.5 mm. x 1.5-2.0 mm., obtusely tetragonous, with longitudinally arranged, crowded vermiform wrinkles; caruncle stipitate, conical, apex depressed and unifoveolate.


Stems 5-28 cm. long, decumbent; median cauline leaves 10-22 mm. x 7-15 mm., subcoriaceous, leaf-margin usually scabrid or cartilaginous denticulate - - - - - - - - - - - - - - - - - - - - - - - a. var. anacampseros

Stems 28-45 cm. long, suberect; median cauline leaves 30-38 mm. x 22-40 mm., usually thinner, leaf-margin + entire - - - - - - - - - - - - - - - - - - - b. var. tmolca

a. var. anacampseros

Syn. : Tithymalus anacampseros (Boiss.) Klotzsch & Gr. in Abh Akad. Wissen. (Physik.) Berlin 37, 86 (1860) !

Euphorbia anacampseros Boiss. var. minor Boiss. in DC. Prodr. 15 (2), 174 (1863) !

Syntypes: [Turkey (C2)] : in regione alpina montium Cariae, Boissier
(G ? - n.v.); Cađmi occidentalis [prov. Denizli, Honas dağ] supra Gheyra, Boissier (G); orientem supra Colossam [Honaz], Boissier (G ? - n.v.); [Turkey, (B)], Tmoli circa Bosdagh, Boissier (G, E, K) June 1842; Caria interiori, aest. 1843, Pinard (G, K).

A2: Bilecik, 15 km. south of Söğüt, 950 m., 15 May 1954,

b. var. tmolea M.S. Khan, var. nov.

A typo caulibus longioribus suberectis, foliis caulinis majoribus plus minus integerrimus differt.

B1: prov. İzmir, dist. Ödemiş, collines entourant l'yaila de
Bozdağ, 25 July 1854, Balansa (Holo. G); Bozdağ, 16 Aug. 1950, Davis 18221.

E. anacampseros Boiss. is easily confused with E. myrsinites L. due to resemblances in seed characters and in the general facies, but the former has only 3-5 umbellate radii instead of more than five, and rhomboid, ovate-rhomboid or rhomboid-orbicular cauline leaves.

E. anacampseros is endemic to the Irano-Turanian and the Mediterranean regions of C. & W. Anatolia, occurring in plains, cornfields, pine forests, brush-wood, steppe and also on calcareous and marly slopes of mountains up to 1750 m. Its ally E. myrsinites, which is a widely distributed species, is restricted in Turkey to the mountains in the North. The much larger var. tmolea is only known from Bozdağ (Tmolus) where it has been collected twice. As the typical form of the species grows on the same mountain, its status needs further investigation. Studies into pollen, stomatal size and cytology might help to rule out the possibility of its suspected polyploid nature.

Syn.: Tithymalus myrsinites (L.) Hill, Br. Herb. 151 (1756).

Root a thick woody tuber. Stems 10-33 cm. long and 3-7 mm. thick, decumbent. Cauline leaves 17-32 mm. x 8-20 mm., elliptic or obovate, entire or scabrid, acuminate or mucronate. Involucral leaves 14-30 mm. x 9-12 mm. obovate-oblong, obtuse or mucronate. Umbellate radii 8-10 in number, 15-30 mm. long, one or more times divided. Involucellar leaves 7-14 mm. x 9-13 mm., subrotund or rhomboidal, obtuse or mucronate, base rounded or subcordate. Cyathial glands transversely oblong, horns obtuse, much shorter than the width of gland. Capsule 5-7 mm. x c. 5 mm., ovoid to globose, cocci usually obtusely keeled, rarely acute. Seeds c. 3.0 mm. x 1.5-2.0 mm., verrucose-rugose; caruncle stipitate, shortly conical and unfoveolate at the tip. Fl. May - Aug. Chamaephyte.

Described from Calabria [South Italy] and Montpelius [Montpellier, S. France], Herb. Linn. No. 69). In Clifford's herbarium there is only a plant with narrow erect stems and narrow lanceolate leaves, apparently distinct from E. myrsinites and obviously representing var. angustifolius of Hort. Cliff.

Common on the mountains of N. Anatolia, often on igneous rocks up to 2700 m. Mainly central Mediterranean, occurring as far west as the Balearic islands and extending in the north through the Balkan peninsula into the Crimea; also reported from N. Iran (cf. Fada, Flore de L'Iran 4, 1273: 1949).

A Cyprian endemic (being described as E. veneris M.S. Khan) resembles very closely E. myrsinites in habit and has been previously confused with it. However, the latter, which does not grow in Cyprus, is distinguished by its wrinkled seeds and by its cauline leaves which are only twice as long as broad and with usually scabrid margin. E. myrsinites is also closely related to a western Irano-Turanian species, E. anacamoseros Boiss.; see the description of the latter for differences.

Nota:-

E. pontica Prokhanov (Type, LE !), a new species said to be allied
to *E. myrsinites* has been described (in *Fl. URSS.* 14, 740, t. 21, f. 2 : 1949) from the mountains near Ardanuc in Prov. Artvin (N. E. Turkey). Prokhanov distinguishes *E. pontica* from *E. myrsinites* by the following characters:— cauline leaves oblong-oblanceolate, more than twice as long as broad, more or less acuminate but not mucronate, almost entire; involucellar leaves not cordate at the base, the lower ones more or less reniform, slightly broader than long, the upper ones, suborbiculate often reddish; and also by the colour of the whole plant — greyish-green, not glaucous. (Sic).

None of these characters seem to be sufficiently valid to be taken as specific criteria due to their homologous variation in the related species, *E. myrsinites*. However, Andronaki’s Artvin plant (Herb. Florae Caucasicae No. 484) which Prokhanov cites (op. cit. p. 408), and Stainton’s gathering from the same locality (Artvin, 500 m, 14 Apr. 1960, No. 8177) do show the cordate base of the involucellar leaves and a slightly different shape of the cyathial glands. They are narrower and transversely oblong with the extreme ends drawn into short usually lobed horns which are more or less horizontally disposed (as shown in the illustration of *E. pontica* in *Fl. URSS.*; the glands on the type specimen are too inadequate to examine this character.). On the other hand, *E. myrsinites*, whose involucellar leaves are usually rounded at the base, has its cyathial glands transversely ovate with the horns arising from the under surface of the gland and more or less arranged parallel to or only slightly divergent from each other.
Another specimen from Artvin (Davis 30217) has the glandular characters of *E. myrsinites* and thus does not approach *E. pontica*. More material of *E. pontica* is needed to assess the status of this seemingly very local plant; it may represent an aberrant peripheral population of *E. myrsinites*. 
E. marschalliana Boiss., Diagn. Or. 1 (7), 94 (1846), (excl. syn.

excl. specimina ex Tauria, Boiss., Fl. Or. 4, 1135 (1879)

Stems 6.5-10.0 cm. long, 2-5 mm. thick. Cauline leaves 15-
23 mm. x 7-15 mm., elliptic, elliptic-rhomboid, or obovate, margin
distinctly pectinate. Involucral leaves 6-10 mm. x 5-8 mm.

Umbellate radii 8-20, 11-22 mm. long. Involucellar leaves 6-7 mm.
x 8-10 mm., base usually rounded. Capsules 5.0-6.0 mm. x 4.5-5.0 mm.,
coecae acutely keeled. Seeds 3.0-3.2 mm. x 1.5-2.0 mm., tetragonal,
smooth or obscurely wrinkled. 

Chamaephyte

Syntypes: in tractu Suwant Prov. Talysh [Caucasia], Hohenacker
(LE - n.v., K, G, W); Armenia, Ancher 5310 (F - n.v., K, G, BM).

B3: Erzurum, M. Zohrab 416.

Due to its close resemblance with E. myrsinites in general
facies, E. marschalliana has been previously confused by Ledebour
and Boissier (loc. cit.) with Crimean plants of the former species.
E. marschalliana, however, is easily recognisable by its more or
less smooth seeds (instead of vermiculate rugose) and smaller
cauline leaves which are always prominently pectinate-margined.

Another species from S. Transcaucasia and N. Iran, described as
E. woronowii Grossheim, seems to differ from E. marschalliana only by
its distinctly rugose seeds.

Whereas E. myrsinites extends as far north as the Crimea,
E. marshalliana is absent from the Crimea (fide Prokh. in Fl. URSS) and is more easterly in geographical range. It extends from Turkish Armenia through S. Transcaucasia, Talysch, Azerbaidjan to the south side of the Caspian.
(79) *E. armena* Prokhanov in Komarov, Fl. URSS. 14, 741 (1949).

Stems 15-30 cm. long and 4-5 mm. thick. Cauline leaves 15-30 mm. x 6-20 mm., broadly elliptic or elliptic-rhomboid, subentire or cartilaginous denticulate, mucronate. Involucral leaves 10-20 mm. x 6-15 mm., broadly elliptic or broadly elliptic rhomboid.

