

ABSTRACT OF THESIS

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Title of Thesis TAXONOMIC STUDIES IN THE GENUS STACHYS WITH PARTICULAR REFERENCE TO
..... THE NEAR EAST
.....

ABSTRACT

The study is mainly concerned with a thorough morphological investigation of the genus Stachys based on herbarium material. The area of investigation covers Europe, N. Africa and S.W. Asia with special reference to Turkey. The study is divided into two parts.

In Part A, the history of the genus and infrageneric classifications are evaluated chronologically and a reclassification of the genus has been proposed on the basis of a reassessment of a range of morphological and a few anatomical characters. Petiole and nutlet anatomy have been found to be useful in deciding the status of Betonica. In this account I have accepted two subgenera, Stachys and Betonica, and divided them into 19 and 2 sections respectively, of which 5 are monotypic. The remaining sections are divided into subsections and informal 'series'. The infrageneric (supraspecific) groups are keyed out and described; nearly all known species and infrageneric taxa from the area concerned are arranged according to their phenetic relationships (so far as a linear sequence allows). Outline maps of the sections and subsections are provided to show their distribution. Ecogeography and endemism in the genera are discussed and an isoflor map is produced showing the centre of maximum morphological diversity. Affinities of the genus with other genera of the tribe Stachydeae, particularly Ballota, have been discussed.

The structure, distribution and ontogeny of stomata and stellate-dendroid hairs have been investigated and their taxonomic importance has been evaluated. Information on pollination and fruit dispersal is summarised. Cytological evidence from available literature has been interpreted in biological and taxonomic terms, in so far as the limited information allows. Stereoscan micrographs of the nutlet surface and pollen grains provide some new taxonomic characters. The taxonomic importance of many characters is emphasised by line-drawings and photographs.

In the light of all available information, some evolutionary trends in the genus have been recognised and an advancement index of each section has been calculated. Using these data, the sections are placed on a target diagram which demonstrates their relative advancement and their phenetic relationship to one another.

In Part B, the genus Stachys as it occurs in Turkey and E. Aegean islands is critically revised, and distributional maps of all Turkish data are given. The revised list comprises 70 species, 31 subspecies and 13 varieties, of which 7 species, 4 subspecies and 5 varieties are new to science. The original description of species are amplified and emended whenever necessary, depending on the material seen. Discussions on variation, relationship, nomenclature etc. are given for taxonomically critical species. For practical convenience, a key to 5 informal groups has been given, and each group is provided with a key to the species. Endemism and distribution of the species in different phytogeographical regions are discussed, and an isoflor map of the species from Turkey and neighbouring countries (Iraq, Iran, Syria, Caucasia and the Balkan peninsula) is produced in order to show the area of species concentration.

Appendix A provides a list of species investigated for anatomical, developmental and stereoscan studies, and a new species from Iraq is described in Appendix B.

The thesis is illustrated by 30 figures, 20 plates containing photographs, 27 maps and 11 tables.

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Erratum

The subsections attributed to Knorring (1954) throughout the thesis (including Table 2) are actually Series.

TAXONOMIC STUDIES IN THE GENUS STACHYS
WITH PARTICULAR REFERENCE TO THE
NEAR EAST

BY
REBA BHATTACHARJEE

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In the light of all available information, some evolutionary trends in the genus have been recognised and an advancement index of each section has been calculated. Using these data, the sections are placed on a target diagram which demonstrates their relative advancement and their phenetic relationship to one another.

In Part B, the genus Stachys as it occurs in Turkey and E. Aegean islands is critically revised, and distributional maps of all Turkish taxa are given. The revised list comprises 70 species, 31 subspecies and 13 varieties, of which 7 species, 4 subspecies and 5 varieties are new to science. The original descriptions of species are amplified and emended whenever necessary, depending on the material seen. Discussions on variation, relationship, nomenclature etc. are given for taxonomically critical species. For practical convenience, a key to 5 informal groups has been given, and each group is provided with a key to the species. Endemism and distribution of the species in different phytogeographical regions are discussed, and an isoflor map of the species from Turkey and neighbouring countries (Iraq, Iran, Syria, Caucasia and the Balkan peninsula) is produced in order to show the area of species concentration.

Appendix A provides a list of species investigated for anatomical, developmental and stereoscan studies, and a new species from Iraq is described in Appendix B.

The thesis is illustrated by 30 figures, 20 plates containing photographs, 27 maps and 11 tables.

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INTRODUCTION

Stachys is one of the largest genera of the Labiatae and comprises about 275 species. It is a subcosmopolitan genus characteristically centred in the warm temperate regions of the Mediterranean and S.W. Asia, with secondary centres in North and South America and Southern Africa, but entirely absent from Australia and New Zealand.

This study is mainly concerned with the systematic and general treatment of the genus as it occurs in Europe, N. Africa and S.W. Asia and including the Tien Shan in Central Asia. The main taxonomic sources are Bentham's invaluable monographic revisions (1834, 1848) on a world-wide basis, and Boissier's account of the oriental species (1879). Regional floristic revisions have also provided useful information; Komarov's Fl. URSS (1954), Grossheim's Fl. Kavkaza ed 2(1964) and the recent Fl. Europaea Vol. 3 (1972) are the most important.

The present investigation is mainly divided into two parts. Part A contains a general treatment of the genus based on a broad survey of the variations of morphological and some anatomical characters of taxonomic importance, and is again divided into five parts. Part B deals with a critical taxonomic revision of the genus in Turkey and the neighbouring E. Aegean islands, and is divided further into two chapters.

Since Boissier's time, the genus has not been revised in detail for most of the area concerned. Infrageneric classification started relatively early when Dumortier (1827), Reichenbach (1830), Boissier (1879) and others tried to classify the genus on the basis of regional floristic studies, followed by Bentham, on a world wide basis. The taxonomic situation has been found to be very unstable, and partly unnatural in so far as the

contents and interrelationships of the groups were concerned. In this chaotic condition, where data from the fields of paleobotany, cytogenetics, phytochemistry etc. are entirely lacking, assessment of natural relationship must depend on a thorough morphological survey together with some relevant data on anatomy. Chapter 1 deals with the history of the genus, and its classification has been discussed mainly from the time of Linnaeus to the present. In chapter 2 an extensive discussion on the taxonomic importance of morphological and anatomical characters in Stachys has been given and their importance in the current system of classification has been elaborated. This has been followed in the next chapter by the new infrageneric classification proposed and the reasons for changing the previous classification has been discussed in detail. A dichotomous key of the proposed infrageneric groups have been provided followed by their detailed systematic accounts. Cytogenetic information from available literature, however, is very incomplete in this genus. Though chromosome counts have been made for some species from Europe and N. America, information is totally lacking about the species occurring exclusively in Turkey. As information on ecogeography and endemism in the genus is limited, in the present study the species have been surveyed throughout their range of distribution. This has been found to be extremely useful in improving previous classifications, speculating on probable evolutionary trend, and qualifying the area of maximum morphological diversity.

In chapter 4 the generic affinities of Stachys have been discussed briefly which was found to be useful in speculating on the evolutionary trends within the genus presented in the next chapter, 5.

In Part B the taxonomic treatment of the 70 species is accompanied by keys, descriptions, discussions, and distribution maps. An account of the distribution and endemism of the Turkish species occurring in different phyto-geographical regions has been provided.

This investigation is mainly based on the rich herbarium collections of the Royal Botanic Garden, Edinburgh (E), Kew (K) and the British Museum (Natural History: BM). Besides these, I had the opportunity of borrowing specimens from G, L, LD, LE, MPU, P, W (abbreviations used according to Index Herbariorum, 1964) and from the private herbaria of Huber-Morath (Basel) and Sorger (Vienna), including valuable types. Twelve species* have been examined under cultivation at the Royal Botanic Garden (Edinburgh) from which I obtained some valuable information on the ~~development~~ ^{development} of stomata and indumentum and ^{on} ~~pollination~~ ^{pollination}.

For the general morphological survey the specimens have been studied under a dissecting microscope (x20). Flowers have been dissected out after soaking in boiling water with a drop of detergent solution and drawings have been made from the reconstituted material. To facilitate comparisons, corresponding parts have been consistently drawn to the same scale.

Unlike the characters of external morphology, the general anatomy has rarely proved of much value taxonomically. The family Labiatae being highly specialised as a whole, ^{the} basic anatomical characters are largely constant throughout the genus, except for some modifications of the internal leaf and stem structures adapted to different ecological conditions. During a general survey of the literature of the family, it was found that anatomical studies of the nutlets (Wojciechowska 1966) have provided characters satisfactory for the delimitation of several other genera of the Labiatae. Investigations

* S. citrina, S. pumila, S. thirkei, S. byzantina, S. spectabilis,
S. lavandulifolia, S. alpina, S. officinalis, S. macrantha,
S. macrostachya, S. monieri and S. arvensis.

have been carried out in that time and some promising results were obtained. Scanning electron microscopic studies of the surface of the nutlets and pollen grains were not found to be of much use taxonomically.

The discussion of the vegetative and anatomical characters has been supplemented by comprehensive illustrations and photographs. Some of the species showing characteristic floral structures are illustrated by line drawings. All the figures, plates and maps are original.

Some new and neglected morphological features supplemented by some important anatomical findings on the nutlets and petiole provide more information for an accurate taxonomic study of the group.

The present study which is a morphological/geographical one mainly aims to improve the general classification of the genus at infrageneric (supra-specific) level and to revise the taxonomy of the Turkish species. Besides that, it also tries to determine the present centre of speciation of the genus by calculating the region of maximum morphological diversity of the species groups. Isoflor maps of the infrageneric groups (up to subsections) covering the whole region and species occurring in Turkey and adjacent areas, have been produced and compared with each other.

The total number of Turkish species recognised (70) considerably exceeds the number expected when the study began, and as the work has been completed in two years it was not possible to explore other fields of research for a thorough and more detailed taxonomic investigation.

PART A

GENERAL ACCOUNT OF STACHYS L.
AND INFRAGENERIC CLASSIFICATION

I. HISTORICAL OUTLINE OF THE GENUS

A. HISTORY OF THE GENUS:

Caspar Bauhin recognised a genus Stachys in his Pinax (p. 236, 1623), but as he accepted the genus Lamium he included within it the polynomial "Lamium maximum sylvaticum foetidum" which is an early name for Stachys sylvatica. Joseph Pitton Tournefort (1700) treated that polynomial under Galeopsis, and Linnaeus's concept of Stachys (1753) included some of Tournefort's Galeopsis, including "Galeopsis procerior foetida spicata", another name for S. sylvatica now regarded as the type of the genus Stachys. Linnaeus's description of the genus appeared first in Systema Naturae (1735) and the genus was validated in modern nomenclature in the 5th edition of his Genera Plantarum (1754). Linnaeus circumscribed the genus by including Tournefort's Galeopsis pro parte and maintained Betonica distinct, mainly on the nature of upper corolla lip. In his Species Plantarum (1753) he gave binomials to 8 species, of which 5 had already been mentioned before in Pinax.

After Linnaeus, different taxonomists like Gleditsch (1764), Haller (1768), Moench (1794), Hoffmannsegg & Link (1809) tried to split the genus under different generic names but did not receive general support by later botanists. Thus Zietenia (Gleditsch), Galeopsis (Moench non L.), Trixago (Haller), Tetrahitum and Eriostomum (Hoffmannsegg & Link) were sunk under the generic name of Stachys by Dumortier (1827) and Bentham (1834).

One of the most important modifications since Linnaeus's circumscription of the genera Stachys and Betonica was that proposed by Bentham in his Labiatarum Genera et Species (1834), where he included Betonica under Stachys and divided the former into two separate sections Betonica and Alopecuros. The main reason for reducing Betonica was the presence of parallel-celled anthers in certain

species of the section Ambleia of Stachys, by which character Betonica had so far been characterised. He also added, "in every other character, as well as in habit, the two genera appear to me inseparable, unless, indeed, as many genera be formed as I have enumerated sections, and the presence of bracteae, inflorescence and the colour of flower be admitted as generic characters". But strangely enough, later in DC., Prodrumus (1848) he changed his view and again treated Betonica as a separate genus, probably being influenced by de Candolle himself. From that time onwards, the position of Betonica became a subject of much controversy. Boissier (1879), Reehinger (1943) and recent Soviet taxonomists have kept Betonica as a distinct genus, whereas Briquet (1896), Hayek (1929), Halácsy (1902) and other European taxonomists have put it under Stachys.

B. HISTORY OF INFRAGENERIC CLASSIFICATION

The subsequent history of the genus is mainly on infrageneric classification which started as early as 1827, when Dumortier in Florula Belgica subdivided the genus into 3 sections, viz. Olisia, Stachydotypus and Eriostomum, of which the first two have his own authorship, while the third one is the genus of Hoffm. & Link reduced to sectional rank. His divisions of the genus were preceded by 'S' signs, which in fact is the normal sign for sections and acceptable as such, unless there are indications to the contrary (as in some works of Boissier, de Candolle, Briquet and others). Dumortier's groups provide the first sectional nomenclature for the genus and make a handy starting point of today's classification. His sections were mainly based upon the number of flowers per verticillaster and on the length of bracts.

Reichenbach (1830) proposed 3 infrageneric groups namely: a) Campanistrum, b) Chamaesideritis and c) Eriestachys mainly on the annual versus perennial habit, calyx shape and corolla colour. Unfortunately he did not make any

statement about their intended rank. Campanistrum has been accepted in the present classification as it is the earliest name for the section including S. arvensis. An excellent survey of the genus on a world wide basis has been made by Bentham (1834). He mainly adopted Dumortier's and Reichenbach's classification with some modifications. Bentham critically investigated the 'structure' of the genus and recognised 9 sections, including two sections of Betonica. He recognised Olisia of Dumortier and Eriostachys and Chamaesideritis of Reichenbach with some amended circumscriptions and thus broadened their limits to include more species. Besides these, he accepted Sect. Stachyotypus (correcting Dumortier's original spelling 'Stachydotypus') including some species of Campanistrum and Eriostachys of Reichenbach. In doing so he emphasised the rose-purple colour of the corolla, smaller bracts and few flowered verticillasters, and subdivided Stachyotypus into three groups, Genuineae, Ruderales and Oligantheae. His remaining 5 sections are Alopecurus, Betonica, Calostachys, Ambleia and Zietenia, of which the first two belong to the genus Betonica and the others to Stachys. The two sections of Betonica contain 1 and 5 species respectively and the first one is delimited from the latter on the yellow coloured corolla and shortly exerted corolla tube. The remaining 3 sections are mainly delimited on a combination of characters like long exerted corolla tube, density of indumentum, herbaceous-perennial versus suffruticose-perennial habit. Section Calostachys of Bentham included 5 species, all found in S. Africa or N. America, and so is not considered further in the present taxonomic treatment.

In 1848 Bentham in DC., *Prodomus* altered his previous classification to a certain extent. He excluded Betonica from Stachys and in the latter recognised another section Chilostachys containing 2 species. He changed the names of

the subdivisions of Stachyotypus into Elatae and Agrestes and did some minor alterations in changing the places of some species from one section to another.

Boissier (1879) followed Bentham (1848) in accepting the 3 main sections Eriostachys, Stachyotypus and Olisia. His classifications are mainly based upon the perennial/annual habit, many to few flowered verticillasters, conspicuous to inconspicuous bracts and herbaceous to suffruticose nature of perennial stem. He made some major alterations in Bentham's classification in subdividing Eriostachys into 2 subgroups Germanieae and Micranthae, mainly on the larger/smaller size of corolla. On the other hand in the section Stachyotypus he transferred Bentham's Chamaesideritis, Ambleia and Zietenia and divided it into 6 subgroups, viz. Sylvaticae, Fragiles, Rectae, Ambleiae, Fruticulosae and Infrarosulares. His subdivisions were mainly based on herbaceous and suffruticose perennial habit, presence of basal rosettes of sterile shoots, erect and fragile nature of flowering stems. Finally he delimited the section Olisia wholly upon annual habit. Below the sectional level his subgroups are indicated by '§' signs and are not given a formal rank.

Briquet (1896) accepted Boissier's classification in most parts but followed Bentham (1834) in including Betonica in Stachys. The main changes from Boissier's classification is the acceptance of the sectional name Eriostomum Hoffm. & Link for Eriostachys and Eustachys for Stachyotypus in which he included Calostachys Benth., Stachydotypus Dum., Olisia Dum., Campanistrum Reichb., Chamaesiderites Reichb. etc. Briquet did not recognise Sect. Olisia but placed it under Sect. Eustachys. But he accepted Bentham's Chilostachys as a distinct section. His subgroups of the main sections Eriostomum and Eustachys follow the same technical defects of Boissier being

preceded by '§' signs. For the sectional name of Eriostomum he did not cite Dumortier (1827) as authority and possibly overlooked that reference. For the subgroups of Eriostomum he followed Boissier but included two more monotypic groups, Temnocerydes and Biflorae. These two groups were erected on the presence of ^a/bifurcated upper corolla lip and 2-flowered verticillasters respectively. In Eustachys he included 8 subgroups, two of which are Bentham's Calostachys and Genuineae of Stachyotypus, and the rest are Boissier's Fragiles, Infrarosulares, Rectae, Fruticulosae and Ambleiae. The eighth one is Olisiae which came from the section Olisia Dum.

Knorring (1954) essentially followed Boissier in maintaining the main sections. He did not provide his subsections and series with Latin descriptions so they cannot be considered valid.

Very recently Kapeller, in her treatment of the genus in the Caucasus (1961) proposed a regional classification for that area. She accepted 5 sections, namely, Thamnostachys, Ambleia, Zietenia, Eriostachys and Stachys of which the first one is new having 5 species and included Zietenia p.p. and Fruticulosae p.p. of Bentham and Boissier respectively. The remaining 4 sections agree with Bentham's sections. For the subsectional and series rank of the Sect. Eriostachys she referred to Knorring (1954) whose nomenclature as we have seen, was invalid.

Assessment of 3 main classifications by Bentham (1834, 1848), Boissier (1879) and Briquet (1896) clearly shows that they have remained very unstable. Overweighting of some selected characters has resulted in unnatural divisions. In Bentham's classification though some of the sections like Eriostachys and Ambleia are homogeneous, other sections like Stachyotypus and Zietenia are in most parts heterogeneous, containing unrelated or very distantly related species, as special emphasis has been laid on the characters liable to be

influenced by environmental selection pressure. Similar treatment has been noticed in Boissier's Sect. Stachyotypus § Fruticulosae. Besides that, for Sect. Eriostachys § Micranthae he put much stress on ^{the} smaller flower, bract length and herbaceous to indurated nature of flowering stem. On the basis of those characters he separated the species like S. longispicata and S. viticina from the closely related species in Sect. Eriostachys § Germanicae which seems an unfortunate decision. In practice this particular character is of limited taxonomic value as it is affected by gynodioecism which occurs in several species. In addition, the flower size is not well correlated with other taxonomic characters, so that these two groups Germanicae and Micranthae cannot be kept apart. On the other hand, overweighting of the characters like bract length and woody flowering stem kept S. setifera far apart from the closely allied S. menthoides, these being placed in two different sections, Eriostachys and Stachyotypus respectively. S. rosea, which on its overall character differences is quite distinct in itself, was put with the unrelated species of § Micranthae mainly on the presence of large and herbaceous bracts. § Amblesiae with its two well correlated characters, dendroid indumentum and woody suffruticose habit is a quite homogeneous assemblage except for the inclusion of S. chrysantha, S. candida and S. iva which do not possess dendroid indumentum although they are densely white-lanate. Briquet (1896) followed ⁱⁿ the foot/steps of Boissier so far as his main subgrouping of sections is concerned. He was quite justified in keeping S. rosea in a separate group Biflorae. On the other hand the recognition of § Tennocorydes for S. graeca, mainly on the basis of a forked upper corolla lip hardly seems justifiable, as this species stands very near to § Germanicae in other well correlated characters.

C. SYNOPSIS OF SUBGENERA AND SECTIONS OF STACHYSIN EUROPE, S.W. ASIA AND N. AFRICA

- I. Subgenus Stachys
- Type: S. sylvatica L.
- Sect. 1. Eriostomum (Hoffm. & Link) Dumort.
- Type: S. germanica L.
- Sect. 2. Mucronata Bhattacharjee
- Type: S. mucronata Sieber ex Sprengel
- Sect. 3. Infrarosularis Bhattacharjee
- Type: S. rupestris Mont. & Auch.
- Sect. 4. Roseostachys Bhattacharjee
- Type: S. rosea (Desf.) Boiss.
- Sect. 5. Setifolia Bhattacharjee
- Type: S. setifera Bieb.
- Sect. 6. Stachys
- Type: S. sylvatica L.
- Sect. 7. Candida Bhattacharjee
- Type: S. candida Bory & Chaub.
- Sect. 8. Swainsoniana Bhattacharjee
- Type: S. swainsonii Benth.
- Sect. 9. Fragilicaulis Bhattacharjee
- Type: S. benthamiana Boiss.
- Sect. 10. Olisia Dumort.
- Type: S. annua L.
- Sect. 11. Campanistrum Reich.
- Type: S. arvensis (L.) L.