Umbellate radii usually 5, sometimes up to 7, 2 or more times divided. Involucellar leaves 7-15 mm. x 8-14 mm., broadly ovate, base cordate or subcordate. Capsules 5.0-6.0 mm. x 4.5-5.5 mm. Seeds 3.0-3.2 mm. x 2.0-2.5 mm., smooth, caruncle conical. Chamaephyte.


*E. armena* is very closely related to *E. marshalliana* Boiss. with which it overlaps in Russian Armenia, but is easily distinguished by its fewer umbellate radii (5-7, not 8-20), broadly ovate involucellar leaves with a subcordate (instead of usually rounded) base. It is endemic to southern Transcaucasia and eastern Armenia.

Syn.: E. puncens Banks & Sol. in Russel, Nat. Hist. Aleppo, ed. 2, 268 (1794), non Lam. (1794)!
Tithymalus rigidus (M.B.) Klotzsch & Gr. in Abh. Akad. Wissen. (Physik.) Berlin 37, 94 (1880).
Euphorbia philomos Candargy in Bull. Soc. Bot. Fr. 44 (4) 156 (1897).

Stems 15-50 cm. long, 4-10 mm. thick, erect or suberect. Cauline leaves 3.0-4.5 cm. x 0.6-1.2 cm., lanceolate, entire, acuminate-spinose. Involucral leaves 1-4 cm. x 1-2 cm., ovate, narrowly ovate to ovate-oblong, usually broader than cauline leaves. Umbellate radii (-6) 8-13 in number. Involucellar leaves (-10) 12-18 mm. x 14-24 mm., yellowish. Capsules 5.5-7.5 mm. x 5.0-7.0 mm. Seeds 3.0-3.5 mm. x 1.7-2.4 mm.; caruncle 0.7 mm., subsessile, longitudinally folded into lobes. Fl. Feb. - May. Chamaephyte.

Type: [Crimea]; in Tauriae meridionalis declivibus siccis mari nigro imminentibus, Marshall von Bieberstein (LE - n.v.).

A plant of limestone rocks, deciduous forests and arable fields, often forming dominant saxatile populations on clayey sea-cliffs reaching an altitude of 1200 m.

_E. rigida_ M.B. was known by Boissier as _E. biglandulosa_ Desf. (1808), and was later regarded by Fiq (op. cit.) as synonymous with _E. pungens_ Banks & Solander (1794). The latter, however, is a later homonym of _E. pungens_ Lam. (1786) and therefore cannot be used. Both _E. rigida_ M.B. (Fl. Taur. Cauc. 1, 375) and _E. biglandulosa_ Desf. (in Ann. Mus. Hist. Nat. Par. 12, 114) were described in the year 1808. Mr. W.T. Stearn informs me that according to a note inserted
by C.D. Sherborn in the British Museum (Nat. Hist.) copy of Ann. Mus. Hist. Nat. Paris, vol. 12, the part of this volume containing the description of E. biglandulosa was published in August, 1808. As the preface of M. Bieberstein's Fl. Taur. Cauc. vol. 1 is dated "mense Januario a. MDCCCVIII", it is reasonable to assume that this volume was published not long after January 1808, which would establish the priority of E. rigida M.B. over E. biglandulosa Deaf.

E. rigida has been previously confused by various authors with a closely related Cyprian endemic now being described as E. veneris M.S. Khan, sharing with it the characters of lanceolate leaves and smooth seeds. However, the leaves in E. rigida are 4 or more times longer than broad (instead of 2.5-4 times as long as broad), the habit usually erect (instead of decumbent), and the involucellar leaves larger and yellowish.

The distributional range of E. rigida, which is absent from Cyprus, extends from Sicily through Greece to the Crimea, Turkey (mainly in the Mediterranean region), W. Caucasus, Anti-Lebanon, Jordan and Palestine.
Subsect. Crotonopsideae Boiss. in DC. Prodr. 15 (2), 101 (1862)

Densely woolly annual herbs resembling in habit Croton or Chrozophora. Cauline leaves petiolate and, with the exception of lower ones, opposite. Cyathial glands pectinate with 2-8 indentations. Style short, thick, recurved, undivided. Seeds pustular, carunculate.

The only representative, C. petiolata could be regarded as the type species. Allied to Subsection Oppositifolii.
2,253 (1794). Boiss., In. Euph., t. 53 (1866); Bouloumoy, Fl. Lib.
Syr., t. 401, f. 3 (1830); Eig, in Journ. Bot. (London) 75, 187 (1937).

Syn. Croton denticulatus Geiseler, Crotonis monogr., 72 (1807).

E. malacophylla Clarke, Travels 2, 354 (1812).
E. lanata Sieb. ex Spreng., Syst. 3, 792 (1826).
E. syriaca Spreng., Syst. 3, 792 (1826).

Dematra sericea Raf., Autikon Botanikon, 96 (1840).

E. lanata Sieb. ex Spreng. var microphylla Post, Fl. Post. 2,
22 (1891) !

Chrozophora warionis Cosson ex Battandier et Trubut, Fl. Alg. 2,
304 (1895) !

Otenadena lanata (Sieb. ex Spreng.) Prokh., Rev. Euph. As. Med.,
28 (1935).

(London) 75, 192 (1937) !

Annual, up to about 30 cm. tall with spreading pseudo-dichotomous
branches, densely woolly. Cauline leaves 1.0-3.0 cm. x 0.7-1.7 cm.,
opposite, ovate, spinulose-dentate, acute, petioles up to 1 cm. long.
Cysthia usually in the upper dichotomies; glands transversely ovate;
margin deeply pectinate. Capsule 4.5-6.0 mm. x 4.5-6.0 mm., broadly
ovate, styles undivided. Seeds 3.0-3.5 mm. x 1.5-2.0 mm.,
quadrangular, truncate at both ends, greyish, pustulose; caruncle

Therophyte.
Holotype: [Syria] Aleppo, Russell (BM)

H2: prov. Malatya, Elazığ - Malatya, Euphrates bridge,
1 Sept. 1954, Davis 24805.

A weed of vineyards, fallow fields and steppe.

E. petiolata is the only species under this subsection and is characterised by its deeply pectinate-margined glands and undivided styles; allied to Subsect. Oppositifoliae but easily distinguished by its petiolate woolly leaves, pectinate glands and quadrangular pustular seeds.

Mainly Eastern Mediterranean but penetrating into Iraq and Iran. Prokhanov (Fl. URSS) reports it from Mountain Turkemania in Central Asia. It presumably occurs spontaneously in Algeria (cf. Battandier et Trubut, op. cit.) where it was described as Chrozophora warionis.
Subsect. Decussatae Boiss. in DC. Prodr. 15 (2), 99 (1862).


Type species: E. lathyris Linn. (The only species under this Subsection.)

Syn.: Tithymalus lathyris (L.) Scop., Fl. Carn. ed. 2 (1), 335 (1772).
Galarhoeus lathyris (L.) Haworth, Syn. Fl. succ., 143 (1812).

A robust, erect, tall, glabrous, annual, 50 cm. or more high.
Stem 6 mm. or more thick at base. Cauline leaves sessile, 5 cm. or more x 1 cm. or more, oblong-lanceolate, entire, base subcordate. Involucral leaves similar to cauline leaves. Umbellate radii 3-4, repeatedly divided, the branches unequal in length. Involucri leaves ovate, ovate-deltoid, or ovate-lanceolate, acute or acuminate, base subcordate. Cyathial glands semilunar, short, subspathulate, obtuse. Bracteoles in between the male flowers obsolete. Capsule large (1 cm. or more x 1 cm. or more), trilobed, cocci rounded or subacute, smooth, but wrinkled when dry. Seeds 5.5-6.0 mm. x 4.0-4.5 mm., ovoid, brown, slightly and irregularly reticulately wrinkled; caruncle c. 1 mm. long, stipitate, conical, margin slightly lobed.

Therophyte. 2n = 20 (Perry : 1943 in Darlington & Wylie : 1955)
Described from S. France and Italy. (Herb. Linn.).


This solitary gathering from Turkey came from gravel and sand on shore near Platamus trees, and growing with Oxalis corniculata L. (s.l.). E. lathyris is common in S. Europe but also extends westwards up to the British isles and Atlantic islands. It was
also reported as occurring in Mexico, Peru, Abyssinia, E. Europe, Caucasus, C. Mediterranean, China etc. - in many areas as a spontaneous weed. It is probably naturalised on the Black Sea coast.

The opposite phyllotaxy of leaves, and the absence of bracteoles in this species are evidently derived characters. The branching of its 'umbels' with unequal radii simulating the 'lateral' branching of Sect. Anisophyllum betrays its trend towards specialisation. Consequently, in this enumeration, E. lathyrhis is placed before Sect. Anisophyllum as the last subsection of Sect. Tithymalus.


Prostrate or ascending herbs, often much branched from the base. Cauline leaves all opposite, more or less oblique at base. Stipules on both sides of the base of petiole contiguous with the pair of cauline leaves, or often united to form interpetiolar stipules. Cyathia minute, rarely larger, solitary or grouped in 'cymes'. Cyathial glands mostly with petaloid appendages. Bracteoles in between the male flowers plumose in many flowered cyathia; setaceous or obsolete in few-flowered ones. Seeds always ecarunculate.

In the warmer parts of all the continents including Australia, reaching greatest development in subtropical regions. Related to and probably derived from Sect. Tithymalus.


Claudous annual with prostrate stems up to 25 cm. long and 3 cm. thick. Leaves 8-17 mm. x 4-7 (–12) mm., opposite, subsessile, ovate-oblong, base unequal and uniauriculate, entire or denticulate, obtuse or retuse. Stylules divided from the base into 2 or 3-fid setaceous or subulate segments. Cyathia on pedicels up to 5 mm. long, in the axils of the upper leaves and in dichotomies. Cyathial lobes triangular, margin ciliate; glands transversely oblong with whitish entire or lobed appendage on the outer margin. Capsule c. 4 mm. x c. 4 mm.; cocciae obtuse or acutely keeled. Seeds c. 2.5 mm. x c. 1.5 mm., smooth scarunculate, greyish, subtetragonous-ovate, apex pointed. Seed surface covered with mucilage which swells up when moistened. Fl. May – Sept. Therophyte.

Described from the coast of Narbonia [Southern France] and Spain (Herb. Linn. No. 13).


Common on the sandy beaches round the coast but also penetrating inland into Armenia and on the shores of salt lakes in the Central Anatolian plateau reaching an altitude of 900 m. Outside Turkey, it is found throughout the Mediterranean littoral with a western extension as far as the British isles; and in the east and the north it extends through eastern Europe to the Crimea, Caucasus, and the Ural mountains.

_E. peplis_ is probably related to _E. chamaesyce_ L. with which it
shares, among other characters, the general leaf shape, appendaged glands and the ecarunculate seeds, but is easily separated by its thicker glaucousent leaves, larger smooth seeds and more robust habit.
Glabrous, hirtellous or canescent annual with several prostrate filiform branched stems up to 25 cm. long and c. 1 mm. thick.

Leaves (-3) 4-7 mm. x (-2) 3-6 mm., opposite, petiolate or subsessile, ovate or suborbiculate, base unequal and uniauriculate, margin crenulate, denticulate or serrate, tip obtuse, sometimes with pink markings on the centre of the lamina. Stipules setaceous. Cyathia in the axils of upper leaves and in the dichotomies. Cyathial lobes
ovate-triangular, fimbriate; glands transversely oblong, light
to dark brown with a whitish lobed appendage on the outer margin
usually broader than the width of the gland. Capsule c. 1.5 mm. x
c. 2 mm.; coccæ acutely keeled. Seeds c. 1.3 mm. x 0.8 mm., ovate-
tetragonous, ecarunculate, greyish, with many irregular, sometimes

Described from Southern Europe and Siberia (Herb. Linn. - Nos.
15 and 16; Hort. Cliff.)

A1 (A): prov. Çanakkale: Dardanelles, 19 May, 1883, Sintenis
297. B7: prov. Tunca: Ovacik, 1400 m., 21 July 1957, Davis
1960, Khan et al. 200; Denizli, 9 July 1904, Saint-Lager; prov.
4661. C8: Diyarbakir, 680 m., 29 June 1949, Huber-Morath 9397.

On calcareous soil and dry gravelly plains, often a very common
weed in fallow fields, ascending up to 1400 m.
*E. canescens* L. was described from Spain, being separated from *E. chamaesyce* L. by its denser indumentum ("albo-villose") and obsoletely emarginate and obsoletely crenate leaves. Although completely glabrous forms occur sporadically in Europe, every transition from sparsely hairy to densely canescent has been seen in both the European and Orient material. Similarly leaf margin and leaf apex also vary as observed in both glabrous and hairy forms. *E. canescens* L. has been maintained as a distinct species by Trokhanov, and in the illustration (Fl. URSS. 14, t. xxv, f. 1 : 1949) the presence of dark central markings on the leaves and the rather prominent crenate leaf margin have been shown as further distinguishing characters. Holmboe treats this taxon as a subspecies, considering that the canescent forms have a separate area of distribution in the Near East.

Several races, forms and subforms of *E. chamaesyce* have been recognised by Thellung in Ascherson & Graebner, *Synop. Mittel-Europ. Fl.* Ed. 7, 450 (1917). However, none of the varying characters of the leaf, viz.: indumentum, margin, apex and dark central markings are constant enough to be taken as criteria even for varietal rank, nor the supposed separate geographical area well enough marked to warrant recognition of *E. canescens* as a subspecies.

*E. chamaesyce* is nearly allied to *E. humifusa* Willd. (Central and N. European) from which it differs by its rugose seeds (instead of smooth or minutely pustulose) and by its more or less hairy broader leaves (instead of glaucouscent and narrow). Other species which approach *E. chamaesyce* are *E. granulata* (entire leaves,
narrower seeds - from Egypt, Arabia, and India) and *E. sanguinea* (narrower, longer leaves, and obscurely rugose seeds - from Arabia, Africa and India).

A very common invasive weed found throughout the Mediterranean and in most parts of Europe and the Near East. It has also been reported as a sporadic weed in North America.

Wheeler (1941) typified *E. chamaesyce* L. by Patrick Brown's Jamaican plant in the Linnaean herbarium, basing his decision on the photograph and some fragments of this specimen which he examined at the Field Museum, Chicago (U.S.A.), and on the description and localities given in *Hort. Cliff.* cited among the earlier references by Linnaeus. Wheeler regarded the plant commonly known as *E. prostrata* Aiton (1789) - native of the New World but now widely introduced in the other tropical and subtropical regions - as conspecific with *E. chamaesyce* L.

In the Linnaean herbarium there are two specimens labelled as *E. chamaesyce* (Nos. 15 & 17), and a third as *E. canescens* (No. 16). There are also 3 plants (2 glabrous, 1 hairy) in *Herb. Cliff.* named as one or the other.

Although Linnaeus in his *Species Plantarum* cites *Hort. Cliff.* under synonymy, he altered considerably the description and evidently also the concept of *E. chamaesyce.* Accordingly the species should be typified by a specimen in the Linnaean herbarium. As the type localities cited for this species in *Sp. Fl.* are S. Europe and Siberia, the name of this entity is applicable to the plant native to the Mediterranean region and Orient.
According to Savage's catalogue (1945), plant No. 15 of the Linnæan herbarium was collected by Löffling who was in Spain in 1752 and sent material and notes to Linnæus (cf. Stearn in Introduction to Linn., Sp. Pl.: 1753, vol. 1, facs. ed., p. 156 : 1957). Specimen No. 16 came from Alströmer during his travels in Spain and the South of Europe from 1760-1764 (cf. Savage's catalogue; Jackson's Index to Linn. Herb. : 1912), and the third was evidently collected in Jamaica by Patrick Brown whose herbarium was bought by Linnæus in 1758.

The two plants of Löffling and Alströmer (both hairy forms) conform to the diagnosis in Species Plantarum. The Jamaican plant has more or less entire and glaucescent leaves. The only plant in the possession of Linnæus before the publication of the Species Plantarum (1753) was Löffling's gathering from Spain (1752) which should be taken as the lectotype of E. chamaesyce.

E. prostrata Aiton is evidently a distinct species and has been typified by Fawcett & Rendle (Fl. Jamaica 4 (2), 341 : 1920) by a specimen in the British Museum (Herb. Cliff.). In this work, they drew attention to Brown's specimen from Jamaica representing this species but named as E. chamaesyce in the Linnæan herbarium.
LIST OF SPECIES IMPERFECTLY KNOWN OR
DOUBTFULLY RECORDED FROM TURKEY.


"Caule erecto, ramis alternis, dichotomis; foliis oppositis: caulínis oblóngis, serrulatís, superioribus semicircularibus, omnibus sessílibus; capsulis solitariís, axillaribus, tuberculatís."

- ad pagum Belgrad prope Constantinop. rarium in sylvis, Forskål (B? KIEL?).

According to Christenson in Dansk. Bot. Arkiv 4 (3), 34 (1922), it seems that no botanist has seen the type specimen. Boissier maintains that this plant is probably a spring form of *E. pubescens* Vahl i.e. *E. verrucosa* L. or *E. platyphylla* L.


This chiefly N. African species was enumerated under its synonym *E. retusa* Forsk. in Tchihatcheff's *Asie Mineure* (Bot.) 1, 163 (1860). The specimen cited was "Bithyniae Olympo, Dominique Sestini". I have not seen this nor any plant representing this species from Anatolia, but for phyto-geographical reasons the record seems highly unlikely to be correct.