- Sect. 12. Corsica Bhattacharjee
 Type: S. corsica Pers.
- Sect. 13. Sideritopsis Bhattacharjee
 Type: S. pseudosideritis Huber-Morath & Bhattacharjee
- Sect. 14. Neurocalyx Bhattacharjee
 Type: S. neurocalycina Boiss.
- Sect. 15. Satureioides Bhattacharjee
 Type: S. satursioides Mont. & Auch.
- Sect. 16. Thamnostachya Kapeller
 Type: S. fruticulosa Bieb.
- Sect. 17. Aucheriana Bhattacharjee
 Type: S. aucheri Benth.
- Sect. 18. Zietenia (Gled.) Benth.
 Type: Zietenia orientalis Gled.
- Sect. 19. Amblesia Benth.
 Type: S. inflata Benth.
- II. Subgen. Betonica (L.) Bhattacharjee
 Type: S. officinalis (L.) Trev.
- Sect. 20. Betonica
 Type: S. officinalis (L.) Trev.
- Sect. 21. Macrostachya Bhattacharjee
 Type: S. macrostachya (Wend.) Briq.

Fig. 1.

HABIT TYPES IN BETONICA AND STACHYS

(Explanation in the text)

- A. S. alopecuros ($\times \frac{1}{2}$), a - Flowering axis lateral;
- B. S. cretica subsp. salviifolia ($\times \frac{1}{2}$), b - Flowering axis terminal.

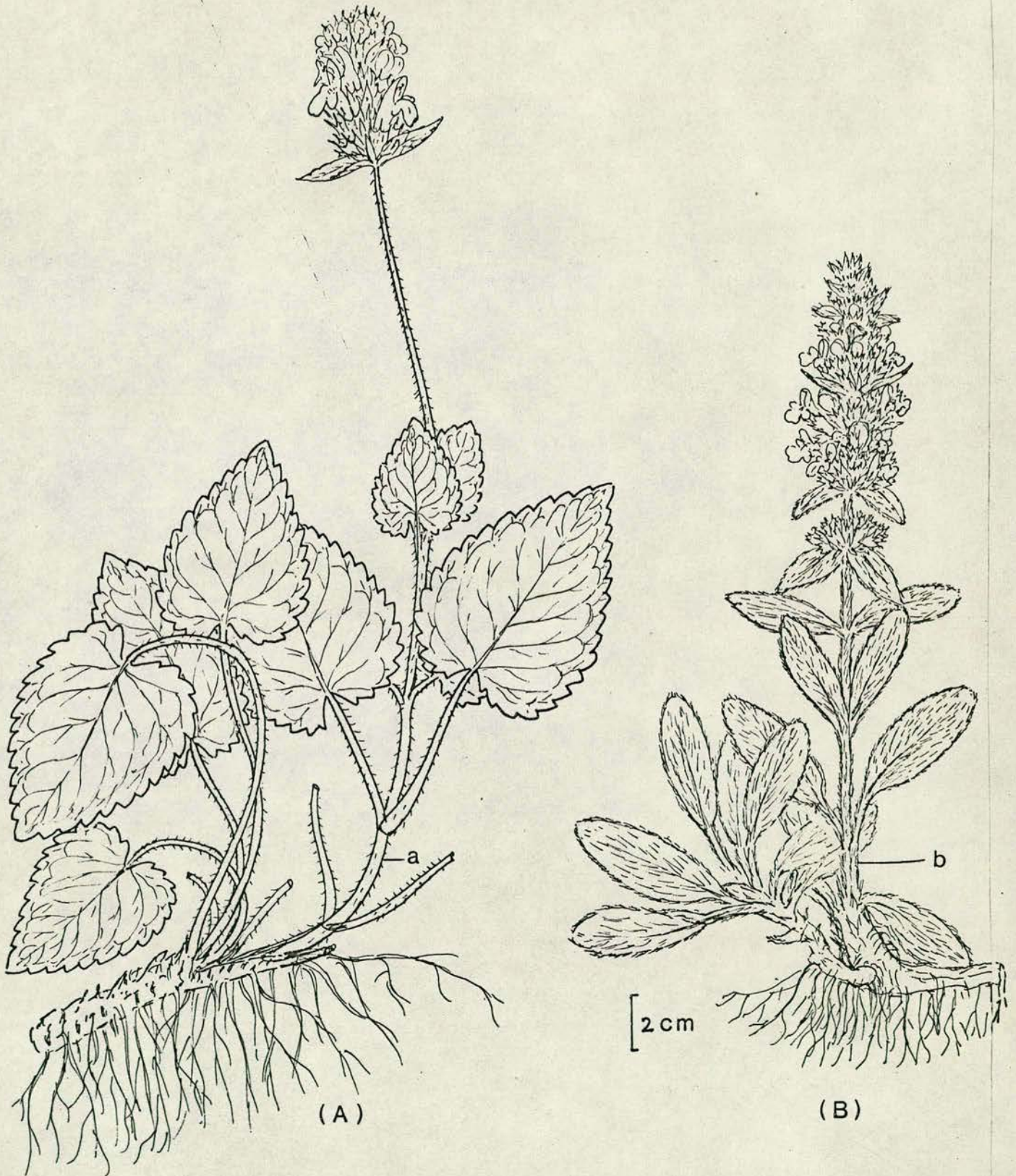


FIG. 1

Habit types in Betonica & Stachys

II. ASSESSMENT OF TAXONOMIC CHARACTERS AND THEIR VARIATION

A. MORPHOLOGY

The following account deals with morphological variations of both vegetative and reproductive parts; characters found to be of special value or interest in classification. They are arranged according to the order of treatment used in the description of species.

Habit: The genus exhibits a remarkable diversity in habit. Predominantly they are perennials with erect to ascendant, usually branched flowering shoots. Two main types of perennials are met with; one is with profusely branched aerial stems woody at the base or sometimes throughout arising every year from the base, the perennating bud remains above soil. In the terminology of Raunkiaer (1937) they can be classified as suffruticose (suffrutescent) chamaephytes. These again are of two types. In one, the growth is rather rapid towards the apex of the flowering shoots and branching is restricted towards the base, thus a more or less erect bushy growth is formed. This kind of habit is common in the Sections Olisia, Zietenia, Infra-rosularis etc. (Fig. 3). In the other, the growth of the aerial stems is slow and a more or less compact cushion is formed by the divaricate branching of the woody flowering stems throughout the whole length (Fig. 4). This type of habit is not so widespread as the former and found in species like S. spinosa, S. mucronata, S. acerosa, S. glutinosa etc. These two main types of chamaephytic life form are certainly of taxonomic importance.

The next type of perennating habit is found in Sections Eriostomum, Stachys subsects. Sylvaticae, Setifolia and in the subgenus Betonica. They are usually herbaceous and erect perennials whose flowering stems usually remain unbranched near the base and are with or without a few branches above. Either they perennate by long creeping rhizomes which give rise to aerial shoots from

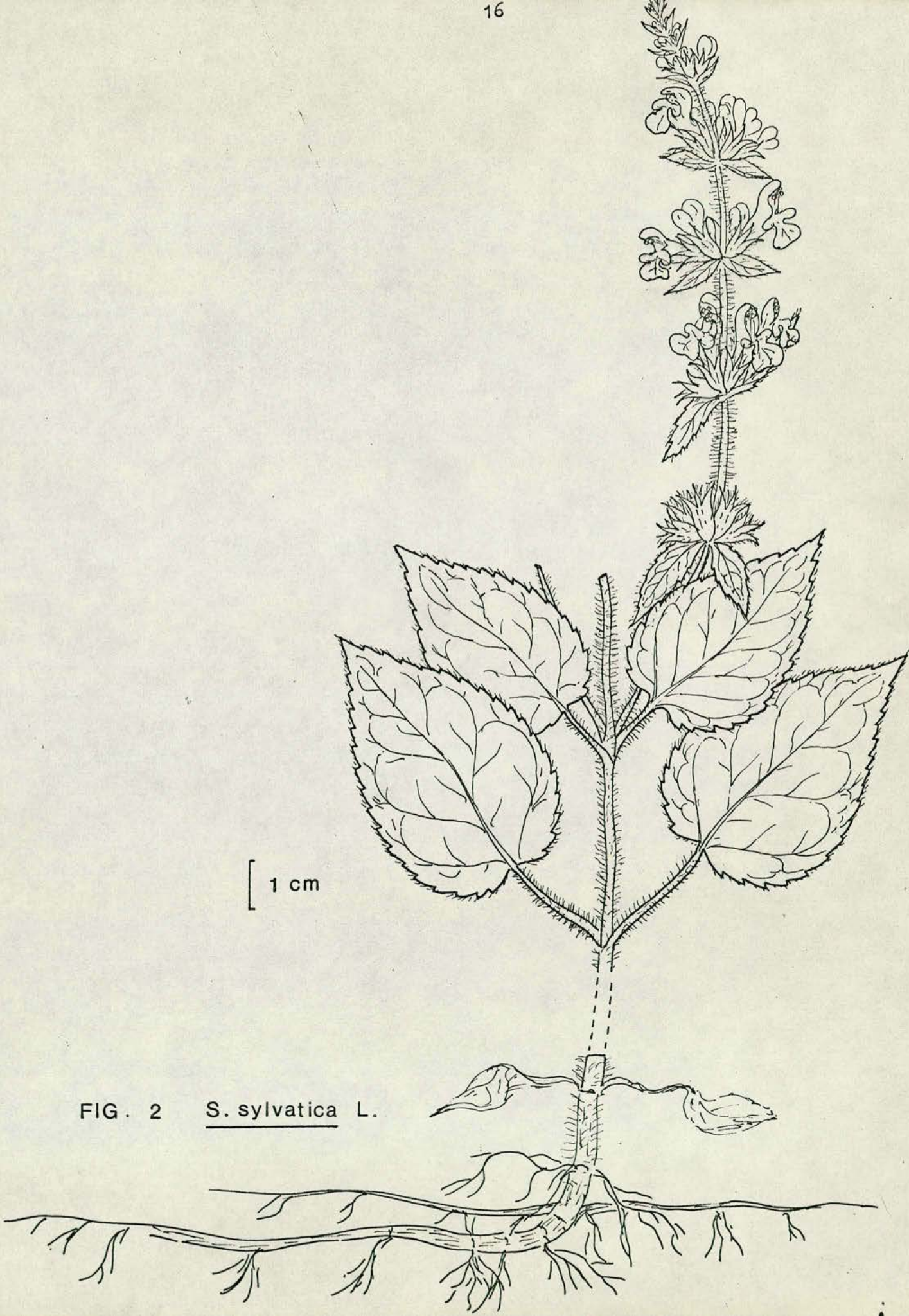


FIG. 2 S. sylvatica L.

their axillary buds, viz. S. palustris, S. sylvatica, S. setifera etc. (Fig. 2) or the rhizome remains shorter and produces sterile and flowering shoots from the end or/and from the axillary buds of the rhizome, viz. in Subgenus Betonica and in subgenus Stachys sect. Eriostomum. In the terminology of Raunkiaer they are hemicryptophytic and most species inhabit moister places. Sterile shoots are usually borne on their rhizomes which are terminal in subgenus Betonica and lateral in subgenus Stachys sect. Eriostomum (Fig. 1). In most species of sect. Eriostomum e.g. S. spectabilis, S. viticina etc. these basal sterile shoots are evanescent and dry up soon after the flowering axes are formed, while in S. cretica, S. thirkei and S. oblique they are persistent. Some suffruticose chamaephytes of subgenus Stachys also bear persistent basal sterile shoots, e.g. Sect. Infrasularis, S. annua, S. diversifolia etc.

Finally the genus shows some exclusively annual sections which either have simple, erect to ascendant stems (Sect. Campanistrum) or are sometimes divaricately branched from the base upwards (Sect. Sideritopsis, Sect. Satureioides). In Sect. Olisia subsect. Annuae gradations from annual to perennial habit have been found even in the same species e.g. S. annua (Pl. 19). The habit characters correlated with other taxonomic features have been found to be of considerable taxonomic significance.

Leaves: The leaves are constantly herbaceous in nature and variable in size, shape, margin and other characters and afford good diagnostic characters. From the point of view of distribution on plant body, 3 kinds are recognisable, viz. basal, cauline and floral leaves.

Basal leaves are usually borne on sterile shoots forming rosettes and grow from the rhizome (Fig. 1). In some biennial species, e.g. S. inanis and S. huber-morathii, they form a rosette surrounding the base of flowering



FIG. 4

S. iberica Bieb.

shoot. Basal leaves are usually long-petioled with a distinct lamina.

Cauline leaves are borne on the flowering axis and are^{more} or less similar to the basal leaves when present; they gradually become smaller and narrower upwards, the petiole become shorter and the leaves ultimately become subsessile to sessile. The transition is referred to as gradual, but in S. diversifolia, S. inanis and S. munzurdagensis the transition is abrupt and the leaves might be considered dimorphic.

Floral leaves subtend verticillasters in their axils. Some taxonomists call them 'bracts', but as there is no difference in appearance between them and the upper (infertile) cauline leaves, I prefer to refer them as floral leaves. Usually the transition from cauline to floral leaves is gradual, but in Subgenus Betonica (except S. betoniciflora) the transition is abrupt and the floral leaves are bractiform. (Fig. 1). Bractiform floral leaves are also present in Sect. Olisia subsect. Distantes. Floral leaves are sometimes characterised by spinescent tips which are useful in delimiting S. recta, S. atherocalyx etc. from non spinescent but related species like S. iberica, S. angustifolia etc.

Petiole: Length of petiole and its presence or absence are useful taxonomic characters. In Subgenus Betonica and in Stachys Sects Eriostomum, Infrarosularis, Olisia, subsects Annuae & Rosulatae, Stachys, Campanistrum etc. they are conspicuous, while in Sects Zietenia, Satureioides, Thamnostachys, Aucheriana etc. they are small and obscure, ranging from 0.2-1 cm. In Sect. Roseostachys the leaves are completely sessile. In Sect. Fragilicaulis, S. euadenia is distinguished from the nearest relative S. pinardii, even the lowermost leaves being shortly petioled to subsessile (0.2-0.8 cm).

Shape: The leaves are either broadly ovate or ovate-oblong with cordate



FIG. 3

S. spinosa L.

to subcordate base or oblong-lanceolate to lanceolate. In the first type the leaves are broadest at the lower part and gradually taper upwards, e.g. S. germanica, S. officinalis, S. sylvatica etc. (Fig. 2). In the second type considerable variation is met with and is of taxonomic significance. In Sect. Eriostomum subsect. Creticae (Fig. 1) the leaves are oblanceolate or spatulate with attenuate to subcordate base but always narrower at the lower part and broader in the middle. In Sects. Satureioides, (Fig. 5) Zietenia, Thamnostachys etc. the leaves are always narrowly lanceolate to oblanceolate with attenuate base. S. angustifolia is aberrant in having linear leaves, the lowermost cauline ones being laciniately incised. S. fragillima and S. epadenia have almost orbicular to even reniform leaves.

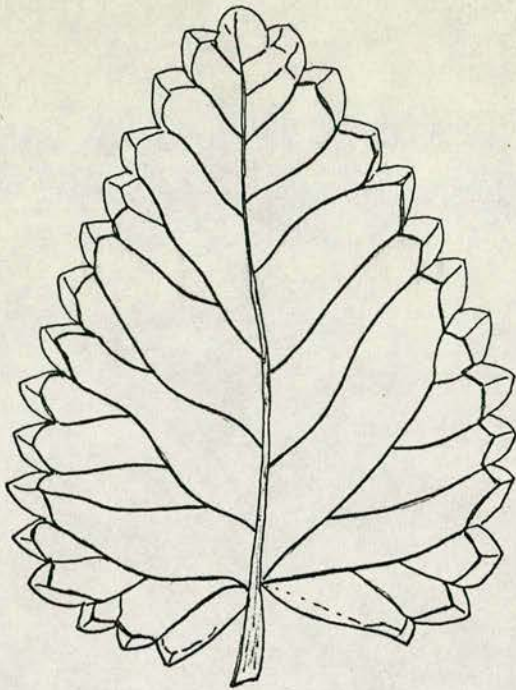
Margin: Subgenus Betonica has very distinctly crenate, rarely serrate margin (Fig. 5 A) while Subgenus Stachys shows considerable variation in that character, which are often used to delimiting species or even subspecies. They are usually obscurely crenulate, e.g. S. cretica, S. thirkei, subentire to entire, e.g. S. satureioides, S. acerosa, (Fig. 5 E), S. glutinosa etc. or rarely distinctly crenate, e.g. S. alpina, S. fragillima etc. S. setifera subsp. lycia and S. iberica ssp. georgica are distinctly from the type subspecies in having distinctly serrate margin margined leaves.

Venation: Basically the leaves are pinnate and brochidodromous type of venation. The lateral veins curve towards apex on approaching the margin and fuse with the next upper vein, so that a series of loops are formed. In crenate and serrate margined leaves one trace is supplied to each lobe. According to the orientation of veins they are a) pinnate-brochidodromous, or b) parallel-brochidodromous. In the first type the main lateral veins diverge towards the margin and then curve upwards to meet the upper one (Fig. 5 A), while in the second one the lateral veins run more or less parallel in respect to the margin and mid-vein

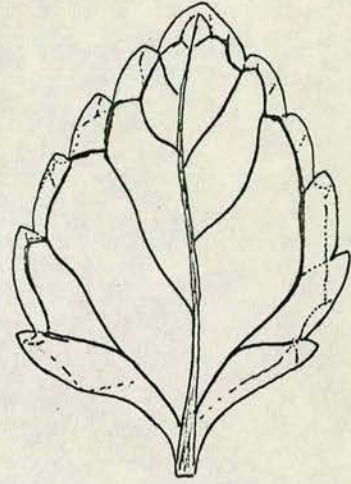
Fig. 5. TYPES OF VENATION

(Explanation in the text)

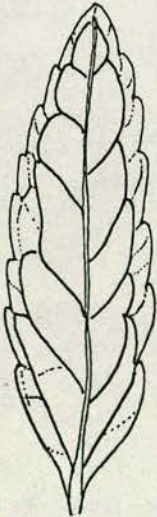
- A - S. macrantha; B - S. arvensis;
C - S. anisochila; D - S. burgsdorffloides;
E - S. acerosa.



A x1M



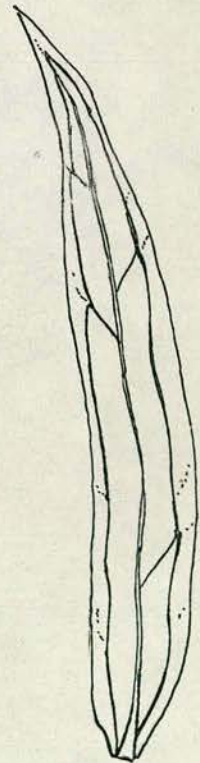
B x2M



C x2M



D x2M



E x6M

FIG. 5 VENATION TYPES

and meet the upper ones on their way towards the apex (Fig. 5D, E). A correlation occurs between the shape of the leaves and venation types. The broader leaves found in Sect. Eriostomum, Betonica, Macrostachya, Stachys etc. have the first kind of venation, while narrower leaves are more usually parallel-veined. Intermediates occur between these two forms where the narrower leaves are pinnately veined, e.g. S. iberica; somewhat broader leaves like S. anisochila have a tendency towards parallel venation (Fig. 5C). It seems that a trend towards narrowness of the lamina and parallel brochidodromous venation is correlated with more xeric adaptation of the species, as is found in Sects. Zietenia, Thamnostachys etc., and also with the evolution of annual species, e.g. Sect. Satureioides.

Leaf Dimorphism: The phenomenon of leaf dimorphism is a common feature in the chamaephytic vegetation of Irano-Turanian and Mediterranean regions (Orshansky, 1964). This dimorphism has been attained in various ways in different taxa, as has been mentioned by earlier authors. Either there is a leaf shedding or the formation of two types of leaves, or there is a dense covering of indumentum over the transpiring surfaces to check excessive transpiration during summer months. There is no field information about seasonal dimorphism of leaves in Stachys in natural conditions. However, from two cultivated species of Stachys, i.e. S. lavandulifolia and S. byzantine, I presume that ⁱⁿ this genus dimorphism is mainly expressed by the increase in hairiness of the summer leaves. Though the garden environment is obviously different from the natural habitat, here too the summer leaves appearing from the month of May to August are densely felted and persist throughout winter, while the winter leaves of the previous season are on the process of drying and withering. In late summer to mid winter (September-January) these thickly

Fig.6. DIAGRAMMATIC REPRESENTATION OF SEASONAL DIMORPHISM
(Explanation in the text)

- A - Plant in late summer (Sept.-Oct.) - flowering shoot drying, summer leaves (s) with thick indumentum appeared as a basal rosette.
- B - Plant in early to mid-winter (Oct.-Jan.) - flowering shoot absent, summer leaves persisting.
- C - Plant in late winter to early spring (Jan.-March), summer leaves beginning to dry, winter leaves with less thick indumentum appeared (W)
- D - Plant in mid spring (mid March to late April) - summer leaves withered, winter leaves persisting.
- E - Plant in late spring to early summer (May-June) - winter leaves beginning to dry, summer leaves coming. Flowering axis with flowers.
- F - Plant in mid summer (July-August) - winter leaves withering and summer leaves appearing; fruits ripe in flowering shoot.