This controversial entity was mentioned by Tchihatcheff (loc. cit. p. 159) as occurring at Trabzon ("Sylvis circa Trapesunt, D'Urv., Enum") and in Russian Armenia ("prov. Erivan, alt. c. 1460 m., C. Koch"). The species (in the sense of Jacquin) is not recorded for Transcaucasia in the Fl. URSS.

Reported by Boissier (Fl. Or.) from Alem dag on the Asiatic side of the Bosphorus ("in monte Alemdagh Anatolia borealis, Nöe"). I have not seen this specimen nor any plant referable to this C. & E. European species from Turkey.


Hayek in Ann. Nathist. Hofmus. Wien 28, 178 (1914) reported this species from the Taurus mountains - "Südtaurus: Sonnige Abhange bei Maaden, 2000 m., [Siehe]" - n.v. Hayek may have mistaken the Cilician endemic *E. schottiana* Boiss. for *E. erythradenia* which it resembles in habit; the latter is restricted to S.W. Iran.


This species, native of Spain and Canaries, was collected only once near Istanbul ("a. 1845, Nöe 226" - G; K) - probably growing as a casual weed.

8. *E. mucronata* Clarke, Travels 2, 260 (1812).

"Euphorbia fruticosa, glabra; foliis ovato-lanceolatis
mucronatis integerrimis; foliolis involucrī ovalibus; involucellī obovatis, integerrimis, petalis dentatis; capsulis verrucosis glabris."

- Makri bay [near Fethiye], Clarke (BM? FI? K?).

Clarke refers to this plant as a shrubby 'Daphne' with slender flexuose shoots, pointed leaves and "petals toothed nearly wedge-shaped". There is no species reliably recorded from the Lycian coast which matches this description.


This S. European plant was recorded twice; by Tochiatcheff (op. cit. p. 163), who cites his own gatherings from Lycaonia, Galatia, and Cappadocia; and by Wettstein in Sitzm. Kaiserl. Akad. Wissen. 98 (4), 386 (1889), from "Baldur-See" [Burdur gölü in prov. Burdur] as collected by Heider. These specimens cited (probably in Algeria) could not be examined; they probably represent either *E. pannonica* Host or *E. macrocalda* Boiss. which are very similar to *E. nicaeensis* in vegetative characters.


Type: habitat in glareosis rupium vulcanicorum ad basin montis Kurd Dagh ad orientem pagi Tochaftalik; floret aprili, [Post] No. 389 (K; BM; G).

The type specimen, which has no capsules, is similar to *E. aucheri* Boiss. (from Iran). Most of Kurt dağ is in Syria and it seems unlikely that the plant was collected on the Turkish side of the mountain.
11. *E. scopoliana* Steudel ex Boiss. in DC. Prodr. 15 (2), 87 (1862).

Syn.: *E. scopoliana* Steudel, Nomencl. Bot. (ed. 2) 1, 615 (1840), nomen nudum.

*E. fimbriata* Scopoli, Delic. Insubri. 3, 8, t. 4 (1788), non alior.

The locality cited by Steudel and Scopoli was Aleppo. Boissier (loc. cit.) observed that the original locality of this cactoid *Euphorbia* is not known and that it is certainly not a spontaneous plant in Aleppo. This species, similar to *E. mamillaris* L. (tropical African) in habit, might have been cultivated at Aleppo. In Index Kewensis, *E. scopoliana* has been given as a native of Cilicia, but no dendroid succulent *Euphorbia* has so far been reported from Anatolia and the natural occurrence of one seems highly unlikely.


Mainly S. European. Reported by Tchihatcheff (op. cit. p.164) from near Istanbul ("circa Byzantium, Rigler" - n.v.).


A species centred in the N. Mediterranean (from Dalmatia westwards). It was enumerated by Tchihatcheff (op. cit.) as occurring on the islands of Leros and Samos (quoted from D'Urv., Enum.) and in Armenia ("valle fl. Tchoruk [Çoruh], alt. 478-975 m., C. Koch" - n.v.). Although its occurrence on the east Aegean islands is a possibility, its
Armenian locality is highly improbable. It is not mentioned in
Rechinger's *Flora Aegaea*.


A Himalayan plant. Tchihatcheff (op. cit. p. 167) erroneously
cites an Anatolian specimen ("Karaman" [ Karamanli in Lycia ? ] - n.v.)
as representing this then undescribed species.
ACNOWLEDGEMENTS.

I should like to thank the authorities of the following herbaria for the facilities to study their Euphorbia collections and/or for the loan of specimens or photographs, including types:


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My grateful thanks are also due to Prof. R. Brown (Botany Department, Edinburgh University) and to Dr. A.R. Fletcher, Regius Keeper, Royal Botanic Garden, Edinburgh for affording me all facilities to work during my Ph.D. course.

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<td>T. aleppicus (L.) KL &amp; Gr.</td>
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<td>T. apios (L.) Hill</td>
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<td>T.aulacosperma (Boiss.) Kl. &amp; Gr.</td>
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<td>T. exigus (L.) Hill</td>
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<td>T. falcatus (L.) Kl. &amp; Gr.</td>
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<td>T. glareosus (Pall. ex M.B.) Prokh.</td>
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<td>T. graeca (Boiss. et Sprun.) Kl. &amp; Gr.</td>
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<td>T. ibericus (Boiss.) Prokh.</td>
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KEY TO SPECIES BASED ON SEED CHARACTERS ALONE.

This key is an attempt to see how far the seed characters allow one to run down the species. Such a key may prove useful especially to the departments of forestry and agriculture in Turkey. Previously seed keys for Euphorbias have been published, e.g. for European species by Rössler (1943); for the species in Iowa, U.S.A. by Murley (1945); for the Moroccan species by Vindt (1953).

The seed lengths given in this key are taken without the caruncle and by measuring the dorsal side of the seed. The breadth of the seed is measured from the broadest point. The instrument used for all measurements was a Leitz mounted lens with a built-in micrometer which allowed the measurements to be made up to 1/10 of a millimeter. In many species, the caruncle is deciduous; hence one should examine enough material, preferably of younger seeds, before deciding whether the seed is carunculate or not.

In some cases of smooth seeds it is impossible to distinguish the species of certain groups, e.g. Subsect. Myrsinitae, group 'Amygdaloidea' and 'Petrophila complex'. Although this shows that closely related species have similar seeds, a number of apparently unrelated species belonging to Subsect. Calarhasei (e.g. E. apios, E. cybirensis, and E. acanthothamnos) have seeds resembling each other so closely that they are virtually indistinguishable. It
Diagrams of seed of *E. petrophila* (about 15 times enlarged) showing some of the features employed in the seed key.

A = ventral view;  B = dorsal view;  C = an outline of seed in transverse section.
appears that smooth seeds have been derived independently of other characters in several different evolutionary lines within the genus.

<table>
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<th>1.</th>
<th>Seed sculptured</th>
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<td>Seed smooth</td>
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<td>2.</td>
<td>Seed more than 3 mm. long</td>
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<td>Seed not more than 3 mm. long</td>
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<td>3.</td>
<td>Apex rounded or pointed in the centre</td>
<td>4</td>
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<tr>
<td></td>
<td>Apex obliquely truncate</td>
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<tr>
<td>4.</td>
<td>Surface with distinct vermiciform wrinkles</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Surface with obscure wrinkles, almost smooth</td>
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<tr>
<td></td>
<td>marschalliana</td>
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<tr>
<td>5.</td>
<td>Caruncle with margin curved outwards, undulate, base equal to breadth of seed apex. Seed 3.0-3.5 mm.</td>
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<td></td>
<td>Caruncle with margin curved inwards, not undulate, often only longitudinally sulcate</td>
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<tr>
<td>6.</td>
<td>Seed not more than 3.5 mm. long</td>
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<td></td>
<td>Seed 4.0 mm. or more long</td>
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<tr>
<td>7.</td>
<td>Seed narrower, 2.0-2.8 mm. broad at base; 4.0-4.5 mm. long</td>
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<tr>
<td></td>
<td>Seed broader, 3.0-3.5 mm. broad at base; 4.5-5.5 mm. long</td>
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<td>8.</td>
<td>Seed tetragonal, c. 3.5 mm. long; surface with scattered pustules</td>
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<td></td>
<td>Seed ovoid, c. 6 mm. long; surface with narrow irregular wrinkles</td>
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<td></td>
<td>petiolata</td>
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<td></td>
<td>lathyris</td>
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</tbody>
</table>
9. (2) Seed surface with minute tubercles
- Seed surface without tubercles

10. (9) Seed with 3 or more transverse grooves on each face; base truncate; caruncle persistent, stipitate. Seeds 2.0-2.5 (-3.0) mm. long
- Seed without transverse grooves on any face; base rounded; caruncle persistent, deciduous or absent, if persistent then flat, not stipitate

11. (10) Seed oblong-tetragonal; tubercles scattered, whitish on darker surface
- Seed ovoid-subcompressed; tubercles arranged in + longitudinal lines, brown, of the same colour as the surface. Caruncle flat, persistent