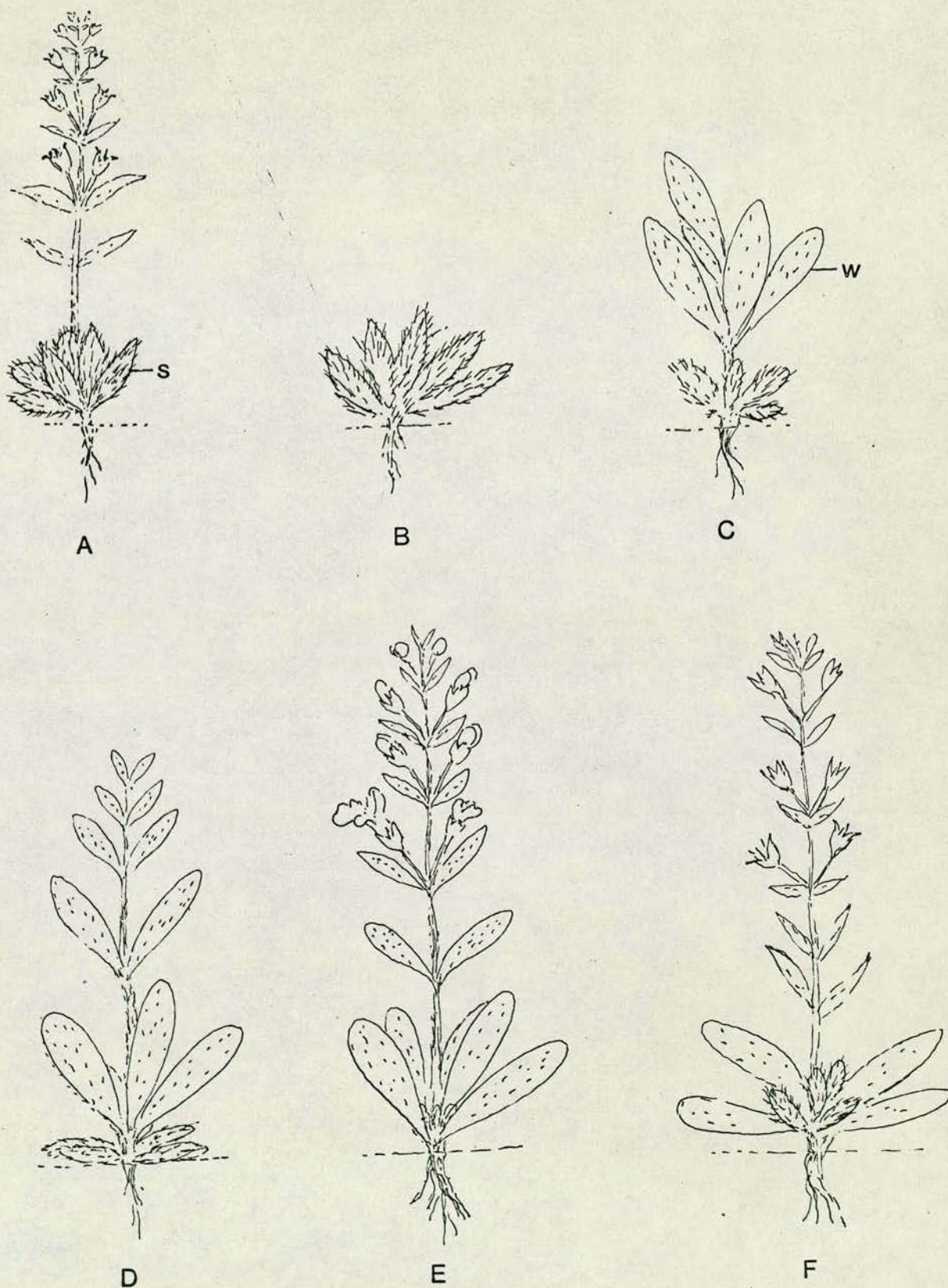


Fig. 6. Diagrammatic representation of seasonal diamorphism in *Stachys*.

felted summer leaves persist. Excessive drought in summer and cold in winter are presumably limiting factors for effective growth. During late winter and early spring (January to middle of March) these leaves begin to dry up and spring leaves with less indumentum begin to develop as the temperature rises and drought no longer limits growth and transpiration. In midspring the temperature and humidity being favourable, the spring leaves continue to grow on the flowering axis. In late spring and early summer again these leaves begin to dry up and new summer leaves begin to appear from the axil of old spring leaves. A diagrammatic representation of the stages of development has been shown in Fig. 6). Although of biological interest, leaf dimorphism is weakly expressed in Stachys and does not have much taxonomic significance.

Indumentum: Nature of pubescence is of profound taxonomic significance in the genus Stachys. Density and degree of pubescence, which is often very variable and changes in different ecological conditions as well as with maturity, are not very useful taxonomic features if under simple genetic control (Rollins, 1958), but still the general morphology, pattern of distribution and insertion of hairs on the epidermis are quite characteristic features in assigning the plants to different groups and species. Sect. Eriostomum, particularly subsects. Germanicae and Creticae in their greatest part, is characterised by lanate-villous to lanate-tomentose indumentum all over the plant body except on the upper surface of leaves where they are usually sericeous tomentose. On the other hand, subsect. Spectabiles is characterised by short and adpressed-tomentose hairs. Sect. Satureioides and Sect. Thamnostachys are on the whole characterised by very short and puberulent hairs all over the plant surface. There are two main types of insertion of hairs on the stem, viz. patent and adpressed.

In the patent type, the hairs are always placed at right angles on the surface of the stems which may be pilose or weakly hairy, or densely lanate. The former condition is universal in Sections Campanistrum, Swainsoniana, Aucheriana, Stachys Subsect. Circinatae, Fragilicaulis Subsect. Fragiles. Sect. Eriostomum Subsect. Germanicae on the other hand has densely and patentely lanate-villous indumentum on the stem surface.

In the adressed type, the hairs are more or less laid down on the surface of stem. From the taxonomic view point they can again be divided into the following types, viz. a) pubescent with short and straight hairs, b) tomentose with short and uneven hairs, and c) felted with long curly crispulate hairs. The whole Section Olisia is characterised by adressed indumentum which is usually pubescent and less frequently of ^{the} felted type, viz. in S. bombycina, S. distantes, S. aleurites and S. fontqueri.

Adressed felted indumentum is also found in Sect. Candida and Sect. Ambleia of which the former is made up of simple hairs and the latter of branched hairs giving on the plant body a whitish tomentose outlook. In Olisia Subsect. Annuae and subsect Rectae the insertion of adressed pubescent hairs are different. Subsect Annuae is separated from subsect Rectae mainly on the direction of insertion of hairs. In the former the hairs are always retrorsely orientated, while in the latter they are antrorse. This feature is very characteristic in delimiting these two coherent groups and has so far been neglected. Sometimes, though rarely, the nature of insertion is variable within the section and even within the same species; it may then be used to delimit species or subspecies. S. sylvatica has patentely hispid hairs, while its related species S. palustris is adressed-pubescent. In Sect. Fragilicaulis subsect. Multibracteatae Ser. A the majority of the species, viz. S. glechomifolia, S. fragillima, S. graveolens etc. have patentely pilose hairs

Fig. 7 TYPES OF INDUMENTUM

(Explanation in the text)

a - g = eglandular hairs; m - s = subsessile glands and glandular hairs.

a, ⁱâ - S. annua; b, ⁱb - S. inanis; c - S. acerosa;

d - S. setifera; e, g - S. alpina; f - S. mecrantha;

k - S. annua; m, n, ⁱp - S. inanis; ⁱm, p - S. acerosa;

q, ⁱⁱs - S. lavandulifolia; s, k - S. alpina;

ⁱk - S. setifera; ⁱâ - S. officinalis; r - S. trinervis

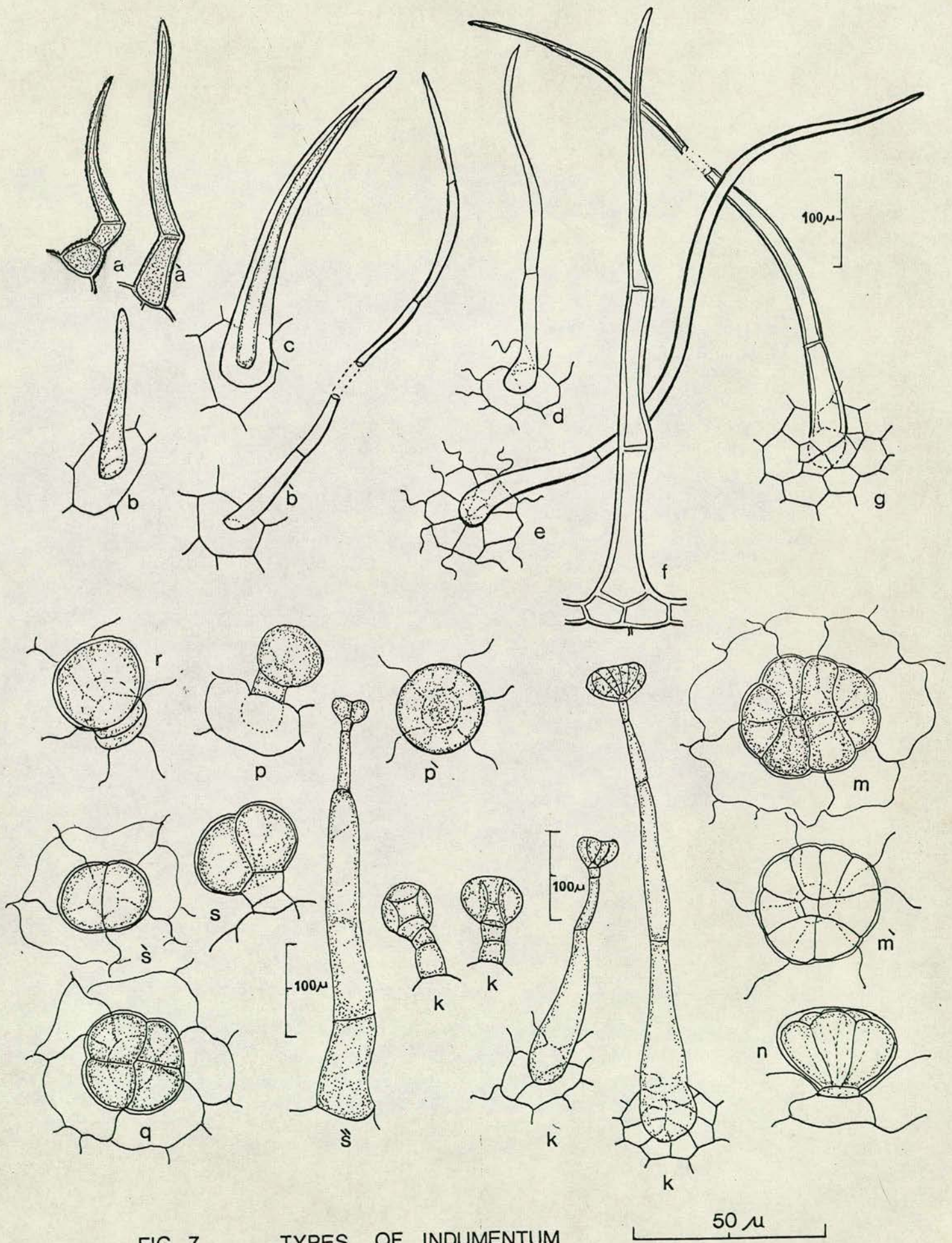


FIG. 7

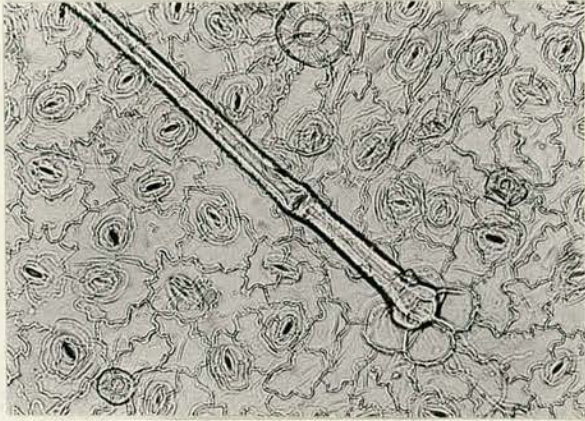
TYPES OF INDUMENTUM

Pl. 1.

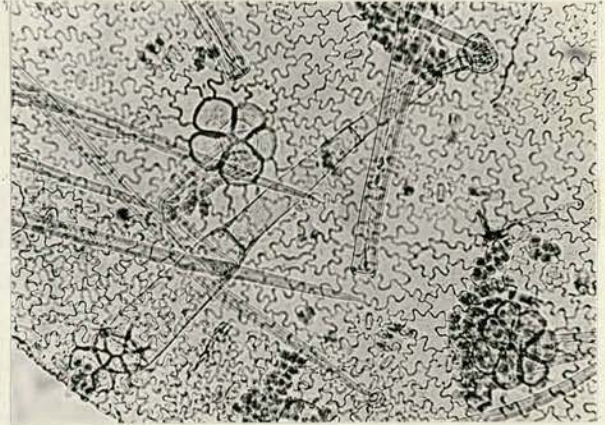
EPIDERMAL PEELINGS FROM LEAVES

(Explanation in the text)

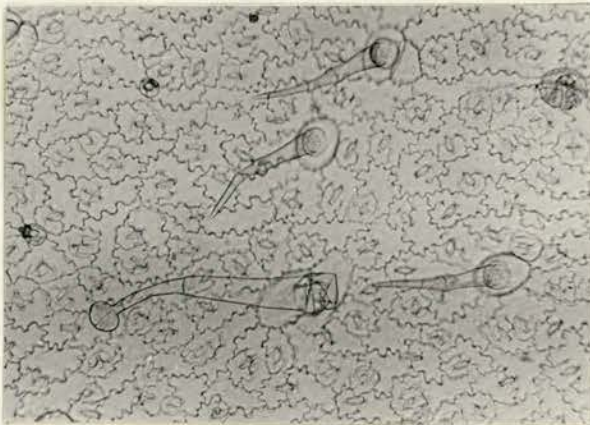
A - Lower epidermis of S. officinalis (x 175, showing multicellular and 4-celled sessile glands and simple hairs from 4-celled base);
B - Lower epidermis of S. alpina (x 125, mark multicellular pedestal of glandular and eglandular hairs); C - Lower epidermis of S. annua (x 140); D - Upper epidermis of S. annua (x 550, 4-celled gland and eglandular hairs); E - Upper epidermis of S. araxina (x 616); F - Lower epidermis of S. macrantha (x 550 with bicelled glands).



A



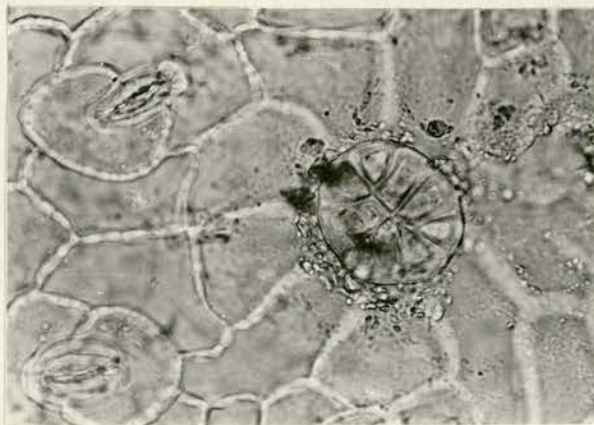
B



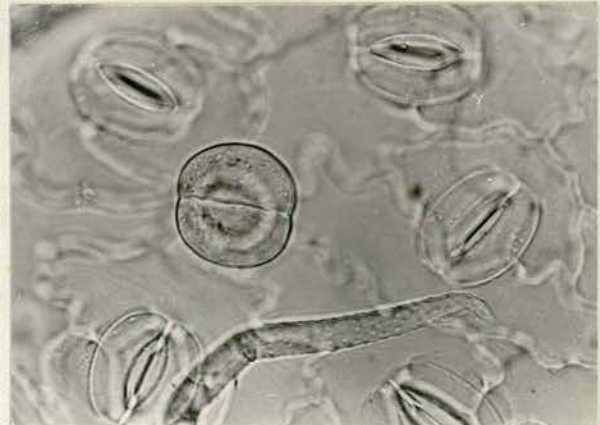
C



D



E



F

while a close relative S. megalodonta has adpressed pubescent indumentum like the rest of the subsect. Multibracteatae Ser. B (viz. S. viscosa, S. ballotiformis etc.). In Sect. Setifolia, variation from patently pilose to adpressed pubescent type is found in the same species, S. setifera and is useful in delimiting the two subspecies within it. Aculeate hairs are another characteristic feature which is unique to S. spinulosa, and hispid hairs with stiff bulbous base characterise the species S. sylvatica, S. arabica, S. arvensis etc. Glabrousness of the epidermis is very infrequent in the whole genus Stachys. In S. menthoides and S. angustifolia plant surfaces are more or less glabrous though some very small and sessile glands are present and very occasionally there are a few eglandular hairs present on the leaf surfaces. Apart from the nature of ^{the} pubescence and insertion type of hairs on the epidermis, the diverse morphology of the individual hairs and glands in the genus provides useful diagnostic characters. Taxonomic importance of the hairs has been mentioned briefly by Solereder (1908) and Metcalfe & Chalk (1950) who reported two types of eglandular and five types of glandular hairs in the family Labiatae. But very little information has so far been recorded about the genus Stachys. For convenience sake, a synopsis of common hair types is given below and some new terms have been accepted, from Roe (1971).

1. Simple, unbranched and eglandular hairs:

These hairs are always uniseriate, consisting of a single row of cells arising from a one, two, three or many-celled pedestal. Sometimes they are unicellular and distributed on the upper surface of leaves arising from a single basal cell, e.g. S. acerosa and S. inanis (Fig. 7). In S. setifera the hairs are usually more than 1-celled and arise from a 2-4-celled pedestal (Fig. 7, Pl. 2). In S. alpina, S. officinalis and S. macrantha the hairs are usually 2, sometimes 3-4-celled, arising from a 2, 3, 4 or many-celled pedestal (Fig. 7, Pl. 1, 2).

Fig. 8. DENDROID AND STELLATE HAIRS

(Explanation in the text)

Dendroid (A-D);

Stellate (E)

A - S. inflata;

B - S. aegyptiaca;

C - S. obtusirena; D - S. nivea;

E - S. lavandulifolia

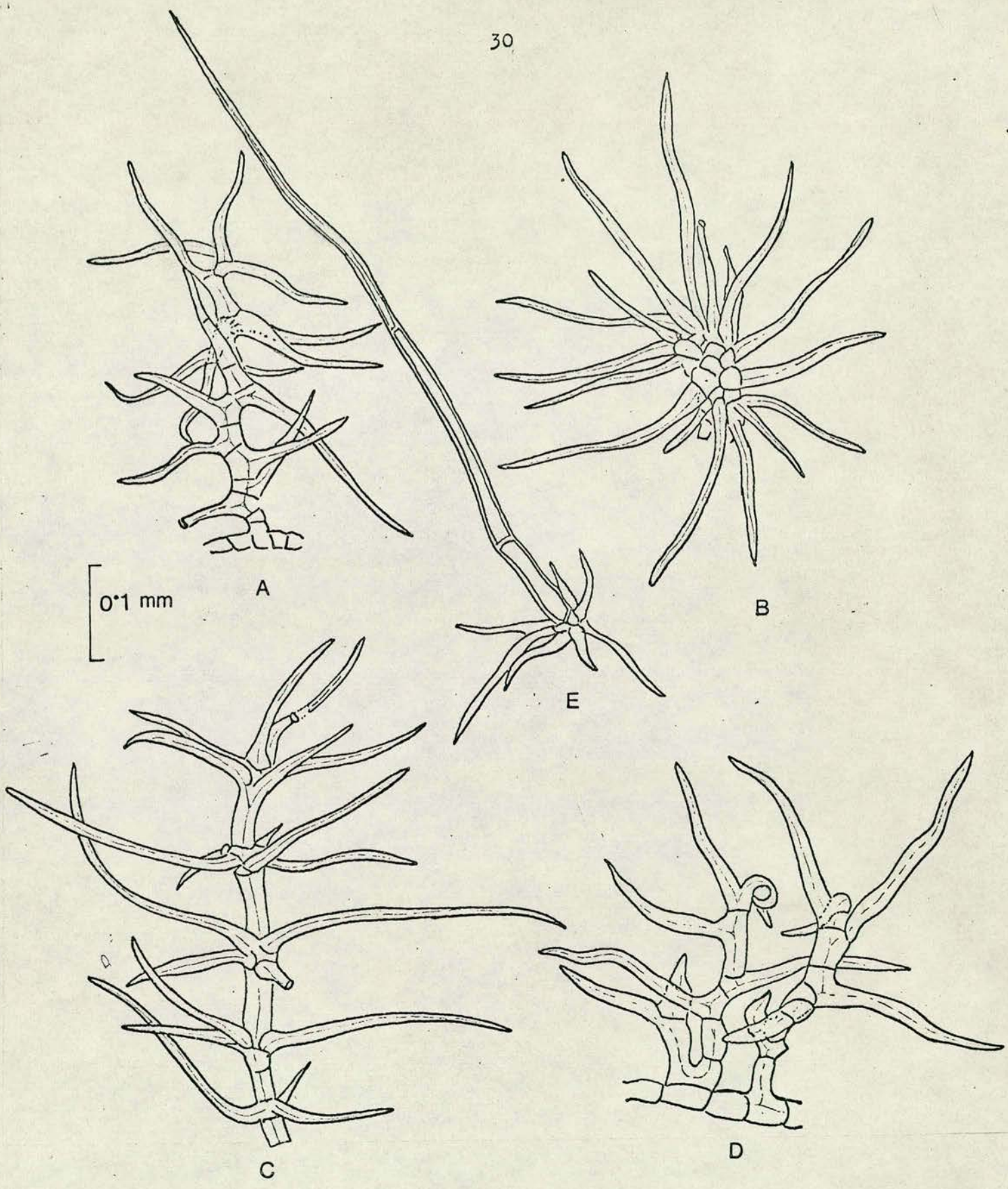


FIG. 8 DENDROID AND STELLATE HAIRS

In S. annua the eglandular leaf hairs are usually 2-celled and bent at the joint, forming a knee-shaped structure, and the wall is impregnated with a characteristic deposit of thickening. (Fig. 7, Pl. 1).