12. (11) Seed c. 1.5 mm. x c. 1.0 mm.; ecarunculate
- Seed 1.0-1.2 mm. x 0.6-0.8 mm.; caruncle deciduous

13. (9) Seed surface with usually 6 parallel longitudinal grooves
- Seed surface not as above

14. (13) Seed surface with 3 or more transverse grooves on each face; manifestly dorsiventrally compressed. Seed 1.0-2.0 mm. long
- Seed surface with pits or wrinkles in various patterns, not transversely grooved; ovoid, tetragonal or only subcompressed

15. (14) Each of the 2 ventral faces with a longitudinal groove; each of the lateral and dorsal faces with a longitudinal row of rounded pits
- Ventral faces (if well marked) without longitudinal grooves; pits, if present, not in longitudinal rows

16. (15) Seed 1.0-1.6 mm. long; caruncle depressed, retuse at base; pits deep
- Seed 1.7-2.5 mm. long; caruncle conical or conico-pyramidal, not retuse at base; pits shallow
17. (15) Caruncle almost half the length of seed, globose-oblong; seed oblong-cylindric; with few scattered shallow pits.
   Seed 1.5-2.0 mm. long
   - Caruncle (if present) less than half the length of seed, not globose-oblong; seed not oblong-cylindric; pitted or wrinkled 18

18. (17) Seed surface with deep or shallow pits, not wrinkled 19
   - Seed surface wrinkled, not pitted 25

19. (18) Seed ovoid; sides rounded 20
   - Seed ovoid-tetragonal or ovoid-oblong; often dorsiventrally subcompressed 21

20. (19) Pits deep, rounded 22
   - Pits shallow, irregular 23

21. (16) Caruncle obscure; seed brown with shallow scattered pits; ovoid-oblong. Seed 2.0-2.2 mm. x c. 1.5 mm.
   - Caruncle prominent; seed usually greyish with shallow or deep pits; ovoid-tetragonal or dorsiventrally subcompressed 24

22. (21) Seed ovoid-tetragonal, sides straight. 1.8-2.3 mm. x 1.3-1.5 mm.
   - Seed dorsiventrally subcompressed, back curved outwards 25

23. (22) Seed apex nearly as wide as the base. Seed 1.7-2.5 mm. x 1.0-1.8 mm.
   - Seed apex distinctly narrower than the base 26

24. (23) Pits narrow, deep, crowded. Seed 2.0-2.2 mm. x 1.5-1.7 mm.
   - Pits broad, shallow, scattered. Seed 2.0-3.5 mm. x 1.5-1.8 mm.

25. (24) Wrinkles discontinuous and in a linear series 26
   - Wrinkles continuous, not in a linear series 27
26. (25)  Seed narrowly or broadly ovoid with + rounded base  
    Seed oblong-tetragonal or ovoid-tetragonal with truncate or rounded base  
27. (26)  Caruncle transversely ovate or semicircular; wrinkles in a regular honey-comb like pattern. Seed 2.0-2.5 mm. x 1.5-1.7 mm.  
    Caruncle rudimentary or absent, if present then transversely ovate; wrinkles in various irregular patterns  
28. (27)  Seed dark-brown; wrinkles in + honey-comb like pattern  
    Seed greyish; wrinkles vermiform or irregularly reticulate  
29. (28)  Caruncle erect, hemisphaerical, retuse at the base on the ventral side; seed 2.0-2.2 mm. x 1.5-1.7 mm.  
    Caruncle rudimentary or absent; seed c. 2 mm. x c. 1.5 mm.  
30. (28)  Seed 2.5-3.0 mm. x c. 1.8 mm. with + longitudinally arranged vermiform wrinkles; caruncle pyramidal, c. 1 mm. long  
    Seed c. 2.0 mm. x c. 1.5 mm. with + irregularly reticulate wrinkles; caruncle shortly conical, c. 0.5 mm. long  
31. (26)  Seed greyish with wrinkles of the same colour  
    Seed brown with greyish wrinkles  
32. (31)  Base truncate; seed 1.3 mm. x 0.7 mm.; wrinkles + transverse  
    Base + rounded; seed 1.5 or more x 1.0 mm. or more; wrinkles irregular  
33. (32)  Seed carunculate; oblong-tetragonal with short thick interrupted transverse wrinkles on each face  

Seed ecarunculate; narrowly ovoid-tetragonal with narrow, faint, continuous wrinkles on each face

34. (1) Seed \( \pm \) globose; apex rounded; ecarunculate; seed colour greyish or light brown, often with lighter specks

- Seed not globose; apex pointed, obliquely truncate or rarely rounded; caruncle present or absent; seed colour greyish to dark brown

35. (34) Seed c. 4-5 mm. across

- Seed 1.5-2.5 mm. across

36. (34) Seed \( \pm \) oblong-tetragonal; apex rounded but with a small abrupt elevation in the centre; base truncate; caruncle conical. Seed size 3.0-3.5 mm. x 0.7-2.5 mm.


37. (36) Seed \( \pm \) turbinate; apex pointed; caruncle absent

- Seed not turbinate; apex obliquely truncate or rounded, caruncle present or absent

38. (37) Seed c. 2.5 mm. x c. 1.5 mm.; surface with whitish covering swelling to form a mucilaginous envelope when moistened

- Seed 3.0-3.5 mm. x 2.5-2.8 mm.; surface greyish, often with darker spots, not swelling to form a mucilaginous covering when moistened

39. (37) Base \( \pm \) truncate; seed oblong or ovoid-oblong; caruncle present, \( \pm \) persistent

- Base \( \pm \) rounded (if truncate, then seeds dorsiventrally compressed); seeds of various shapes; caruncle present, often deciduous

40. (39) Seed subcarinante on back and sides

- Seed with back and sides rounded, not subcarinate
41. (40) Seed 2.5-3.5 mm. x 2.0-2.3 mm.; caruncle c. 1 mm. long, pyramidal
- Seed 2.0-2.5 mm. x 1.5-1.7 mm.; caruncle c. 0.5 mm. long, shortly conical

42. (40) Caruncle 2 mm. or more long, pyramidal, deeply longitudinally sulcate, excavated on its ventral side, sessile; seed apex transversely truncate; seed 3.5-4.0 mm. x 2.8-3.0 mm.
- Caruncle not more than 1 mm. long, peltate or depressed and projected towards the raphe side; stipitate or subsessile; seed apex obliquely truncate; seed 2.5-3.5 mm. x 1.8-3.0 mm.

43. (42) Caruncle stipitate, often peltate; seed usually larger (2.5-3.5 mm. x 2.0-3.0 mm.) Group 'Amygdaloidea', p.p. kotschyana
- Caruncle sessile or subsessile, depressed, often projected towards the raphe side; seed usually smaller (2.0-3.0 (-3.5) mm. x 2.0-2.5 mm.) Group 'Amygdaloidea', p.p.

44. (39) Seed laterally compressed, 2.0-3.3 mm. x 2.0-2.5 mm.; caruncle c. 0.7 mm. long, crested
- Seed not laterally compressed

45. (44) Seed 4 mm. or more long; broadly ovoid; caruncle obscure
- Seed less than 4 mm. long; seed shape various; caruncle present or absent

46. (45) Seed ± dorsiventrally compressed; often brown
- Seed not dorsiventrally compressed; greyish to dark brown

47. (46) Caruncle absent; seed surface with fine sticky granular covering; seed c. 1.6 mm. x c. 1.3 mm.; ovoid

macroclada
pannonica
ispahanica
sibthorpii
kotschyana
macrostegia
amygdaloidea
robtiae
davisii
macroceras
oblondifolia
dendroides
grisophylla
ancyrensis
- Caruncle present, + persistent; seed surface not with fine sticky granular covering; (if greyish, then 2.0 mm. or more long) 48

48. (47) Seed surface shining, brown or yellowish 49
- Seed surface not shining, yellowish to light brown 52

49. (48) Caruncle globose, minute; seed yellowish; c. 2.5 mm. x c. 1.7 mm.; oblong-ovoid 50
- Caruncle discoid or reniform, base + retuse; seed brown to dark brown 52

50. (49) Seed 3 mm. or more long, and more than 2 mm. broad 49
- Seed 1.8-2.2 (-2.5) mm. long and not more than 2 mm. broad 51

51. (50) Seed not more than 1 mm. broad; ovoid-oblong 50
- Seed 1-2 mm. broad; ovoid to broadly ovoid 54

52. (48) Caruncle subglobose, + beaked; seed c. 3.0 mm. x c. 2.5 mm. 52
- Caruncle pyramidal or conical; seed 2.0-2.5 mm. x 1.5-1.5 mm. 'Erythrodon' complex, p.p. 54

53. (46) Seed ovoid- or oblong-subtetragonal 53
- Seed not ovoid- or oblong-subtetragonal 55

54. (53) Seed c. 2 mm. x c. 1.5 mm.; caruncle stipitate, projected towards the raphe side 55
- Seed c. 1.5 mm. x c. 1 mm.; caruncle minute, deciduous 55

55. (53) Seed 1.0 mm. - 1.5 mm. broad; ovoid; 1.5-2.5 mm. long 55
Seed more than 1.5 mm. broad; ovoid, ovoid-globose, or subcylindrical

56. (55) Seed subcylindrical; caruncle beaked, not retuse at base; seed size 2.0-2.5 mm. x 1.5-1.8 mm.

- Seed ovoid, ovoid-oblong, or ovoid-globose; caruncle depressed, discoid, or shortly conical, usually retuse at base, rarely slightly beaked, often deciduous

57. (56) Seed ovoid-globose

- Seed ovoid or ovoid-oblong

58. (57) Seed c. 3 mm. x c. 2.7 mm.; caruncle slightly beaked

- Seed 1.5-2.5 (3.0) mm. x 1.5-2.0 (-2.5) mm.; caruncle not slightly beaked

59. (58) Raphe deep and prominent; seed surface dirty brown, rough

- Raphe obscure; seed surface yellowish to light brown, not rough

60. (57) Caruncle slightly beaked; seed 3 mm. x 2.7 mm.

- Caruncle shortly conical or discoid, not slightly beaked

61. (60) Caruncle flat

- Caruncle shortly conical, suborbicular or subglobose, not flat; seed ovoid

62. (61) Seed 2.5-3.0 mm. x 1.7-2.0 mm.

- Seed 3.0-3.5 mm. x 2.5-3.0 mm.

63. (62) Seed ovoid-oblong

- Seed ovoid

64. (61) Seed 3.5-4.0 mm. long

- Seed 2.5-2.8 mm. long

65. (64) Seed surface greyish or brown, not shining

- Seed surface often shining, brown or reddish-brown
APPENDIX II

Distributional maps of some Turkish *Euphorbias* based on herbarium material seen.
Map 2. Distribution in Turkey of *E. orientalis*, *E. altissima*; and *E. macroclada*, and *E. pannonica*. 
Map 4. Distribution in Turkey of *E. verrucosa*, *E. platyphyllos*, *E. gaillardotii*, *E. cybirensis*, and *E. microsphaera*. 
Map 6. Distribution in Turkey of *E. denticulata*, *E. craspedia*, *E. anacamptos*, and *E. myrsinites*.
APPENDIX III

Photographs of some representative seed types.
E. helioscopia L.

E. haussknechtii Boiss.

E. verrucosa L.

E. falcata L.
E. denticulata Lam.

E. myrsinites L.

E. ispahanica Boiss.
E. petrophila C.A. Meyer

E. phymatosperma Boiss. et Gaill.

E. terracina L.

E. petiolata Banks & Sol.
APPENDIX IV

The following two papers about two new Euphorbias from Iraq and Cyprus have already been accepted for publication. These new species described from areas adjacent to Turkey have come to light during the revision of Turkish species.
Critical notes on 
Euphorbia chesneyi (Klotzsch & Garcke) Boiss. 
and related species. 

M. S. Khan. 
(University Department of Botany, Edinburgh)

The object of this account is to elucidate the confusion that has surrounded the interpretation of Euphorbia chesneyi. Klotzsch and Garcke based Tithymalus chesneyi (i.e. Euphorbia chesneyi) on the collection made by Colonel Chesney during the latter's Expedition to the Euphrates. However, capsule and seed characters were not included in the description nor is there any information about the exact locality of the gathering; it seems likely to have come from N. Syria or Iraq.

Boissier cited in his Flora Orientalis (vol. 4, p. 1118 : 1879) the following plants under E. chesneyi:-

2. Ad Diarbekir, Kotschy 232 (also cited in DC. Prodr.)
3. A° Snoa Fadel deserti ad Palmyram, Blanche
4. In argillosa montis Schergi Antilibani, Kotschy 532
5. In deserto fluvii Chabur, Haussknecht.

The three specimens collected by Blanche and Kotschy have since been identified as E. cheiradenia Boiss. et Hohen. on the characters of the stems and involucellar leaves; indeed, Kotschy 232 had been chosen previously by Boissier as a syntype of E. cheiradenia (cf. Diagn. 1 (12), 112 : 1853). Haussknecht's plant listed above represents a new species, described in the present paper as
E. mesopotamica M. S. Khan. Thus, the characters of "E. chesneyi" described by Boissier in Flora Orientalis (loc. cit.) are apparently derived from three species, the description of the seed referring to E. mesopotamica. E. chesneyi, however, is specifically distinct from E. cheiradenia and E. mesopotamica, and is probably restricted to the desert area of Jordan, Iraq and possibly N. Syria. The differences between the three species, along with the allied E. petrophila C. A. Meyer, are summarised in the table given at the end of the paper. In the following annotation, only specimens examined have been cited.

Euphorbia chesneyi (Klotzsch & Garcke) Boiss. in DC., Prodr. 15 (2), 152 (1862). Boiss., Fl. Or. 4, 1118 (1879); Rechinger fil. in Arkiv Bot. Bd. 2 (5), 332, f. 5 (1932). Fig. 1, A.


Euphorbia fieldii Shiriaev in Papers of the Peabody Museum of Archaeology & Ethnology, Harvard University 48 (2), 74 (1956).

Perennial, with woody erect, subterranean caudiculi springing from a woody taproot. Stems several, erect, up to 45 cm. tall and 2.0-2.5 mm. thick at the bases, subflexuose, usually unbranched; juvenile shoots usually absent. Cauline leaves 10-22 mm. x 3-9 mm., oblong-oblanceolate, usually cartilaginous-denticulate towards apex, glaucous, glabrous when mature, rather sparsely arranged, often exceeding the internodes. Involucral leaves 4-5, 9-18 mm. x 6-10 mm.,
similar to cauline leaves. Umbellate radii 2-6 (-8), 15-70 mm. long (up to first dichotomy), slender, branched once to several times. Involucellar leaves 5-10 mm. x 5-11 mm., suborbicular-rhomboïd, coriaceous, cartilagineous-denticulate, acute or mucronate, base rounded, truncate or subcordate. Cyathia campanulate, lobes broadly ovate, laciniate, glands more or less semicircular, truncate, margin sometimes slightly eroded or incised, drawn at the corners into short broad blunt horns not longer than the breadth of glands. Bracteoles between the male flowers many, usually branched, ciliate. Capsules 4-6 mm. x 3.5-4.5 mm., ovoid, trilobed, usually pointed at apex. Seeds 2.3-3.0 mm. x 1.5-2.0 mm., smooth, subquadrate, whitish or light brown, caruncle c. 1 mm., conical. Fl. Apr. - May.

Type: ad Euphratem, Chesney's Expedition to the Euphrates 1837, No. 157 (Holotype B - n.v.; iso. G ! W ! K !).

JORDAN: between Amman and Rutbah, 163 km. from Amman towards the East, 27 May 1957, K. H. Rechinger 15835; 220-240 km. from Amman towards Rutbah, 27 May 1957, K. H. Rechinger 12864; Azraq El Azraq, c. 570 m., 2 Apr. 1933, Gunnar Samuelsson 2827; ibid., 600 m., 4 Apr. 1937, J. E. Dinsmore 11819; Jordan, Hunting Aeo Survey, Ref. no. 212.

IRAQ: 20 miles of Rutbah, 21 Apr. 1933, Meinertzhagen; Qaara depression north of Rutba, 5 Apr. 1950, Henry Field 67, 69, 72 and 74 (syntypes of E. fieldii Shiriaev GH !).

A plant of desert regions, often amongst basaltic rocks.

K. H. Rechinger (op. cit.), basing his observations on some specimens of E. chesneyi, draws attention to a probable occurrence of sexual dimorphism in this species in which the cyathia of the primary
dichotomies in certain plants have only male flowers while those of the subsequent dichotomies are hermaphrodite. Although Meinertzhagen's specimen from Rutbah shows this condition, it is not present in the other gatherings examined. The illustration of the seed with vermiform wrinkles labelled in Rechinger's work as that of *E. chesneyi*, taken from an Iraqi specimen ("zwischen Ana und Dier, 6 May 1894, Strauss"), obviously refers to *E. cheiradenia*. The other illustration of a pitted seed in the same figure, said to belong to *E. petrophila* ("Antilibanon, Dohr Abu el Hin, 16 July 1890, Post 131") may represent the unidentified taxon from Nebk (cf. the discussion at the end of the present paper).

Dr. Rechinger has kindly drawn my attention to *Euphorbia fieldii* recently described from Rutbah in Iraq. The examination of the syntypes indicates that this plant is conspecific with *E. chesneyi* as interpreted here; *E. fieldii* should, therefore, be treated as a synonym of *E. chesneyi*.