2. Stellate hairs:

These are star shaped hairs with rays projecting from the centre. Two kinds of stellate hairs have been recognised in the genus, viz. a) Porrect-stellate type and b) multiangulate type. In the first type, the hair consists of a central ascending ray and 3-10 horizontal rays arranged in a spoke-like manner surrounding the central ray (Fig. 8 E). The latter is usually 4-10 times larger than the lateral rays, e.g. S. lavandulifolia, though variation in length occur even in the same species, and the terminal ray may be \pm equal to lateral rays, e.g. S. macrostachya. In S. lavandulifolia porrect-stellate hairs are scattered throughout the plant body, mixed with simple uniseriate hairs. But as the central ray is much bigger and the lateral very inconspicuous and small, apparently (without the aid of strong binocular or compound microscope) they look like simple hairs and are confused with the simple hairs mixed with them. Multiangulate hairs have 2 to several rays projecting from the centre at various angles instead of a regular disposition of rays like porrect-stellate type, and there is no ascending central ray. This type is found in the lower leaf epidermis and calyx indumentum of S. betoniciflora (Pl. 2 F) and is very sparsely scattered on the surface. The number of rays is usually 2, 3, or 4 or few.

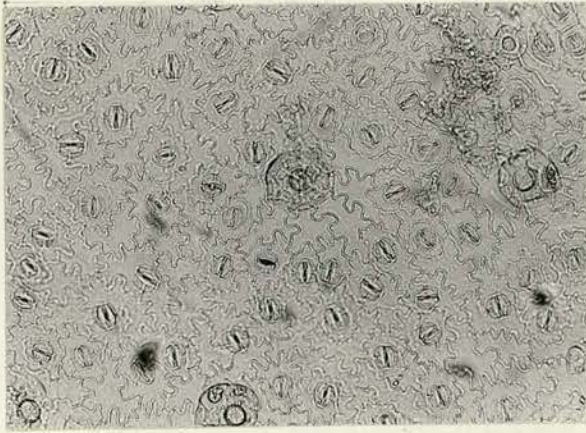
3. Dendroid hairs:

These are tree-like hairs having branches or rays along an elongated stalk. Three different types of dendroid hairs have been found in Stachys, Sect. Ambleia viz. a) dendritic type, b) dendritio-echinoid type and c) candelabra or abietiform type. This section is unique in having these

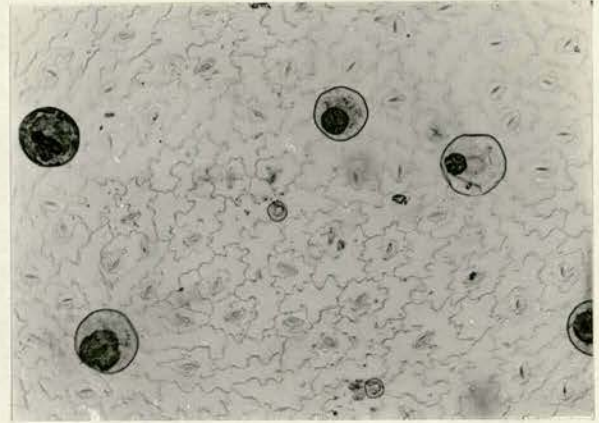
Pl. 2. EPIDERMAL PEELINGS FROM LEAVES AND CALYX

(Explanation in the text)

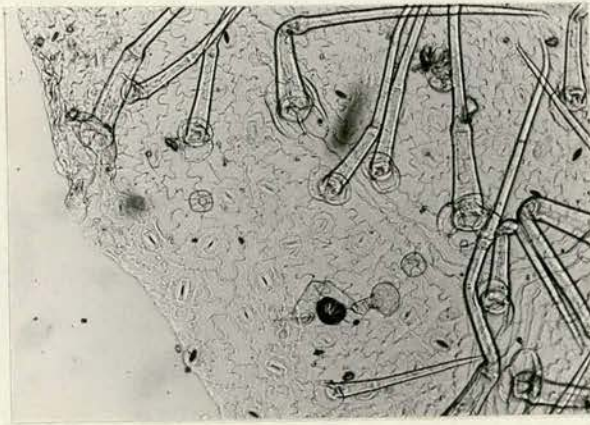
A - Lower epidermis of S. macrantha (x 125); B - Lower epidermis of S. annua (x 125, with stomata, multi-cellular and 4-celled glands); C - Lower epidermis of S. setifera (x 125); D - Lower epidermis of S. acerosa (x 125); E - Upper epidermis of S. trinervis (x 140, with echinoid-dendritic hairs); F - Calyx epidermis of S. betoniciflora (x 140, with stellate hairs).



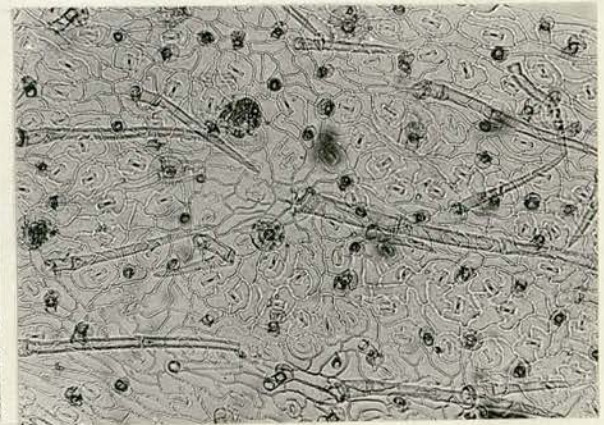
A



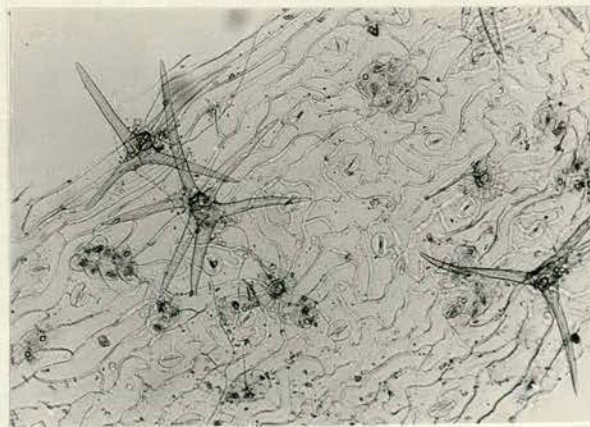
B



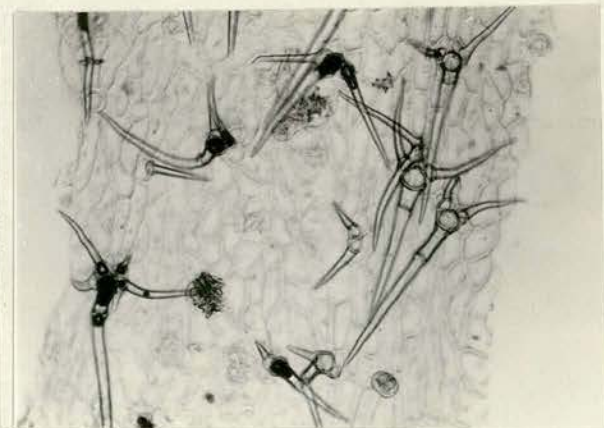
C



D



E



F

hairs usually forming a little felt over the surface of leaves and stems. The dendritic type consists of a uniseriate flexuous main stem with few to several divergent branches or rays distributed at random and with interruption (Fig. 8A-D). This is found in S. inflata, S. tomentosa, S. nivea etc. The dendritic echinoid type has a elongated usually multiseriate or uniseriate central axis with many rays projecting along the stalk without interruption (Fig. 8 B). This is found in S. palestina, S. trinervis, S. aegyptiaca etc. Candelabra or abietiform type has a uniseriate stalk and whorls of rays coming out at regular intervals (Fig. 8 C). This type of hair is found in S. obtusicrena. Of these 3 types the first two types of hairs are more common than the third.

4. Simple, unbranched, glandular hairs:

According to Solereder (1908) these belong to a separate class of hairs from the eglandular types. In Stachys these hairs always consist of uniseriate and multicellular stalks bearing secretory swellings or glands at the tip having 1, 2, 4, 8 or more cells. Like eglandular hairs they always arise from a 1, 2 or many-celled base, and the number of basal cells is the same in species bearing glandular and eglandular hairs. A unicellular gland tip is of rare occurrence and found in S. lavandulifolia. On the other hand a 2, 4 or many-celled gland tip is of frequent occurrence, viz. S. alpina, S. setifera, S. lavandulifolia etc. ^(Fig. 7) and is not of much taxonomic importance.

5. Short stalked or peltate glands:

Solereder (1908), Metcalfe & Chalk (1950) reported this type of trichome in Labiatae. Tunmann (1913, 1914) considered these glands as secreting volatile oils. Usually the glands consist of a very short one celled stalk and 2-4 or ∞ -celled head. The walls are usually anticlinal and the cells are in the same tier, but sometimes periclinal division gives rise to more than one

Pl. 3.

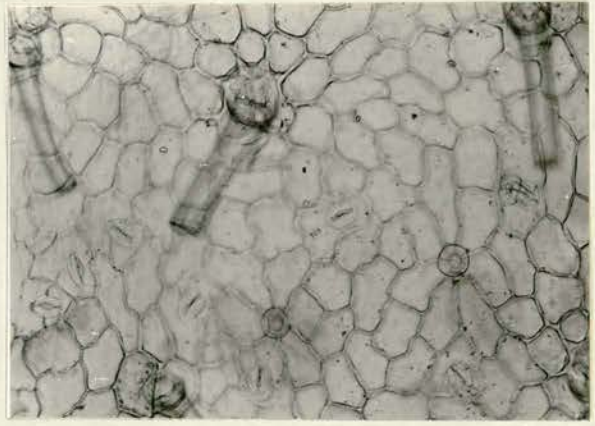
EPIDERMAL PEELING FROM LEAVES

(Explanation in the text)

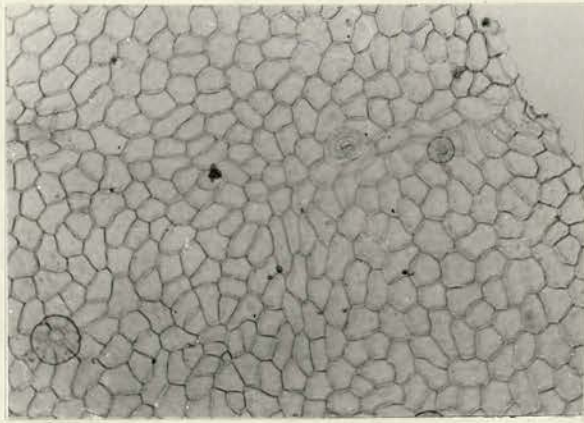
A - Lower epidermis of S. macrantha (x 125; with contiguous stomata, c);
B - Upper epidermis of S. macrantha (x 550); C - Upper epidermis of
S. officinalis (x 125; with one stoma in the whole field); D - Lower
epidermis of S. officinalis (x 550); E - Lower epidermis of
S. alpina (x 616); F - Upper epidermis of S. araxina with contiguous
stomata (x 550).



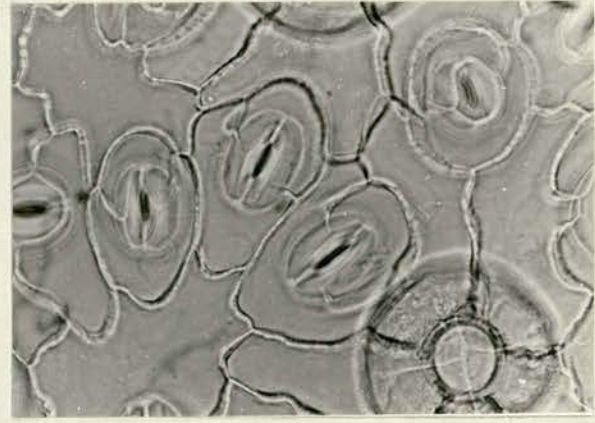
A



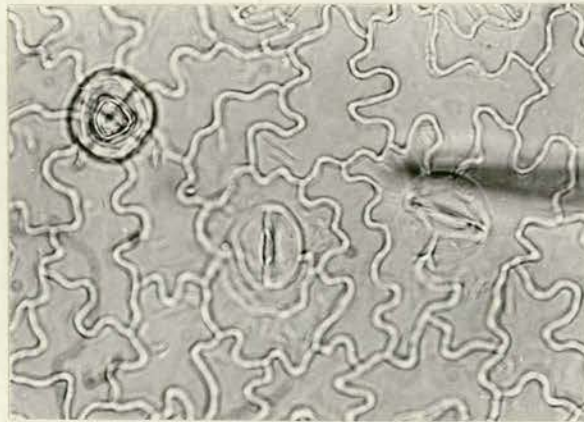
B



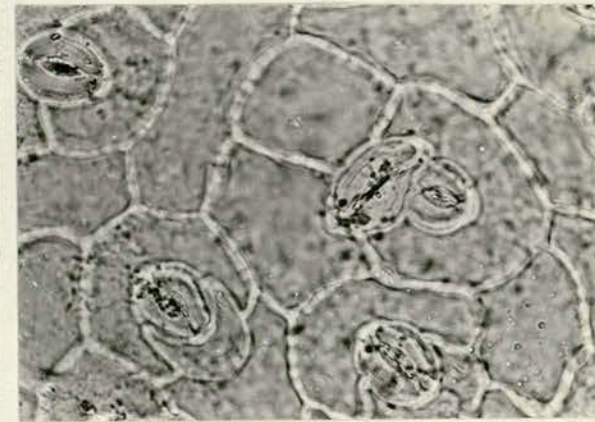
C



D



E



F

tier of cells. A 1-celled gland is found in S. acerosa, S. trinervis, S. inanis etc. (Fig. 7) and 2-4-celled glands are frequent in several species, e.g. S. alpina, S. lavandulifolia, S. officinalis etc. Multicellular glands are present in S. annua, S. trinervis, S. inanis, S. acerosa etc. S. macrantha has 2-3-celled glands on upper epidermis, and multicellular glands are common on lower epidermis. Usually multicellular peltate glands are common on the lower surface of the leaf, while on the upper surface 2-4-celled glands and eglandular hairs are frequent, e.g. in S. annua, S. acerosa, S. trinervis etc.

Distribution of indumentum:

Glandular and eglandular hairs occur almost everywhere in the plant body including corolla and staminal filaments, but ^{are} exceptionally absent in the female reproductive organs such as style, stigma and ovary wall. Inside the corolla tube and at the base of the filaments the hairs are somewhat different. They are thin-walled, 2-4-celled, short and very turgid in appearance (Fig. 15). These are referred to as papillate hairs. On the young anther lobes (before anthesis) of the subgenus Betonica and in some species of Sect. Eriostomum, multicellular sessile glands are present. In some glabrescent species like S. menthoides, S. inanis, S. angustifolia etc. 4- ∞ -celled glands are frequent on the epidermis of leaves and eglandular hairs are rare and only exceptionally present. Presence or absence of glandular hairs or sessile glands from the calyx teeth and stem has considerable significance in delimiting infra- and supraspecific taxa. Sect. Eriostomum subsect. Spectabiles and S. germanica ssp. germanica are characterised by the absence of glandular hairs from their calyx teeth and stem whereas in S. germanica ssp. bithynica and ssp. tymphaea glandular hairs are constant in these organs. S. cretica subsp. myrnaea and subsp. anatolica are distinguished from the subspecies salvifolia, cretica and mersinaea in having

glandular hairs on their calyx teeth. On the other hand, S. viscosa and S. megalodonta of Sect. Fragilicaulis are distinguished from their related species S. laetivirens and S. ballotiformis by having sessile glands on their calyx teeth and stem surface.

In conclusion, it can be said that the genus varies considerably in structure, appearance, density, distribution and orientation of glandular and eglandular hair types which are of considerable taxonomic significance in the grouping of species, though in the glandular type of hairs the number of cells in the gland is not of much significance; the density of glandular hairs varies considerably within the species.

Verticillasters: Basically the verticillaster in Stachys is composed of two congested dichotomous cymes in the axils of opposite leaves, forming a whorl. By the word 'compressed' it means that the peduncle is usually suppressed, leaving only the pedicels of individual flowers. Verticillasters in this genus shows much variation in the number of flowers and bracts. The presence of a pedicel is constant in the Subgenus Stachys, where its length varies from 1-6-(14) mm. The extremes of pedicel length are represented by S. mucronata and S. balansae with pedicels about 10-14 mm, and S. bombycina and S. aleurites with c. 0.8-1.5 mm. In Subgenus Betonica on the other hand, the pedicels are completely suppressed and attached to the axil of the leaf by a broad and hardened base. In some members of Sect. Eriostomum (S. viticina, S. cretica subsp. garana, subsp. mersinaea etc.) and Sect. Fragilicaulis (S. laetivirens and S. ballotiformis) the peduncles of the verticillasters are not completely suppressed and show a tendency to dichotomous branching. Regarding the number of flowers per verticillaster, considerable variation occurs in delimiting species and higher groups. Sections Eriostomum, Betonica and Macrostachya are usually characterised by many-flowered verticillasters

Fig. 9.

TYPES OF INFLORESCENCES

(Explanation in the text)

A - S. alpina;

B - S. officinalis;

C - S. recta;

D - S. spinosa;

E - S. araxina;

F - S. diversifolia (Diagrammatic)

(a - Flowering shoot; b - sterile bud; c - Flower; d - Bract)

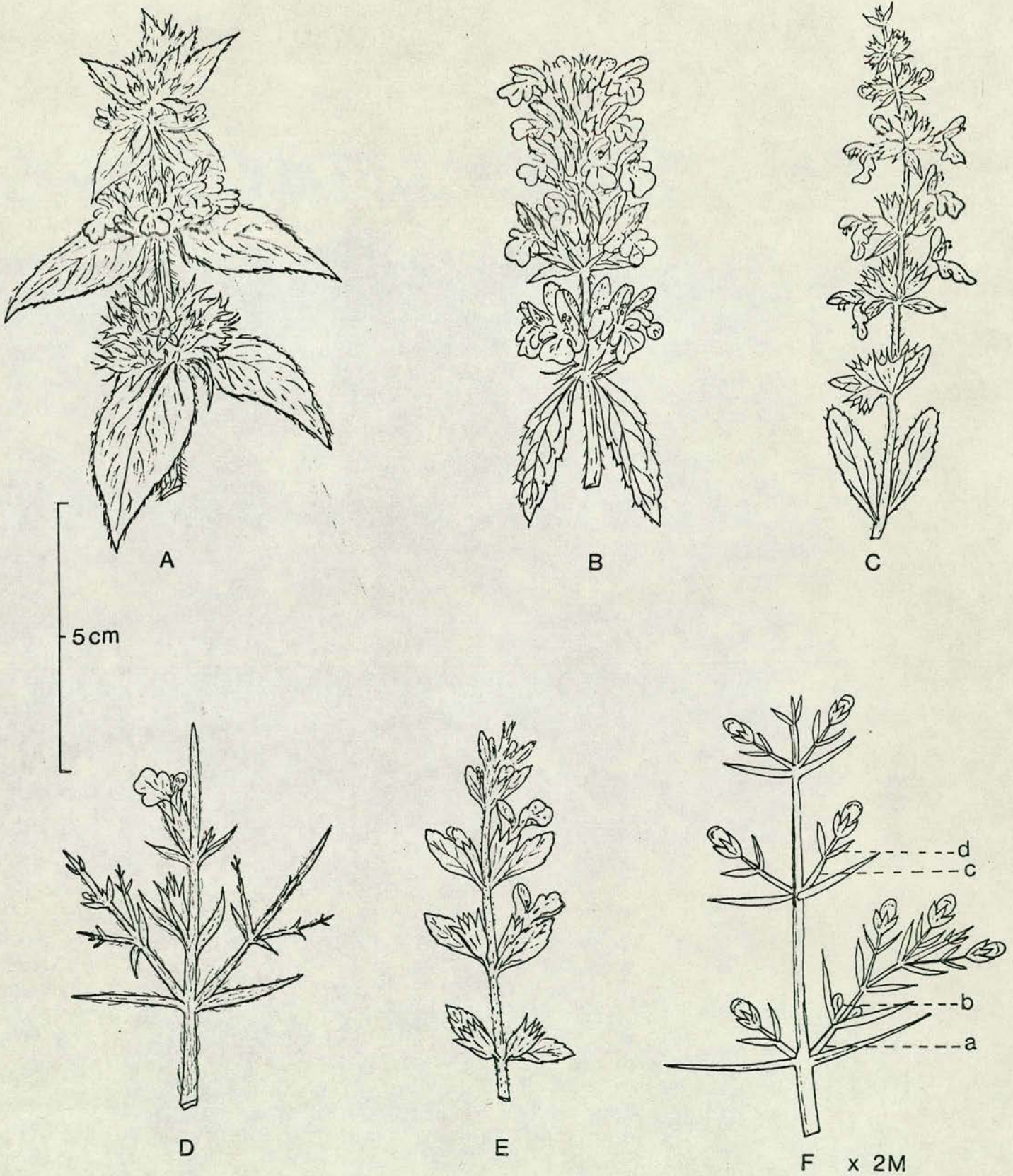


FIG. 9

INFLORESCENCE TYPES

(Fig. 9A & B) though there are certain exceptions, viz. S. libanotica, S. sericantha and S. longispicata have 4-6-flowered verticillasters, while in S. macrantha and S. serbica the number is 8-10. On the other hand, in Sections Thamnostachys and Mucronata and in the species S. angustifolia and S. inanis etc. the verticillasters are 2-flowered (Fig. 9E), while in the species like S. spinosa, S. glutinosa, S. diversifolia, S. acerosa etc. (Fig. 9 D & F) the verticillasters usually become 1-flowered as one side of the verticil is either completely absorbed or transformed into flowering or vegetative axis. The rest of the sections are characterised by 6-8-(10)-flowered verticillasters though in some sections a tendency to both increase or decrease in number has been noticed, particularly in Sections Olisia, Fragilicaulis and Infrarosularis. Sect. Olisia Subsect Distantes has about 12-14-flowered verticillasters, while Subsections Annuae and Rectae are 6-8-flowered (Fig. 9 C), and in Spinosa and Rosulatae 1-2 or 4-flowered. Sect. Fragilicaulis Subsect. Fragiles has 4-6-flowered verticillasters with reduction to 2 in S. longiflora. On the other hand, Subsect. Multibracteatae has ∞ flowered verticillasters in S. laetivirens (12-14) and extreme reduction has been seen in S. asterocalyx where the number is 2-4. In Sect. Infrarosularis, S. rupestris and S. citrina have 8-10 flowered verticillasters while S. amica and S. petrokosmos are only 2-4-flowered.