*E. chesneyi* is related to *E. mesopotamica*, but distinguished by its smooth seeds and erect stems.

*Euphorbia mesopotamica* M.S. Khan, spec. nov. Fig. 1, B

Valde affinis *E. petrophila* C.A. Meyer sed caulibus procumbentibus, foliis caulinis strictis, foliis involucellae coriaceis cartilagineo- denticulatis, seminibus majoribus recedit.

*Planta* perennis, ex toto pruinoso-puberula. *Radix* ad 10 cm. longa et ad 7 mm. crassa, verticalis, cylindrica, lignosa. *Caules* floriferi procumbentes, saepe 3-10, subflexuosi, 7-30 cm. longi et 1-2 mm. lati,
inferne simplices, surculis hornotinis brevibus commixti, superne saepe ramis floriferis, foliis quam internodiis longioribus. Folia caulina mediana 7-17 mm. × 2-6 mm., sessilia, oblongo-oblanceolata vel oblongo-spæthulata, stricta, subcoriacea, integra vel supra medium scæbrida, obtusa vel mucronata. Folia involucrī 4-5, elliptica vel late elliptica vel obovata, 5-14 mm. × 7-11 mm. Radii umbellae 3-5, 1-3 cm. longi (quoad radii primarii), semel vel bis 2-3-fidi. Folia involucrīllae (primariae) 5-10 mm. × 7-11 mm., suborbiculari-rhomboida, coriacea, cartilagineo-denticulata, libera. Cyathia 2.5-3. mm. longa, campanulata, lobis late ovatis, laciniatis, glæulis (in sicco) atropurpureis, late trapeziformibus, truncatis, breviter bicorruptis (cornibus glæulâe latitudinì multò brevissimis) vel interdum margine totò pectinatis. Bracteolae inter flores masculos ramosae ciliatae. Capsula c. 1 mm. longa, conico-trilobata, coccis obtuse carinatis pruinosis; styli 1.5-2.0 mm. longi ad apicem versus semel bifidi ad basin coælitis. Sperm 2.0-2.7 mm. × 1.2-1.6 mm., subtetragono-oblongum, griseum vel flavescens, irregulariter et leviter multifoveolato-punctatum; caruncula c. 1 mm. longa, conico-pyramidalis. Fl. Mar. - Jun.

IRAQ: ad Euphratem medium inter Abukemal et Ramadi, in desertis inter Nahije et Ana, ca. 120-180 m., 6 Apr. 1910, Handel-Mazzetti 742 (Hol. : W - sub E. chesneyi (KL. & Gr.) Boiss.); inter Tell Afar et Ain-el-Ghasal ad occid. urbis Mossul, ca. 400 m., 6 June 1910, Handel-Mazzetti 1345 (as E. chesneyi).


In deserts, sometimes on calcareous rock, reaching an altitude of 400 m. Chamaephyte.
Handel-Mazzetti (in Ann. Naturh. Hofm. Wien 26, 138, 1912) confused his two numbers cited above with *E. chesneyi* (Kl. & Gr.) Boiss. He could not match his plants with two of the specimens quoted under *E. chesneyi* by Boissier in Flora Orientalis (viz. type of *E. chesneyi* and Kotschy's 232 representing *E. cheiradenia*) because the latter lacked the characteristic pruinosity of his own gatherings and Kotschy's plant did not agree in seed characters.

In fact, *E. mesopotamica* is closely allied to *E. petrophila* C.A. Meyer, which has a more northerly distribution (cf. map). However, the former is readily separated by its procumbent stems, cartilaginous-denticulate involucellar leaves, strict cauline leaves, and larger seeds with larger caruncles.

A specimen in flower and fruit from the Anti-Lebanon in Syria (Sahel, above Nebk. 1380 m., fallow fields, procumbent, 21 June 1943, Davis 6449 A) is certainly very closely allied to *E. mesopotamica*, but differs from it in its broader (1.7–2.0 mm. broad) more compressed seeds, longer stems and more pointed, oblong cauline leaves. More material is required before its status can be decided.

My grateful thanks are due to Dr. P.H. Davis (Edinburgh) for encouragement and assistance during the preparation of this paper, and to Dr. K.H. Reichinger (Vienna Museum) for going through the manuscript, offering helpful advice, and sending the Vienna material on loan. I should also like to thank the curator of the Gray Herbarium of Harvard University, Cambridge, Massachusetts, (U.S.A.) for the loan of Field's specimens.

<table>
<thead>
<tr>
<th><strong>E. cheesneyi</strong></th>
<th><strong>E. mesopotamica</strong></th>
<th><strong>E. petrophila</strong></th>
<th><strong>E. cheiradenia</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Stems erect.</td>
<td>Stems procumbent.</td>
<td>Stems ascending.</td>
<td>Stems erect or ascending.</td>
</tr>
<tr>
<td>Involucellar leaves suborbicular-rhomboid, coriaceous, margin cartilaginous-denticulate.</td>
<td>Involucellar leaves suborbicular-rhomboid, coriaceous, margin cartilaginous-denticulate.</td>
<td>Involucellar leaves semi-orbicular to very broadly ovate, subcoriaceous, base truncate or subcordate, margin entire.</td>
<td>Involucellar leaves semi-orbicular, thin, base rounded or truncate, margin entire or eroded.</td>
</tr>
<tr>
<td>Cysthial glands 2-horned, horns simple, glandular margin entire or sometimes eroded or incised.</td>
<td>Cysthial glands 2-horned, horns simple, slender, glandular margin entire, occasionally pectinate.</td>
<td>Cysthial glands 2-horned when young, later with 1 or more accessory horns in between, horns simple or lobed at tip, often broad, glandular margin often pectinate.</td>
<td>Cysthial glands 2-horned when young, later with 1 or more accessory horns in between, horns simple or lobed at tip, often broad, glandular margin often pectinate.</td>
</tr>
<tr>
<td>Seeds 2.5-2.7 mm. long, smooth; caruncle c. 1 mm. long, conical, longer than broad.</td>
<td>Seeds 2.0-2.7 mm. long with many irregularly arranged, shallow pits or punctae; caruncle c. 1 mm. long, longer than broad, conico-pyramidal.</td>
<td>Seeds 1.7-2.5 mm. long with many irregularly arranged, shallow pits or punctae; caruncle depressed, broader than long.</td>
<td>Seeds 2.5-3.0 mm. long with crowded, deep, verriform, anastomosing wrinkles; caruncle c. 1 mm. long, longer than broad.</td>
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A NEW EUPHORBIA FROM CYPRUS

M. S. Khan

(Univ. Dept. of Botany, Edinburgh)

Euphorbia veneris M. S. Khan, spec. nov. (Sect. Tithymalus (Tourn. ex Hill) Duby Subsect. Myrsiniteae Boiss.) - Plate 1.

Affinis E. myrsiniti L. et E. rigidae M. B.; a priori foliis angustioribus longioribus integerrimis et seminibus laevibus recedit; ab altera caulibus gracilloribus ascendentibus vel decumbentibus, foliis duplo brevioribus et foliis involucris et involucellae minoribus virescentibus differt.

Planta perennis, glauca sed saepe purpureo-suffusa. Radix indurata, verticalis, ad 30 cm. longa vel ultra, basi ad 2.5 cm. crassa. Caules floriferi plures, flexuosi, ascendentes vel decumbentes, 10-35 cm. longi et 2-5 mm. lati, glabri, densissime foliiosii caulibus sterilibus hornotinis brevibus commixti. Folia caulina mediana 9-25 mm. x 4-11 mm., latitudine 2.5-4 - plio longiora, elliptica vel elliptico-lanceolata, sessilia, integra, glabra, coriacea, glauca, mucronata vel breviter acuminata, infima minora pro proportione latiora; folia juvenilia sub lente plus minus pruinosa. Folia involucrri 5-10, elliptico-oblunga vel obovata, 7-25 mm. x 5-18 mm., integra, obtusa, mucronata. Radii umbellae (-2) 3-7 (-10), 8-40 mm. longi (quoad radii primarri), 1-2 mm. lati, semel vel bis rarius tres bifidi. Folia involucellae (primarriae) 6-14 mm. x 7-19 mm., libera, late ovata vel ovato-rotundata, integra vel scabro-marginata, mucronata, luteo-viridia. Cyathia campanulato-hemisphaericà, glagra, lobi oblongo-ovatis circa circumcirca velutino-ciliatis virento-flavis
saepe purpureo-suffusis, glandulis purpureis transverse oblongis
bicorunis cernuus glandulae latitudini plus minus aequilongis apice
saepe dilatatis. Prarteolae inter flores masculos millae. Capsula
latissime oblongo-trilobata, 7-8 mm. x 6-7 mm., laevis, cocis acute
carinatis glabris minute punctatis. Styli 2-3 mm. longi, versus basin
coaliti. Semina obsolete tetragona vel cylindrica, 3-3.5 mm. x 1.5-
2 mm., grisea, laevia, caruncula c. 1 mm. longa, conica, breviter

CYPRUS: Kryos Potamos (near Platres), 18 Feb. 1937, E.W. Kennedy 604;
607; ibid., 30 Mar. 1937, E.W. Kennedy 607; ibid., 4 May 1937, E.W. Kennedy
607 (holo. K, iso. C); ibid., 7 Apr. 1937, E.W. Kennedy 607; ibid., 28
Prodromus Prodromos, 7 July 1940, Davis 1780; ibid., 19 June 1939,
Lindberg; ibid., 6 Sept. 1955, C.E. Atherton 560; ad pagum Prodromus
montis Troodos, 6 Apr. 1859, Kotschy 399. Platres, 21 Feb. 1937,
E.W. Kennedy 605. Chionistra, above Platres, 12 Apr. 1941, Davis 3157.
Troodos mts., July 1937, Charles Wyatt 22 (sterile); ibid., July 1929,
C.E. Usher ? 70 (sterile); ibid., July 1914, G.H.C. Feilden 4; ibid.,
20 June 1880, Sintenis et Rigo 695; ibid., 6 May 1947, G.A. Mavromoustakis;
948; ibid., 9 Mar. 1932, Syngrassides 348 (untypical, leaves up to 5 times
as long as broad). Cyprus, Apr. 1901, A.C. & W. E. Lascelles.

Habitat: Mainly a plant of igneous rocky slopes, often near streams,
ascending from 870 m. - 1630 m. but also growing on flat damp shady
places, dried up river beds, and wayside walls.
E. veneris holds an intermediate position between E. myrsinites L. and E. rigida M.B. (E. birlandulosa Desf., E. pungens Banks & Sol.) and has been previously confused by various authors due to the close resemblance in habit to the former species and in leaf-shape to the latter. Sibth. & Sm. (Fl. Gr. Prod. 1, 331: 1806), Boissier (Fl. Or. 4, 1134: 1879), and Holmboe (Studies on the vegetation of Cyprus, 122: 1914) referred to the Cyprus plant as E. myrsinites L.; Jackson (Kew Bull. 1934: 273), Jackson & Turrill (Kew Bull. 1938: 467) and Lindberg (Acta Soc. Sc. Fen., nov. ser. B. 2 (7), 21: 1948) referred it to E. rigida M.B. (or one of its synonyms). All the Kew material of E. veneris was previously determined as one or other of these species. E. veneris, however, is specifically quite distinct, differing from E. myrsinites in its smooth seeds and in its narrower longer leaves with entire margins; and from E. rigida in its more slender decumbent habit, shorter leaves, and smaller greenish involucellar leaves.

The distinguishing characters of these three closely allied species are summarised overleaf:
**E. rigida**
Stems 5-7 mm. thick at the base, robust, usually erect.
Leaves more than 4 times as long as broad, margin entire.
Involucellar leaves (-10)12-18 mm. x 14-24 mm., yellow
Seeds smooth.

**E. veneris**
Stems 2-5 mm. thick at the base, slender, ascending or decumbent.
Leaves 2.5-4 times as long as broad, margin entire.
Involucellar leaves 6-14 mm. x 7-19 mm., yellowish green.
Seeds smooth.

**E. myrsinites**
Stems 2-5 (-6) mm. thick at the base, slender, ascending or decumbent.
Leaves only twice as long as broad, margin usually scabrid.
Involucellar leaves 8-10 mm. x 7-15 mm., usually green.
Seeds vermiculate-rugulose.

While **E. veneris** M.S. Khan is endemic to the central range of Cyprus, its two near relatives, which are both absent from Cyprus, have a much wider distribution. **E. myrsinites** L. extends from the North and Eastern Mediterranean through the Balkan Peninsula, W. & N. Anatolia and Crimea to the Caucasus and North Persia, whereas **E. rigida** M.B., which grows as far west as Sicily, extends through Greece to the Crimea, Turkey (mainly in the Mediterranean region), W. Caucasus, Anti-Lebanon and Jordan.

The nomenclature of **E. rigida** M.B. requires a note. This is the plant known by Boissier as **E. biglandulosa** Desf. (1809) and later
shown by Eig (Journ. Bot. 75, 187 : 1937) to be synonymous with
E. pungens Banks & Sol. (1794). The latter, however, is a later
homonym for E. pungens Lam. (1786) and therefore cannot be used.
Both E. rigida M.B. (Fl. Taur. Cauc. 1, 375) and E. biglandulosa Desf.
in Ann. Mus. Hist. Natur. Par. 12, 114) were described in the year
1808. Mr. W.T. Stearn informs me that, according to a note inserted by
Par. vol. 12, the part of this volume containing the description of
E. biglandulosa Desf. was published in August 1808. As the preface
of M. Bieberstein's Fl. Taur. Cauc. vol. 1 is dated "mense Januario a.
MDCOCVIII", it is reasonable to assume that this volume was published
not long after January 1808, which would establish the priority of
E. rigida M.B. over E. biglandulosa Desf.

I am indebted to Dr. P.H. Davis, Mr. B.L. Burtt (Edinburgh) and
Mr. R.D. Meikle (Kew) for valuable advice and useful criticism in
preparation of this paper, and to the Keeper of the Kew Herbarium for
providing facilities to examine the material.

(The paper has been accepted for publication in Kew Bulletin, in October, 1962)
ABSTRACT OF THESIS

Name of Candidate
Mohammad Salar Khan

Address
University Department of Botany, Edinburgh.

Degree	Ph.D.
Date	October, 1962.

Title of Thesis
"Taxonomic studies in the genus Euphorbia L."

1. In this account, the genus Euphorbia L. as it occurs in Turkey has been revised; 84 species have been recorded.

2. The morphology of the highly complex cyathium of Euphorbia L. has been interpreted and its taxonomic significance summarised.

3. The pollination and dispersal mechanisms have been described.

4. An assessment has been given of taxonomic characters and their variation as observed in the species covered by this revision. This investigation has revealed certain serial trends of variation in the different organs and the probable lines of evolution of certain characters.

5. The phyto-geographical distribution of all the enumerated species throughout their whole range has been summarised in two tables (Table I, endemic; and Table II, non-endemic species). Out of the 84 species recorded here, 16 are endemic to Turkey (about 19%), the greatest concentration of endemics being in the Mediterranean region, mostly in the Taurus mountains. 13 endemics also have their closest allies in Anatolia; of the latter, however, 12 extend into adjacent countries. The remaining 65 non-endemic species have rather wide distributions extending from Europe through N. Africa into the Orient.

6. A summary of altitudinal range, life forms, and ecological habitats in Turkey of all the species has been given in Table III. Most of the 55 perennial species grow in rocky places, often in forests, scrub vegetation and in Mediterranean communities with a wide altitudinal range (0-2000 m. and above). Amongst these, 32 are Chamaephytes while others are either Geophytes or Hemicryptophytes. A large majority of 29 annuals (Therophytes) are mainly ruderal-segetals.

7. The arrangement of taxa at Sectional and Subsectional level has been based on Boissier's monograph (in DC. Prodr.), with a few modifications. Some informal groups of apparently closely related species have been recognised. The emphasis in this work has been particularly on specific delimitations; hence no decisions about the generic or infra-generic limits have been taken in view of the world-wide distribution of this group of about 1600 species.

8. The analytical keys to Sections, Subsections, informals groups, and species have been made on characters that can be easily observed.

9. All the Turkish species annotated belong to two Sections: (a) Tithymalus (Tourn. ex] Hill) Duby represented by 7 Subsections including 82 species, and (b) Anisophyllum (Haworth) Römer ex Duby with only 2 species. The arrangement of the species has been put in as natural an order as a linear sequence allows.

The taxa enumerated in this work include 7 new species and 3 new varieties of which Latin descriptions have been given. The examination of additional herbarium material, including types, has led to a better understanding of the delimitation and relationships of certain species (e.g. E. haussknechtii Boiss.).

Use other side if necessary.
The nomenclatural confusion surrounding *E. verrucosa* L. and *E. ricida* M.B. has been clarified. Typification of the controversial cases of two Linnaean species, *E. chamaesyce* L. and *E. apios* L. has been dealt with. 4 species have been reduced to synonymy.

10. In the enumeration, the following information has been furnished under each species:

(a) nomenclature, including synonymy, (b) brief description, (c) type and its location, (d) life form, ecological habitat, and cytology, (e) discussion about relationships, distinguishing features, nomenclatural problems and any other interesting aspects, and (f) distribution inside and outside Turkey.

11. A list of species imperfectly known and doubtfully recorded from Turkey has been given at the end of the enumeration.

12. The following Appendices have been included:

(a) Key to Turkish Rumhorbias based on seed characters alone,

(b) Distribution maps of some species,

(c) Photographs of some representative seed types, and

(d) 2 papers (already accepted for publication) on 2 new Rumhorbias from Cyprus and Iraq.