Bracts: Number, size, shape, texture and indumentum of bracts and their correlation provide useful taxonomic characters. In subgenus Stachys, Sect. Eriostomum, Sect. Infrarosularis, S. decumbens, S. fragillima, S. glechomifolia etc. and in Subgenus Betonica bracts are usually numerous, large, herbaceous and leafy in nature. In S. officinalis, S. macrantha etc. (Fig. 11 B) of Subgenus Betonica, the outer bracts are more or less hard and scarious near the margin. Usually in subgenus Betonica the bracts are attached to the axil of

the leaves with a broad and hardened base, while in the rest of Stachys they are always narrowed and softer towards the base. Often there is a good correlation between the number of flowers per verticillaster, number of bracts and relative length of bracts in respect of calyx and texture of bracts, i.e., when the verticillasters are many-flowered, the bracts are also numerous, the outer ones as long as the calyces and the bracts are herbaceous in texture, e.g. Sections Eriostomum, Betonica, Macrostachya etc. (Fig. 11A, B, C). On the other hand, in few-flowered verticillasters, bracts are small ($\frac{1}{3}$ - $\frac{1}{2}$ as long as calyx), and setaceous (Fig. 10 I, J, L & 11 F). Exceptions occur in Sections Mucronata, Roseostachys etc. where the verticillasters are 2-4-flowered but the bracts are as long as the calyx and herbaceous though few in number (Fig. 10 K, 11 H). In S. libanotica and S. sericantha of Sect. Eriostomum the bracts are always leafy and spinescent. Annual Sections Satureioides and Neurocalyx are characterised by ebracteate verticillasters.

Calyx: Diversity in shape, size and obliqueness of tube and teeth, and their relative proportion, texture, nervature and indumentum are found to be useful taxonomic characters. Though the genus is characterised by its sub-bilabiate calyx, i.e. the upper teeth slightly unequal to two lower, in S. pseudosideritis, S. neurocalycina, S. anisochila and S. mentifolia the calyx is strongly bilabiate with distinctly unequal upper and lower teeth (Fig. 12 G); their measurements are taken as shown in the Figure. At the other extreme in Sect. Satureioides, Sect. Mucronata and Sect. Roseostachys the calyx is almost regular (Fig. 12 E, 10 K & 11 H) and radially symmetrical. Obliqueness of the calyx tube, in respect of the vertical axis passing through the centre of the tube is pronounced in S. cretica ssp cassia (Fig. 12 C) whereas in S. germanica, S. iberica etc. it is less pronounced and the calyx is suboblique.

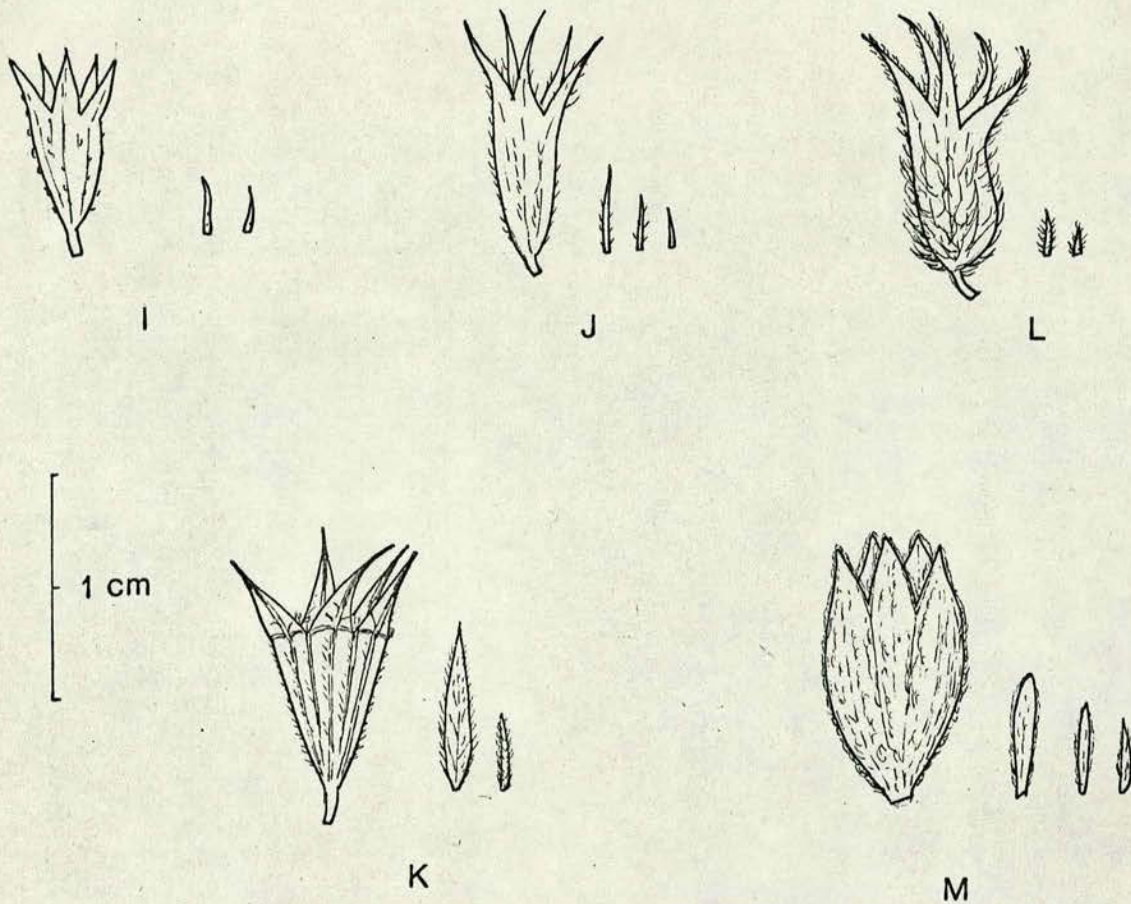


FIG. 10

BRACTS & CALYCES

Fig. 10-11 BRACT TYPES IN RELATION TO CALYCES

(Explanation in the text)

- | | |
|-----------------------------|-------------------------------|
| A - <u>S. aleurites</u> ; | B - <u>S. macrantha</u> ; |
| C - <u>S. libanotica</u> ; | D - <u>S. betoniciflora</u> ; |
| E - <u>S. pumila</u> ; | F - <u>S. atherocalyx</u> ; |
| G - <u>S. balansae</u> ; | H - <u>S. rosea</u> ; |
| I - <u>S. grossheimii</u> ; | J - <u>S. iberica</u> ; |
| K - <u>S. mucronata</u> ; | L - <u>S. annua</u> . |
| M - <u>S. inflata</u> | |

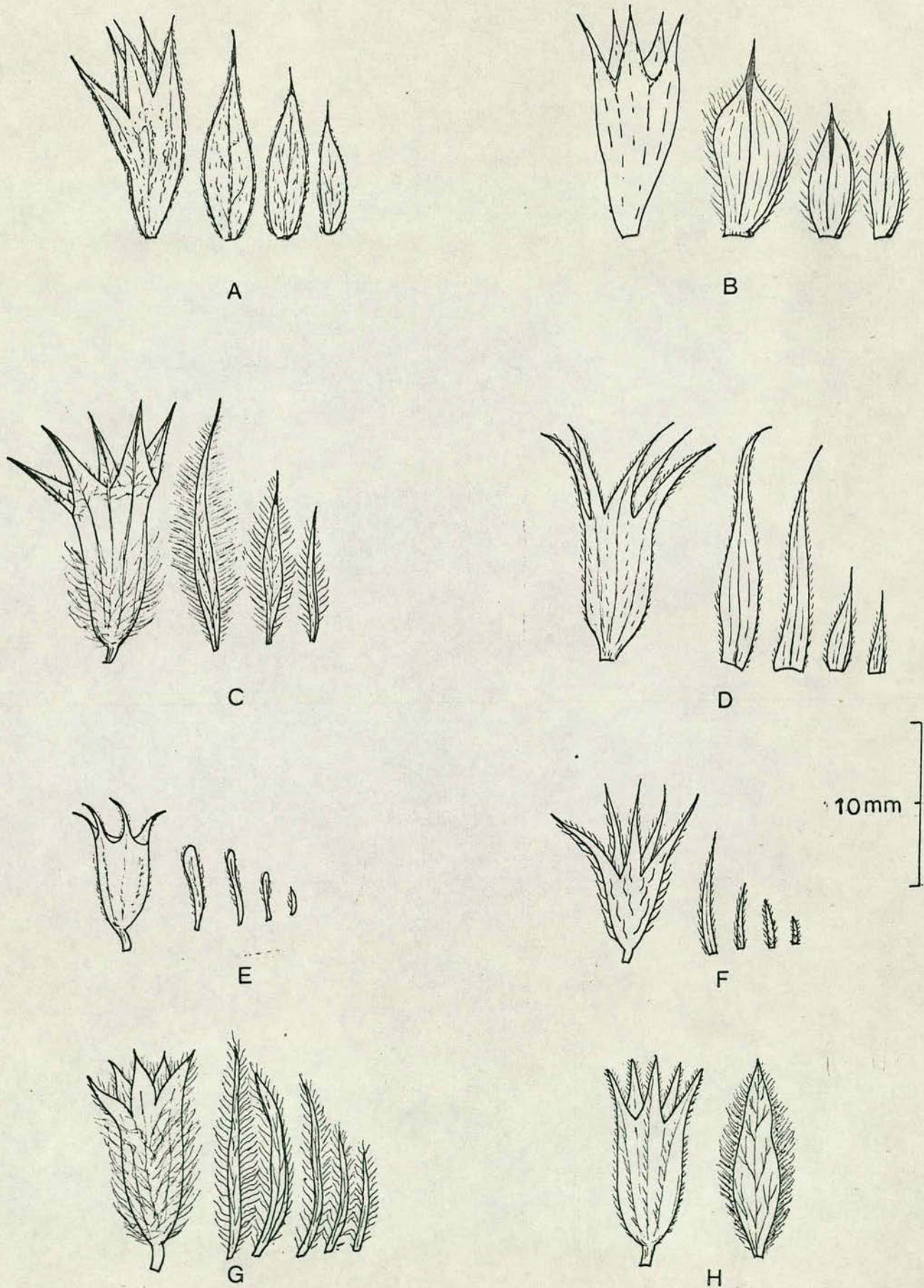


FIG.11 BRACT TYPES IN RELATION TO CALYCES

Shape: Usually calyces are subcampanulate in Stachys but tubular forms are rarely found, e.g. S. rosea (Fig. 11 H), S. araxina etc. A widely campanulate calyx is present in S. spinulosa, S. mucronata (Fig. 10 K), S. sericantha and a few other species. S. inflata has a very much inflated calyx with short and erect teeth, so that it appears almost globose, while in Sect. Satureioides the calyx tube is constricted at the middle when mature and thus attains an urceolate shape.

In Sections Sideritopsis, Neurocalyx, Corsica and in S. kurdica var. kurdica, S. arvensis, the calyx teeth are broadly oblong with abruptly mucronate tip (Fig. 12 D, G), while in S. alpina (Fig. 12 I) S. cretica ssp. anatolica, ssp. smyrnaea and ssp. trapezuntica the calyx teeth are ovate rounded and thereby of useful taxonomic significance. In subgenus Betonica (except S. alopecuroides and S. serbica) the calyx teeth are triangular subulate with abruptly tapering ends (Fig. 11 B, 12 F). In rare instances the shape of the calyx teeth shows variability within the same species, e.g. in S. rupestris the teeth may be oblong, triangular-lanceolate or triangular subulate.

Calyx teeth/tube ratio provides another important taxonomic character. S. lavandulifolia (Fig. 12 K) has its calyx teeth usually 3-4 times longer than the tube and rarely in var. brachyodon they are 1.5-2 times longer. In S. cretica ssp. cassia, S. germanica ssp. lusitanica, S. aucheri, S. tomentosa etc., the teeth are as long as the tube, while in S. longiflora, S. inflata, S. euadenia, S. kurdica var. brevidentis they are $\frac{1}{5}$ to $\frac{1}{3}$ the length of the tube.

Calyx teeth usually terminate in a short or long mucro in most of the species in the genus, but in Sect. Fragilicaulis the tips are soft and herbaceous or with very soft spinulescent tip only except in S. viscosa which has a rigid mucronate tip. Herbaceous calyx tips also occur in S. rosea, S. decumbens and S. lavandulifolia (Fig. 11 H, 12 K).

Fig. 12. CALYX-TYPES (WHOLE & SPLIT-OPEN)

(Explanation in the text: upper lip on left hand side)

- | | | |
|---------------------------------|------------------------------|--------------------------|
| A - <u>S. ocymastrum</u> ; | B - <u>S. spectabilis</u> ; | C - <u>S. cassia</u> ; |
| D - <u>S. arvensis</u> ; | E - <u>S. satureioides</u> ; | F - <u>S. scardica</u> ; |
| G - <u>S. pseudosideritis</u> ; | H - <u>S. serbica</u> ; | I - <u>S. alpina</u> ; |
| J - <u>S. longiflora</u> ; | K - <u>S. lavandulifolia</u> | |

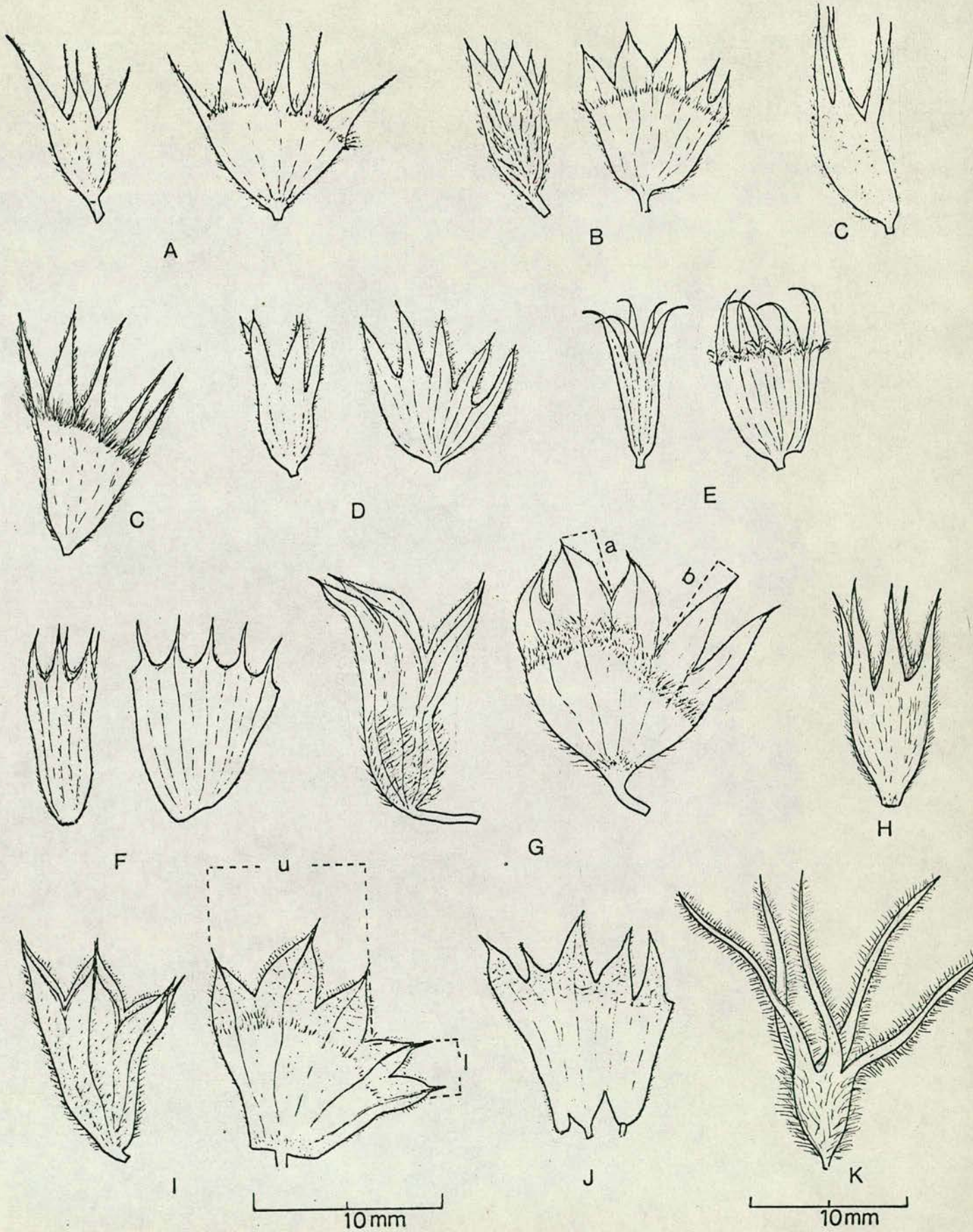


FIG. 12 CALYX TYPES (WHOLE & SPLIT-OPEN)

Calyx teeth may remain erect, recurved or patently spreading. S. satureioides and S. ramosissima has very widely recurved calyx teeth, appearing almost convex (Fig. 12 E). S. alpina, S. pinetorum, S. libanotica have the teeth widely recurved at maturity, while in S. scardica, S. grossheimii, S. rosea etc. the teeth are more or less erect (Fig. 10 I, 11 H & 12 F, H). In S. annua (Fig. 10 L) the upper teeth are curved outwards and the inner inwards (towards the centre of the tube), giving the calyx a very characteristic appearance.

Texture and nervation of calyx teeth are also very useful. Usually the calyx teeth are stiff, each supported by a strong vein, but in S. lavandulifolia, S. kurdica, S. fragillima etc. they are manifestly herbaceous and soft. The nerves are usually concealed under the thick indumentum, e.g. S. cretica, S. germanica, S. byzantina etc., but in S. libanotica, S. sericantha, S. mucronata, S. neurocalycina the nerves are very prominent on the whole calyx, whereas in S. alpina, S. pinetorum, S. cretica ssp. garana they are prominent on the calyx teeth.

Apart from the general density of the indumentum on ^{the} calyx (similar to the species density), the distribution of hairs on the calyx mouth and margin of the calyx teeth afford good taxonomic characters. With a few exceptions, the whole Section Eriostomum and Sections Sideritopsis, Campanistrum, Mucronata and Satureioides have a dense ring of hairs at the calyx mouth, blocking the opening of the fruiting calyx completely. At the other extreme, Sections Neurocalyx, Fragilicaulis, Swainsoniana, Roseostachys and Betonica have either a sparsely developed ring of hairs at their mouth or a completely naked calyx mouth. Regarding the insertion of hairs on the calyx teeth margin, usually the hairs are adpressed-tomentose, but in Sections Zietenia, Sideritopsis, Campanistrum and S. fragillima, S. glechomifolia etc. they are patently pilose (Fig. 12 D, G & K). In very few species, like S. glutinosa, S. angustifolia, S. officinalis etc.,

the calyx teeth margin remains almost glabrous. Presence of sessile and sessile glands on calyx is a very important characteristic feature of S. megalodonta, S. viscosa etc.

Corolla: Variation of corolla structure provide useful taxonomic characters. For convenience it is considered under two headings: a) tube, b) lips.

Tube: Length of the tube varies considerably in the genus. Usually the tube is subexserted from the mouth of the calyx tube. Complete inclusion within the calyx tube is of much rarer occurrence, e.g. in S. rosea, while in Sect. Eriostomum and Sect. Mucronata the corolla tube is subincluded. Sometimes the calyx teeth, being very long and erect, and the corolla much smaller, include the whole corolla (tube and lips) inside the calyx. Apparently the corolla seems completely included, but according to my definition of exsertion (cf. Ch. III A), the corolla tube is subexserted from the calyx tube itself.

Examples are S. arvensis, S. pseudosideritis and S. lavandulifolia. Long-exserted corolla tubes are a characteristic feature in most of the subgenus Betonica and some species of Sect. Fragilicaulis such as S. longiflora, S. euadenia, S. fragillima etc., in which the corolla tube is almost 3-5 times longer than the calyx. In S. sylvatica, S. palustris, S. arvensis and S. annua, the corolla tube is saccate near the base of the anterior side (Fig. 13 a-c). Presence of an annulus, i.e. a ring of hairs inside the corolla tube, is a characteristic of subgenus Stachys, except for S. longiflora and S. pinardii, whereas in subgenus Betonica it is usually absent (excepting S. alopecuros). The annulus probably serves the purpose of protecting nectar from rain and/or unbidden insect visitors. Absence of an annulus is often correlated with a long corolla tube, as found in the examples cited above. These hinder the visit of short tongued insects and thus may be adapted for specialised pollinators. The speculation is not always applicable as a well formed annulus is

Fig. 13. FLOWER AND COROLLA TYPES

(Explanation in the text)

- A, a - S. sylvatica; B, b - S. setifera;
C, c - S. arvensis; D, d - S. satureioides;
E, e - S. officinalis; F, f - S. rosea.

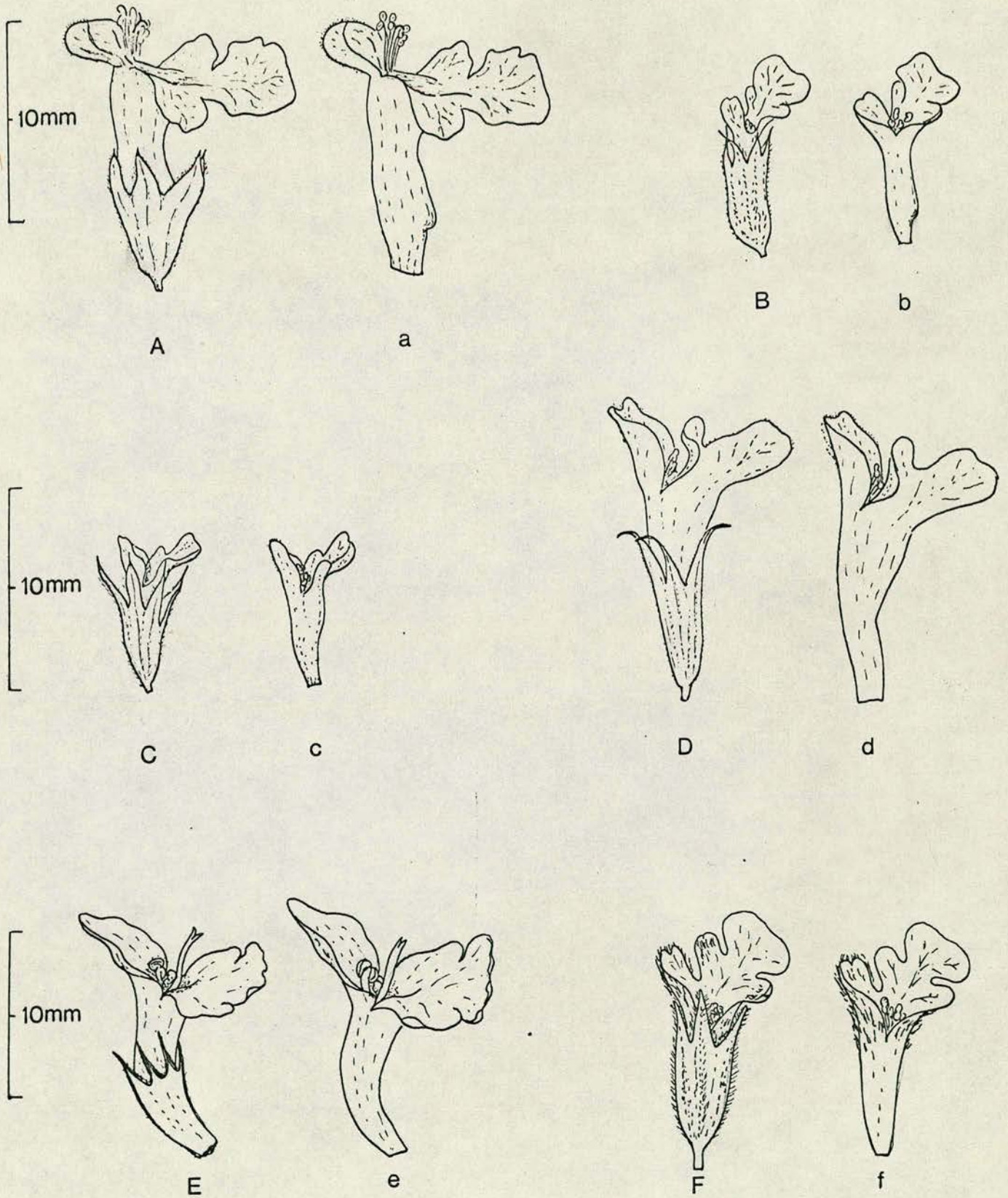


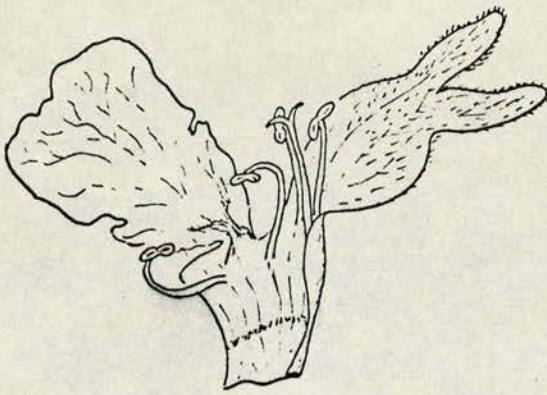
FIG. 13

FLOWER & COROLLA TYPES

Fig. 14. TYPES OF COROLLA (SPLIT-OPEN))

(Explanation in the text: upper lip on right-hand side)

- | | | |
|------------------------------|------------------------------|----------------------------|
| A - <u>S. ocymastrum</u> ; | B - <u>S. diversifolia</u> ; | C - <u>S. arvensis</u> ; |
| D - <u>S. sylvatica</u> ; | E - <u>S. setifera</u> ; | F - <u>S. longiflora</u> ; |
| G - <u>S. longispicata</u> ; | H - <u>S. serbica</u> ; | I - <u>S. fontqueri</u> |



A



B



C

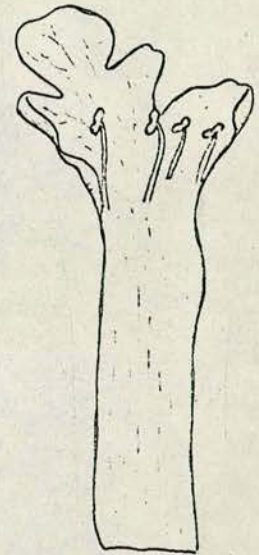


D

10mm



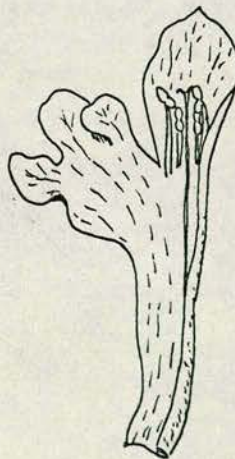
E



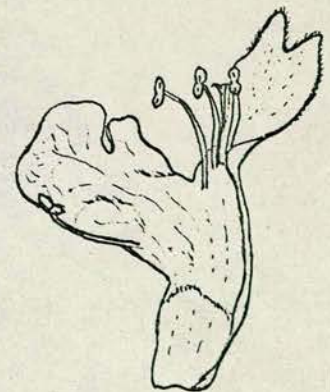
F



G



H



I

FIG. 14

COROLLA TYPES (SPLIT-OPEN)

found in S. fragillima, a species with a long corolla tube.

Lips: The upper corolla lip is usually smaller than the lower lip (Fig. 13) but in S. ocymastrum, S. brachyolada, S. durioei the upper lip is usually larger and conspicuous (Fig. 14 A). The shape of the upper lip varies considerably. It is usually entire, retuse, and emarginate, but rarely deeply bifid. The last type is found in species like S. fontqueri, S. ocymastrum, S. acutifolia etc. (Fig. 14 A, I). In the related species S. fruticulosa, S. araxina and S. sosnowskyi the upper lip is narrowed considerably towards the apex.

The angle of divergence between upper and lower corolla lip is also worth mentioning. In most cases the lower lip is orientated at an angle less than 90° , but in Sects. Stachys, Swainsoniana, Candida, Olisia subsect. Rectae the angular divergence is either at right angles or sometimes more than that (Fig. 13 A, I).

Indumentum on the upper corolla lip is of some taxonomic significance. Sect. Eriostomum is usually characterised by the presence of large and dense sericeous hairs on the upper surface of the upper corolla lip which exceeds the margin considerably. Though in other sections like Infrarosularis, Ambleia, Zietenia etc. hairs are present on the upper surface of the upper lip, they are not densely sericeous and never exceed the margin like the former.

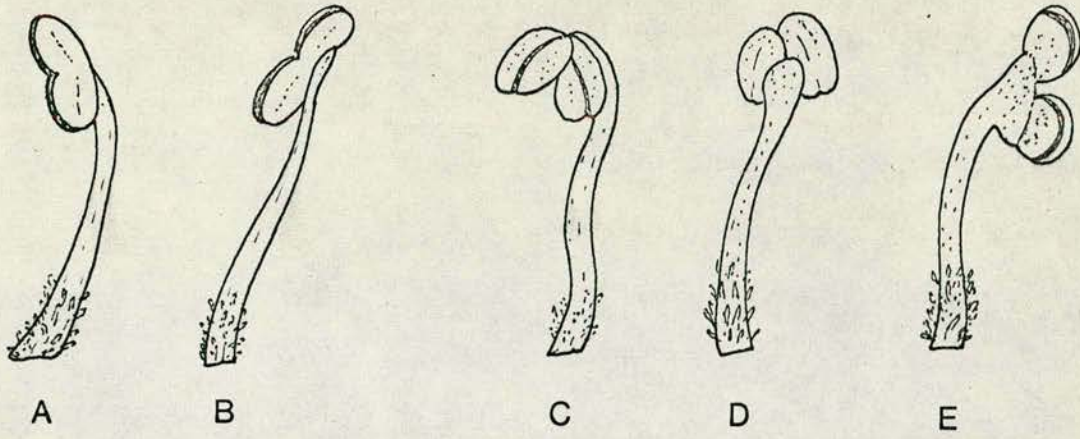
Androecium: The most significant feature in the nature of stamens, that the anterior pair is larger than the posterior pair (used as a tribal character by Briquet, 1896) is not found to be very satisfactory as a tribal character because it breaks down in few species, viz. S. sylvatica, S. palustris and some New World species. But in the course of my study, I came across another character found to be quite satisfactory in delimiting the genus. It is the relative position of attachment of outer and inner pair of stamens inside the corolla tube. The anterior or the outer pair is always found to be attached within the

Fig. 15.

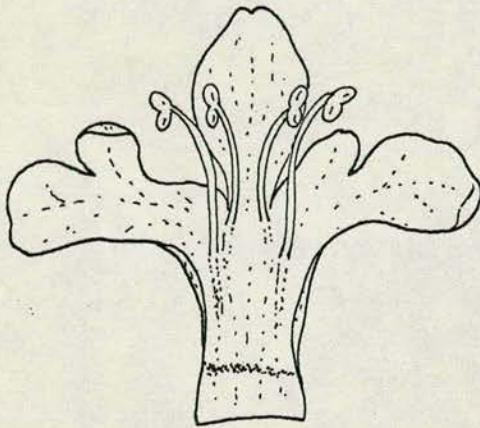
ANDROECIUM AND GYNAECIUM

(Explanation in the text)

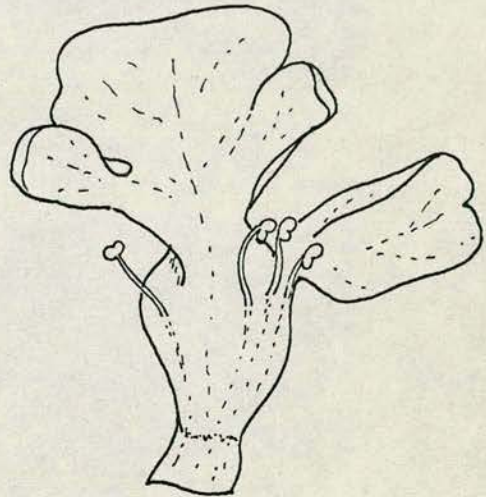
- A - B - Stamens of S. iberica (showing divaricate anther lobes);
C - D - Stamens of S. macrostachya (showing subparallel anther cells
in front and back views respectively); E - Stamen of S. macrantha
(anther cells separate from each other); F - S. recta (corolla split-
open showing different position of insertion of anterior and posterior
pair of stamens); G - S. burgsdorffioides (stamens just exerted from
the corolla tube); H - 4-lobed nectary in S. macrostachya;
K - Gynaecium in S. officinalis (anterior lobe of nectary more prominent);
M - Ovary with 4-nutlets in S. arvensis.
(a - anterior stamen; p - posterior stamen).



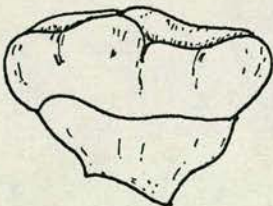
3 mm



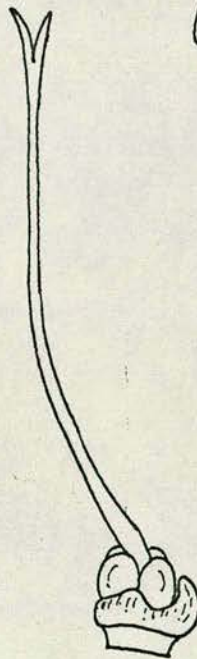
F x 4



G x 5



H x 25



K x 12



M x 12

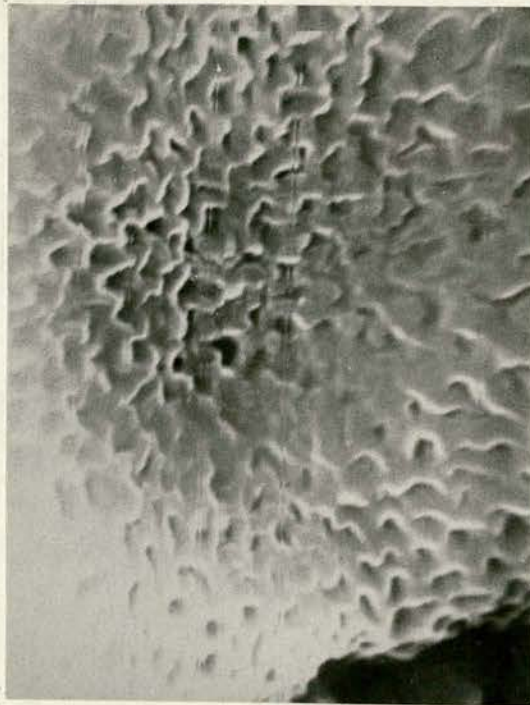
FIG. 15

Androecium & Gynaecium

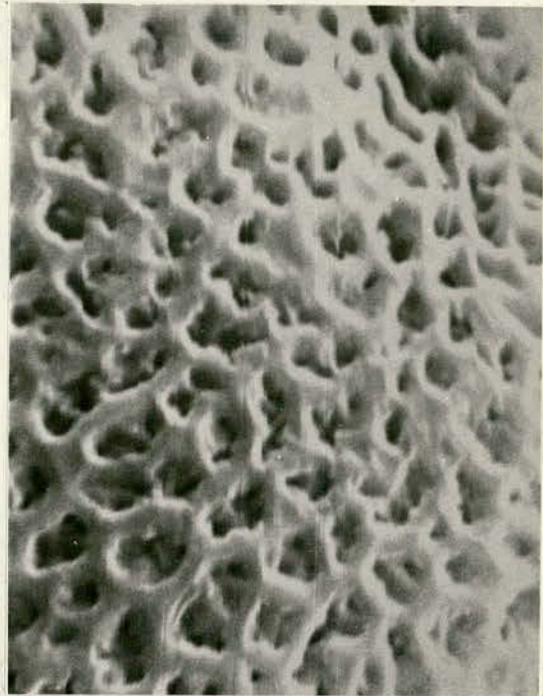
corolla tube at a lower level in comparison to the posterior or inner pair. Thus if we compare the total length of anterior and posterior pair of stamens, the anterior is always longer than the posterior pair, though they may apparently attain the same level when exerted, e.g. S. sylvatica (Fig. 14 D). This character is so uniform throughout the genus Stachys that the separation of the genus Phlomidoschema for S. parviflora seems justified to me, as it is correlated with other features of taxonomic importance (cf. Ch. IV). Besides that, the relative length of exerted stamens in relation to the upper corolla lip is another feature of taxonomic value. The stamens are either slightly exerted from the tube, i.e. less than half way along the length of the upper corolla lip (Fig. 14 B, 15 G), or the exertion may exceed half way (Fig. 14 D, 15 F). On this and other correlated characters S. iberica can be separated from its closest relative S. recta and Sect. Stachys from Sect. Setifolia (Fig. 14 D, & E).

The anther loculi in Stachys, except in a few species in the Sect Ambleia and subgenus Betonica, are always divaricate (Fig. 15 A & B), while in the latter they are subparallel to parallel (Fig. 15 C, D, E).

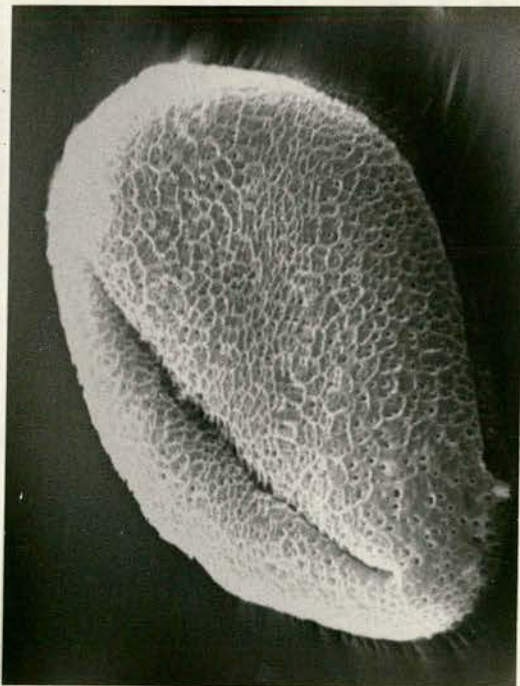
Pollen grains: Labiatae is a stenopalynous family and exhibits slight variation in pollen morphology. Fritzsche (1832) reported tri-(or tetra-) and hexacolpate grains in the whole family, which was confirmed by later workers (Erdtman, 1972). Engler & Diels (1936) pointed out that at the time of shedding, pollen grains are binucleate in some plants and trinucleate in the others. Risch (1940) for the first time proposed a tentative rearrangement of subfamilies and tribes of the Labiatae on pollen morphology. Erdtman (1972) pointed out marked homogeneity in pollen morphology of subfamilies Ajugoideae and Scutellararioideae, while considering Stachydoideae as more or less heterogeneous. There is a marked correlation with the number of nuclei in pollen grains at shedding time with the number of colpi, i.e. when two nucleate they are tricolpate, and when 3 nucleate hexacolpate. I have examined 31 species



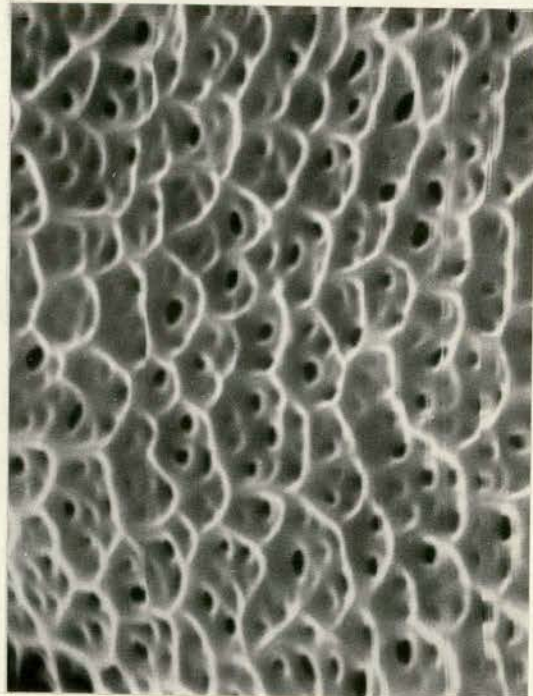
A



B



C



D

Pl. 4. SCANNING ELECTRON MICROGRAPHS OF POLLEN GRAINS

(Explanation in the text)

A - S. germanica (x 49500); B - S. ballotiformis; C - D - S. macrostachya
(x 9900 & x 49500).



belonging to 18 Sections of Stachys with a scanning electron microscope (cf. Appendix A). As to the shape of pollen grains, the examined species are very homogeneous. According to Erdtman (1972) the grains are oblate-prolate. They are tricolpate and the range of dimension varies from 32-41 x 4.6-4.8 μ s it has been seen by me in over 50 species belonging to different sections. The exine pattern is reticulate and does not show much variation (Pl. 5). Muri are relatively narrow in comparison to lumina, but S. germanica has very narrow lumina and broad muri all over the grain, (Pl. 5 A). In S. ballotiformis and S. fragillima (Pl. 5 B, C) the lumina and muri are both wide. At first sight it does not seem likely that pollen morphology will be of much help in the classification of Stachys, but wide sampling is needed before its taxonomic value can be properly assessed.

Gynoecium: The gynoecium consists of 3 main parts, ovary, style and stigma. Style and stigmatic lobes do not show any variation of taxonomic importance. The stigmatic lobes are subequal in size and terete; usually the anterior arm is slightly larger but exceptions occur frequently and are not of any taxonomic significance.

Nectary: The young ovary is surrounded by a fleshy and annular nectar-secreting disc which is very weakly differentiated into 4 lobes alternating with the lobes of the ovary. Usually the anterior lobe is more prominent than the posterior, but it is more pronounced in Subgenus Batonica, particularly S. officinalis and S. macrostachya (Fig. 15).

Nutlets: Mature nutlets provide useful taxonomic characters in delimiting the infrageneric groups and species. Previously its importance has been demonstrated for identification of genera and species in the Labiatae by several investigators like Bilimovitsch (1935) and Wojciechowska (1958, 1961, 1966). Hedge (1968, 1970) found the macroscopic and microscopic characters of nutlets

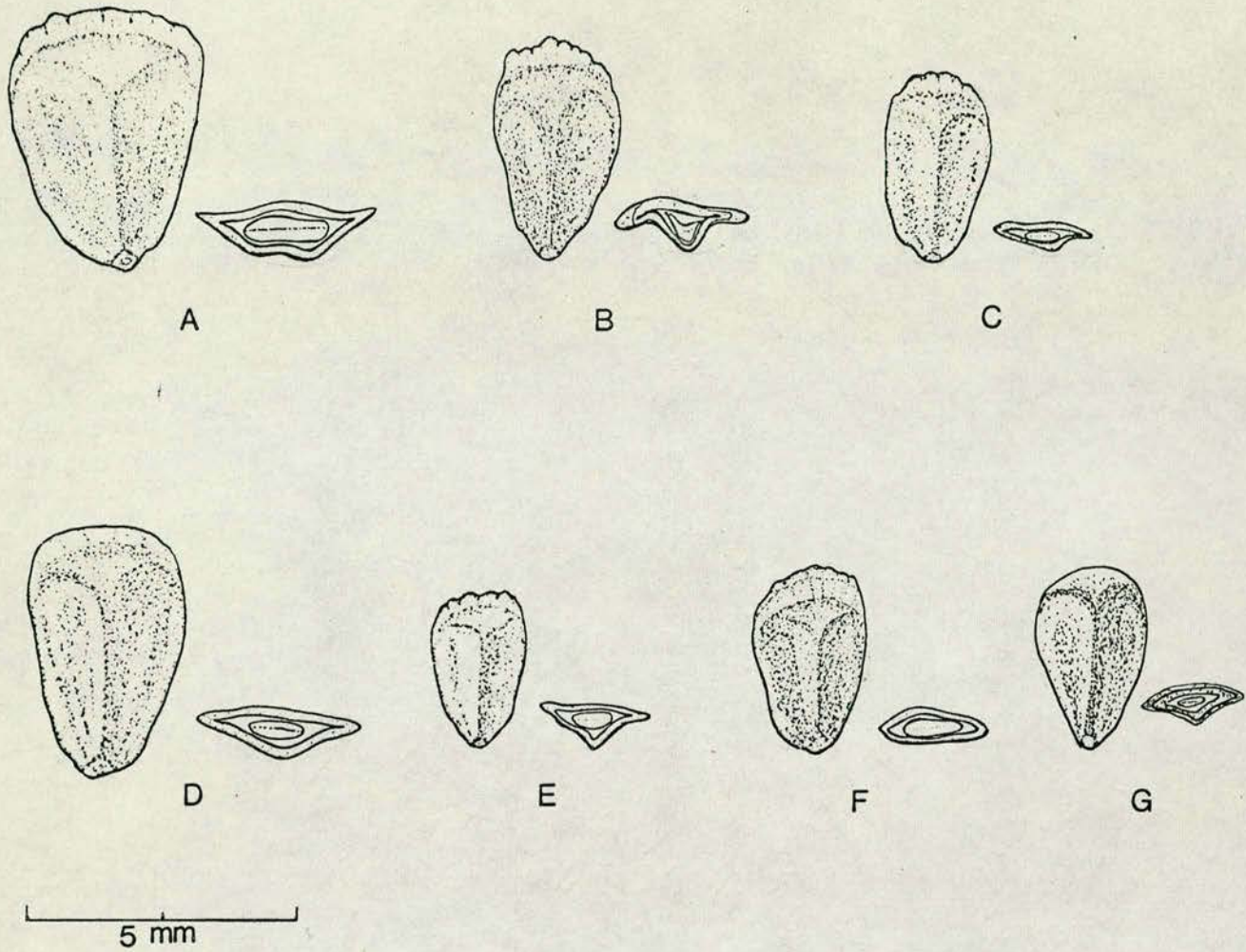


FIG. 16 NUTLET TYPES IN SUBGENUS BETONICA
(ENTIRE & T.S.)

- | | |
|------------------------------|---------------------------|
| A. <u>S. macrantha</u> ; | B. <u>S. monieri</u> ; |
| C. <u>S. betoniciflora</u> ; | D. <u>S. discolor</u> ; |
| E. <u>S. officinalis</u> ; | F. <u>S. alopecuros</u> ; |
| G. <u>S. serbica</u> | |

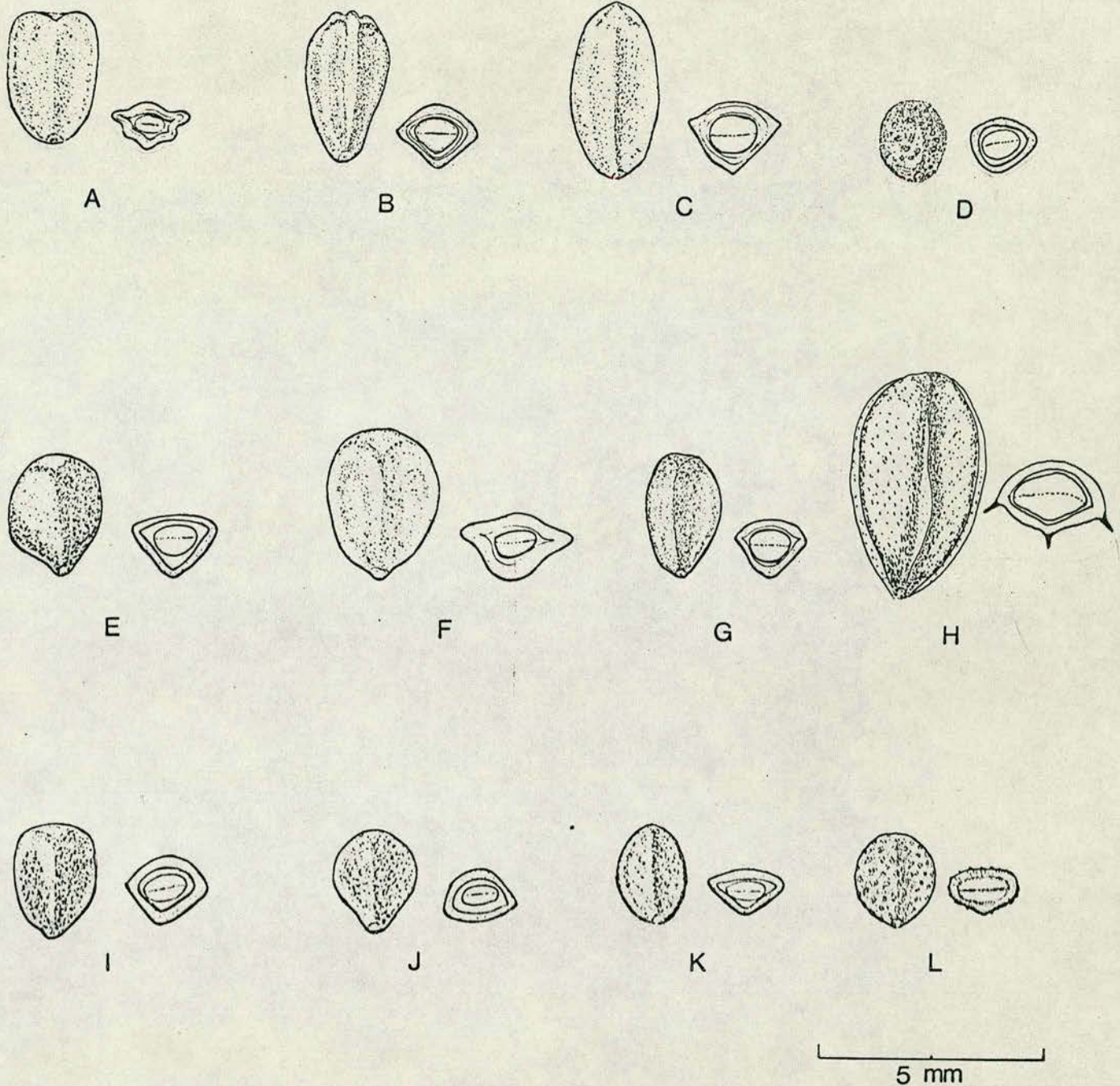


FIG.17 NUTLET TYPES IN SUBGENUS STACHYS (ENTIRE & T.S.)

- | | | |
|---------------------------------------|-------------------------------------|--------------------------------------|
| A. <u><i>S. fragillima</i></u> ; | B. <u><i>S. euadenia</i></u> ; | C. <u><i>S. longiflora</i></u> ; |
| D. <u><i>S. pseudosideritis</i></u> ; | E. <u><i>S. circinata</i></u> ; | F. <u><i>S. lavandulifolia</i></u> ; |
| G. <u><i>S. glechomifolia</i></u> ; | H. <u><i>S. trinervis</i></u> ; | I. <u><i>S. alpina</i></u> ; |
| J. <u><i>S. sylvatica</i></u> ; | K. <u><i>S. ballotiformis</i></u> ; | L. <u><i>S. arvensis</i></u> ; |

very suitable for delimiting and grouping the species of Nepeta and Salvia.

In the present work variability in size, shape and structure of the nutlets has been observed which is useful in delimiting two Subgenera Stachys and Betonica, and also some sections and species of Subgenus Stachys. In Subgenus Stachys nutlets are usually obovoid with a rounded apex, and either circular or broadly triangular in transverse sections. But in Sect. Fragilicaulis Subsect. Fragiles, the nutlets are more or less oblong-elongate with l/b ratio 2.1. Besides that, the apices of the nutlets in S. euadenia and S. longiflora of this subsection are apiculate instead of being smooth (Fig. 17 B, C). In S. fragillima and S. glechomifolia usually the nutlets have pronounced marginal wing and thus appear flat triangular in t.s. and in S. fragillima particularly the apex is obovate with a median notch (Fig. 17 A). In certain species of Sect. Eriostomum, Sect. Swainsoniana and Sect. Zietenia, marginal wings are slightly developed near the base of the nutlets, e.g. in S. circinata, S. lavandulifolia, S. alpina etc. (Fig. 17 E, F, I). In S. pseudosideritis, S. arvensis etc. no marginal wings are present (Fig. 17 D, L). In S. trinervis (Fig. 17 H) the nutlets have very characteristic papery wings at the margin and ventral sides. In Subgenus Betonica the nutlets are very distinct in some characters. They are usually elongate, more or less twice as long as broad, flat-trigonous with distinctly flattened marginal and apical wings. In most species, excepting S. discolor and S. serbica (Fig. 16 D, G) the apical wing is irregularly lobed (Fig. 16 A, B, C, E, F).

The extremes of size are represented by S. trinervis, S. inflata and S. macrantha with nutlets 4-5 x 3-3.5 mm and S. satureioides and S. pseudosideritis 1-1.2-1 mm. The common type of surface texture is somewhat smooth with faintly alveolate to reticulate ornamentations. This is found in S. sylvatica, S. germanica and others while in S. pseudosideritis and S. arvensis

Pl. 5.

SCANNING ELECTRON MICROGRAPHS FROM

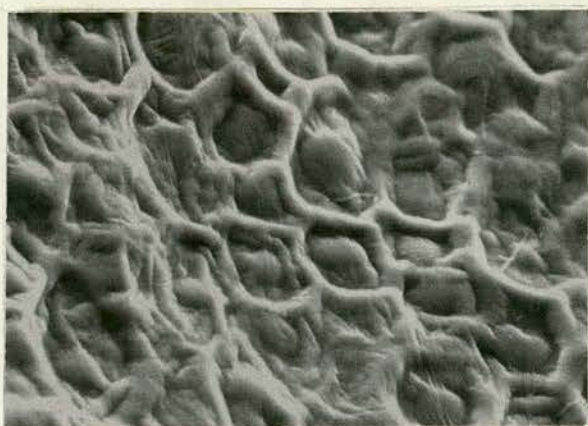
DORSAL SURFACES OF NUTLETS

(Explanation in the text)

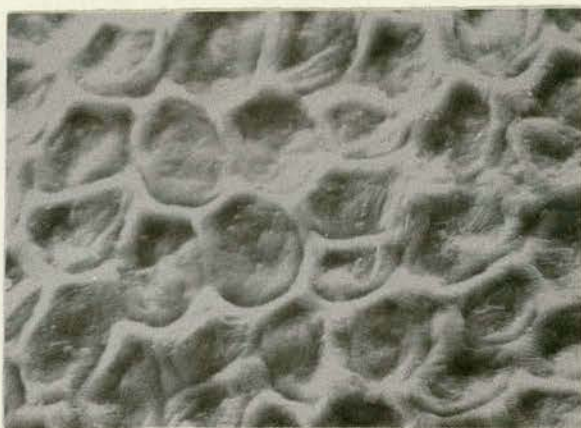
A - S. officinalis (x 2550); B - S. ballotiformis (x 2550);

C - S. annua (x 2550); D - S. burgsdorffioides (x 2550);

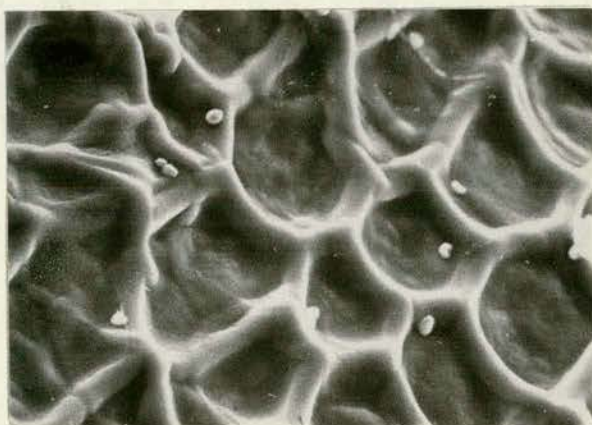
E - S. spinosa (x 2550); F - S. rupestris (x 2550).



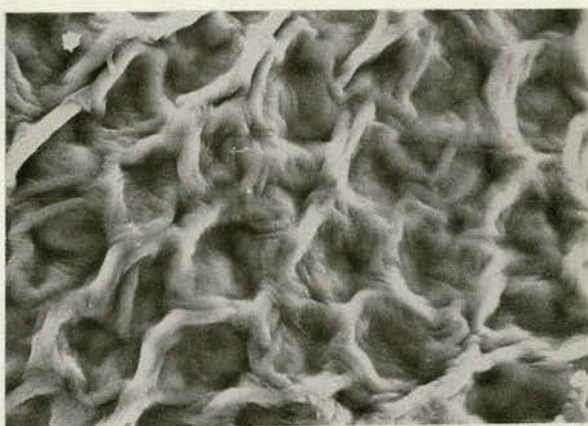
A



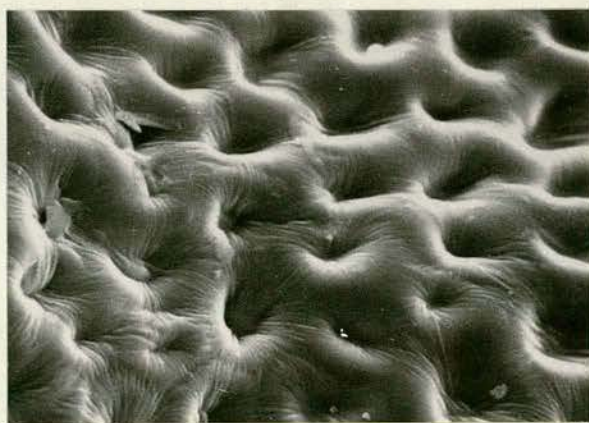
B



C



D



E



F

Pl. 6.

SCANNING ELECTRON MICROGRAPHS FROM

DORSAL SURFACES OF NUTLETS

(Explanation in the text)

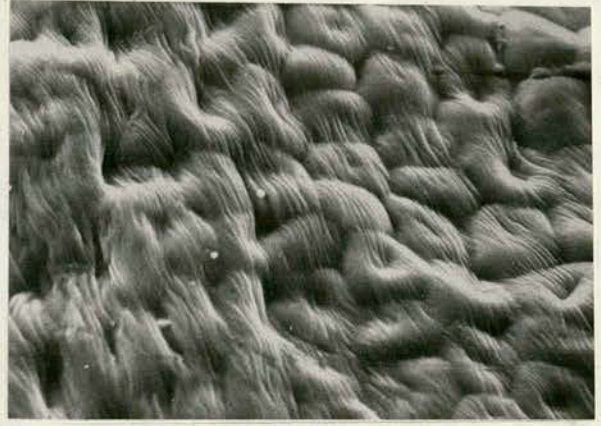
A - S. fragillima (x 2550); B - S. macrostachya (x 2550)

C - S. mucronata (x 2550); D - S. serbica (x 2550);

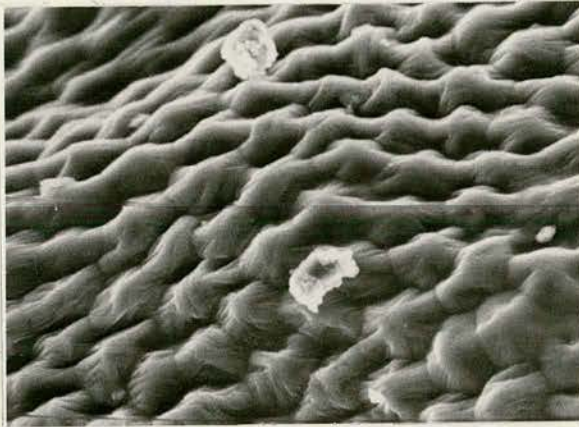
E - S. palustris (x 2550).



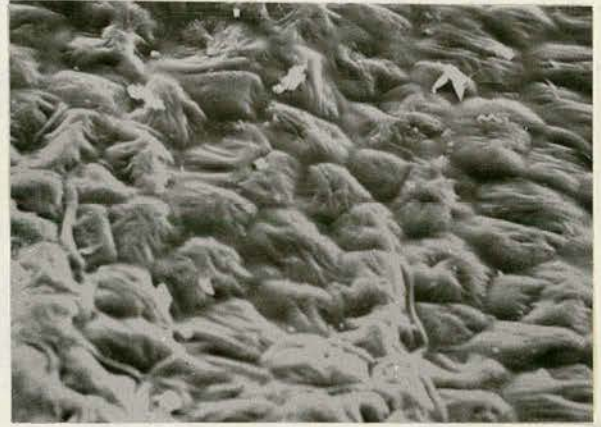
A



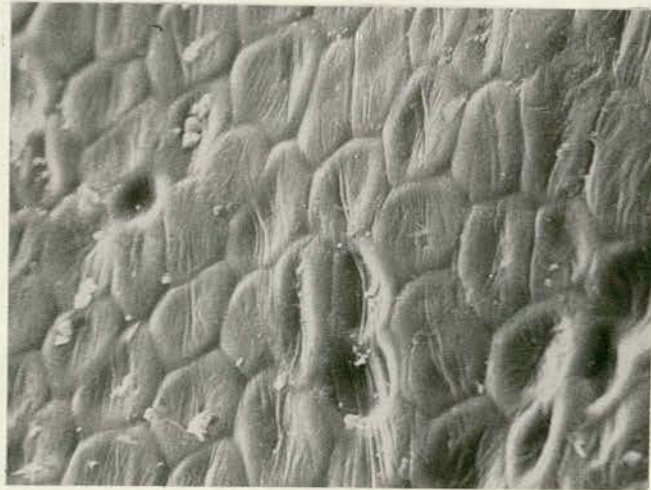
B



C



D



E

the surface is rough matt. The colour of the nutlet surface is usually brownish to greyish black but in S. fragillima and S. glechomifolia it is reddish-brown and in S. arvensis, S. saxicola, more blackish.

Nutlet surface: I have examined nutlet surfaces of 31 species of Stachys belonging to 21 sections under the scanning electron microscope, i.e. at least 1-3 typical representatives from each section dealt in the present study has been investigated (cf. Appendix A).

Most of the species have a reticulate surface texture, e.g. S. officinalis, S. annua, S. burgsdorffioides etc. (Pl. 5 A, C, D), but other patterns are also frequent. Using Stearn's (1966) terminology, in S. palustris (Pl. 6 E) it is between colliculate and ocellate type, in S. fragillima verrucate (Pl. 6 A), in S. macrostachya and S. serbica ocellate (Pl. 6 B, D) and in S. mucronata it is of pusticulate texture (Pl. 6 C). Some intermediate forms also occur, e.g. in S. spinosa it is reticulate-foveate, and in S. rupestris reticulate-rugose (Pl. 5 E, F). Considerable variation has been noticed in the width, length and breadth of the elevation and interstices of the reticulate texture. To facilitate comparison all the nutlets have been photographed at the same magnification and from their abaxial surfaces. From a taxonomic standpoint the surface texture is not of any particular significance in delimiting sections and subgenera but is sometimes of value in distinguishing between species.

Gynodioecism: Throughout the Labiatae an appreciable amount of floral variation pattern associated with gynodioecism has been observed. It is particularly prevalent in the genera Hypogomphia (Hedge, 1967), Mentha, Nepeta, Thymus, Origanum, Satureia, Salvia etc. (Correns, 1928, Lewis & Crowe, 1956, Hedge, 1968). The phenomenon is evidently rare in Stachys and I have observed

it only in 5 perennial species. Gynodioecism is often associated with reduction in the length of corolla tube and stamens and exertion of styles in the male-sterile individuals, while the hermaphrodite flowers have normal sized flowers. This has been observed in S. byzantina (Fig. 18), S. germanica, S. pinetorum and S. euaenia. However, no appreciable size reduction has been observed in S. cretica subsp. mersinaea. It is not always possible to assess the presence or absence of gynodioecism in a species from limited herbarium material; unless male-sterile specimens are present in a sample, we cannot tell whether the species is hermaphrodite or gynodioecious. Male sterile sex forms are usually found in polymorphic and widely spread species or in taxonomically more stable species with limited geographical distribution in the genera of Labiatae. In Stachys the former case is found in S. germanica and S. cretica while S. euaenia and S. pinetorum are examples of the latter.

The significance of gynodioecism is that it is an outbreeding device and hence increases flexibility and thus maintains heterozygosity in the population. However, the chances of self-fertilisation are not eliminated in hermaphrodite individuals and thus balance between fitness and flexibility can be maintained.

The genetic basis gynodioecy has been analysed by Lewis & Crowe (1955) in Origanum, who found that it was controlled by two independent genes, one of which has suppressor effects. Although the hermaphrodite plants will tend to outnumber male sterile plants, the latter appear to be favoured to some extent by increased fertility. Van der Pijl (1972) has suggested another advantage of gynodioecy: the male sterile plants escape from the secondary danger of protandry, i.e. the delay of receptivity of stigma in some cases may be dangerous to the plant itself as

Fig. 18. SEX-FORMS IN S. BYZANTINA C. Koch

(Explanation in the text)

A - B - Hermaphrodite flower (excluding calyx) and split-opened corolla (Sintenis 4449); C - D - Male sterile flower (excluding calyx) and split-opened corolla (Sintenis 4571).

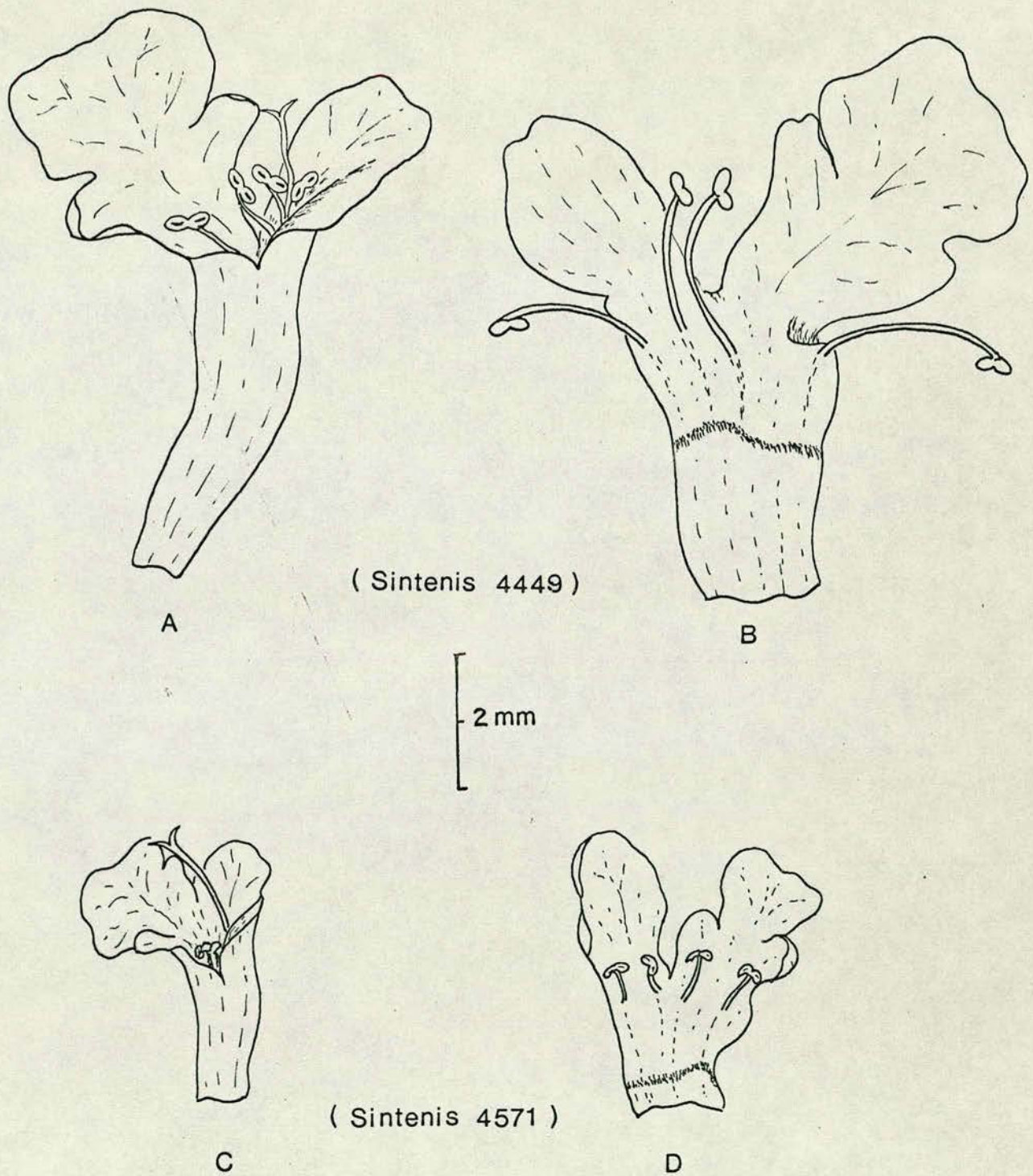


FIG. 18

SEX - FORMS IN S. BYZANTINA C. KOCH

the nectar is possibly exhausted and the attractiveness of the flower is diminished to the insect visitors.

From a taxonomic standpoint gynodioecism (usually associated with a shortened corolla tube) cannot be considered very important, unless it is correlated with other taxonomic characters. This has been pointed out in the taxonomic treatment of some species of Hypogomphia, Ziziphora etc. (Hedge 1961, 1967). On the other hand, it is biologically significant and failure to observe or assess it correctly may lead to faulty taxonomy.

Boissier (1879) in his classification of Stachys in the Orient put much emphasis on corolla length by dividing Section Eriostachys into § Micranthae (small flower) and § Germanicae (long flowered), though both of these subgroups show a close relationship in other well correlated characters. However, I have observed a few species of the subgroup Germanicae (sensu Boissier) with short corolla tubes associated with male sterility in the same population with hermaphrodite flowers of greater corolla length. Thus the separation of § Micranthae and § Germanicae on flower size is obscured by the presence of small-flowered sex-forms in the latter. In the present classification they are treated together in the Section Eriostomum, due to the large number of other characters they have in common.

B. ANATOMY

Some attention has been made by previous workers like Briquet (1893), Solereder (1908) and Metcalfe & Chalk (1950) to the stem and petiole anatomy of Stachys. Recently nutlet anatomy has been found to be very useful in the identification and delimitation of genera and species of the Labiatae (Wojciechowska, 1964, 1966).

In the present investigation I tried to focus particular attention on petiole and nutlet (particularly pericarp) anatomy of the genus which has not been previously studied very thoroughly. Good correlations with other morphological characters have been obtained in delimiting subgenus Stachys from Betonica (cf. Ch. III A). However, my observations are not complete, as the survey has not been done throughout the whole genus. Most of the species in subgenus Betonica have been studied but for subgenus Stachys some relevant species (which show resemblances with subgenus Betonica in some differential characters) have been selected for survey. (cf. Appendix A for the list of species).

Materials and methods: For anatomical studies of petioles and stems, fresh and dried herbarium specimens have been used. Dried specimens were soaked overnight in dilute KOH solution (5%) for softening. They were washed thoroughly and preserved in 70% alcohol for hardening and section cutting. Free hand sections were made from comparable regions. Anatomical investigation of the nutlets was done by cutting trans-sections (c.20-25 μ thick) with a Reichert sledge microtome. Adequate sections were difficult to obtain, due to hardness of fruit wall and small size. However, the method involving embedding of nutlets in methacrylate plastic following the technique of Feder & O'Brien (1968) prior to section cutting has been found to be satisfactory. The data obtained during the investigation are discussed as follows:-

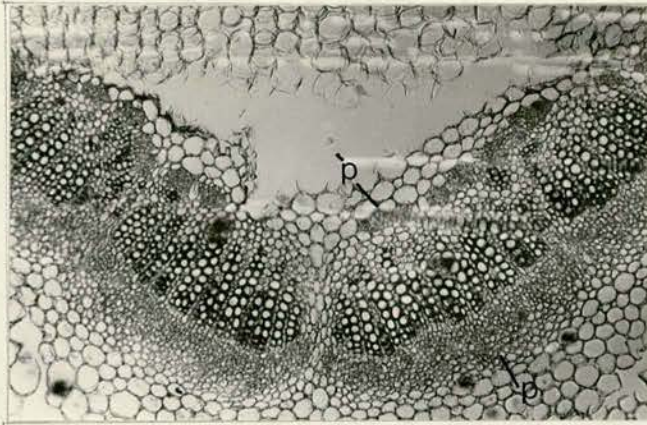
Pl. 7. T.S. OF PETIOLES IN SUBGENUS BETONICA

(Explanation in the text)

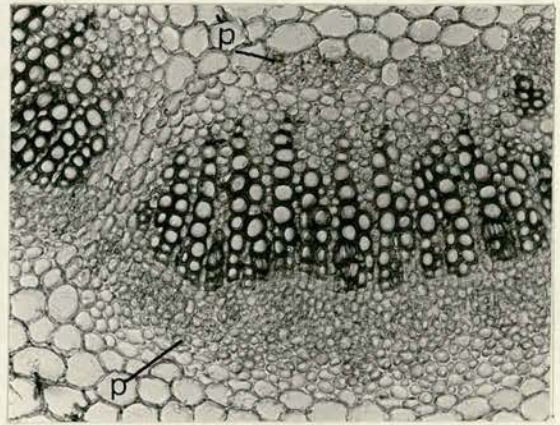
A - B - S. macrantha showing central confluent bundles (x 25, & x 125 respectively); C - D - S. betoniciflora (x 22 & x 140 respectively);

E - S. officinalis (x 25); F - S. macrostachya (x 125).

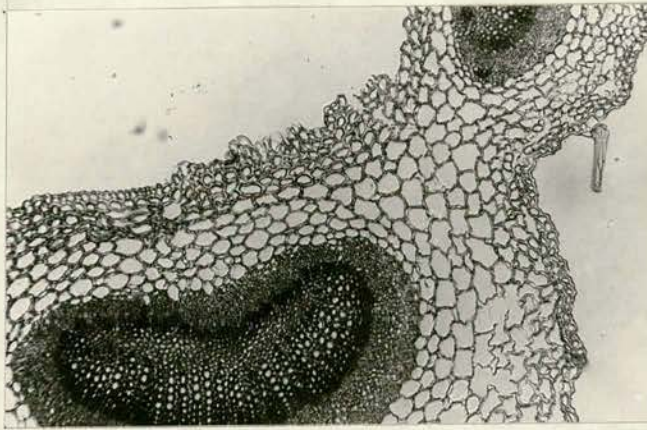
(c - collenchyma tissue; p - abaxial phloem; p' - adaxial phloem).



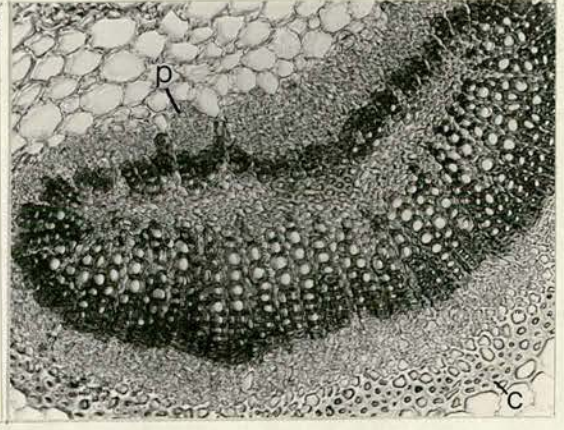
A



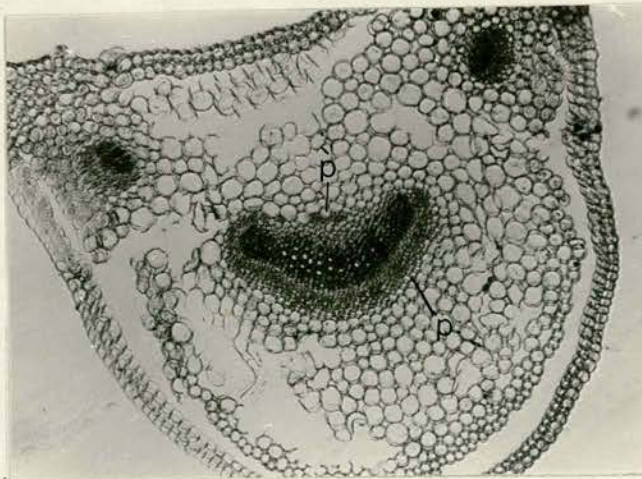
B



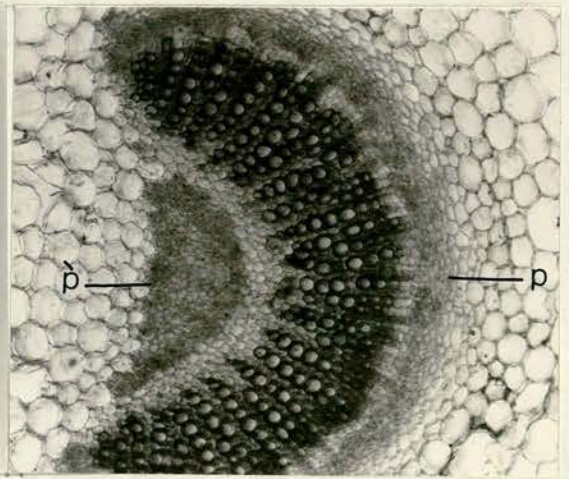
C



D



E



F

Pl. 8. T.S. OF PETIOLES IN SUBGENUS STACHYS

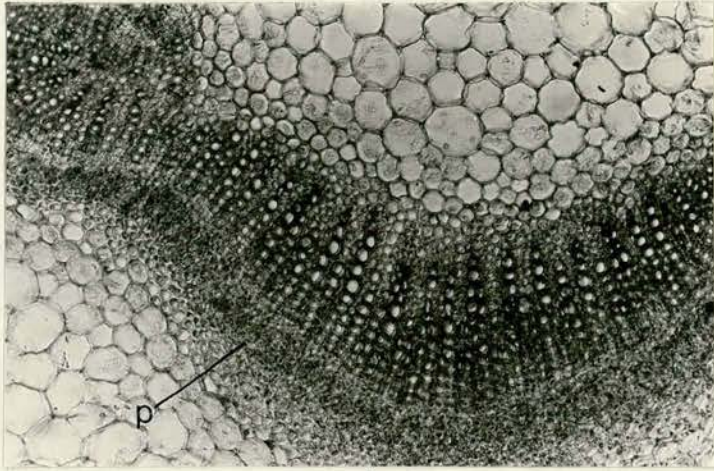
(Explanation in the text)

A - S. alpina (x 125); B - S. lavandulifolia (x 140); C -

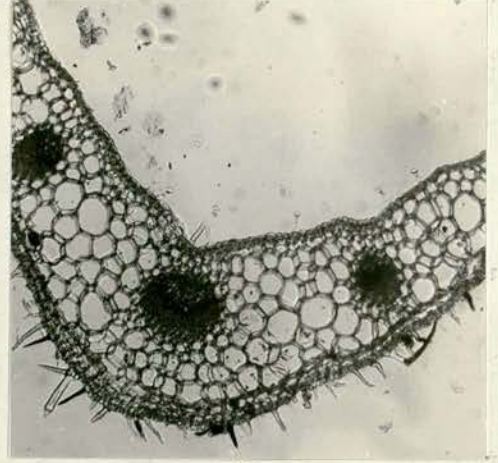
S. atherocalyx (x 125); D - S. grossheimii (x 140);

E - S. anisochila (x 125); F - S. thirkei (x 125).

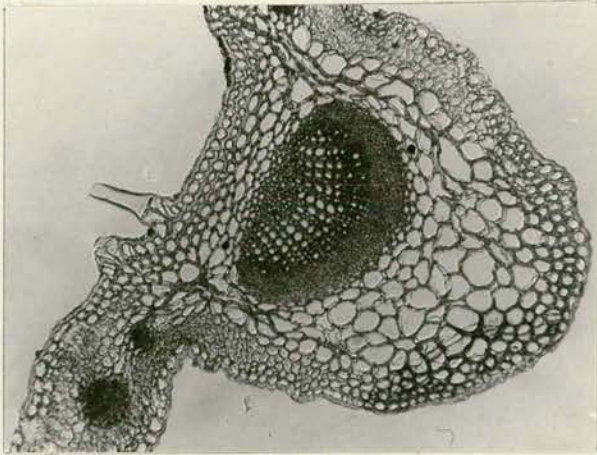
(p - abaxial phloem).



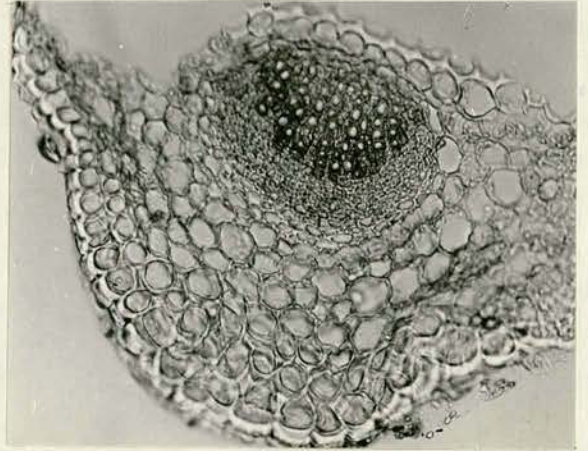
A



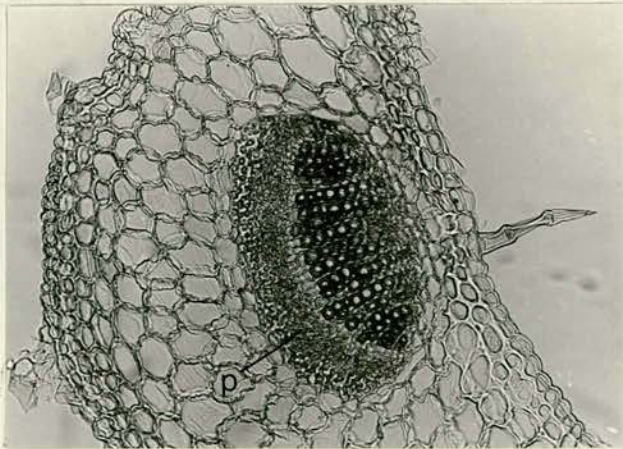
B



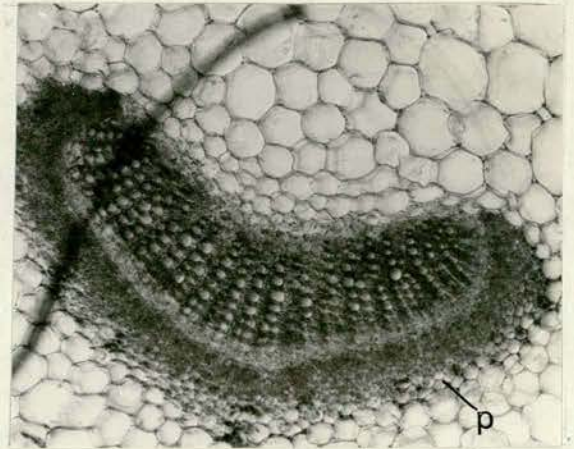
C



D



E



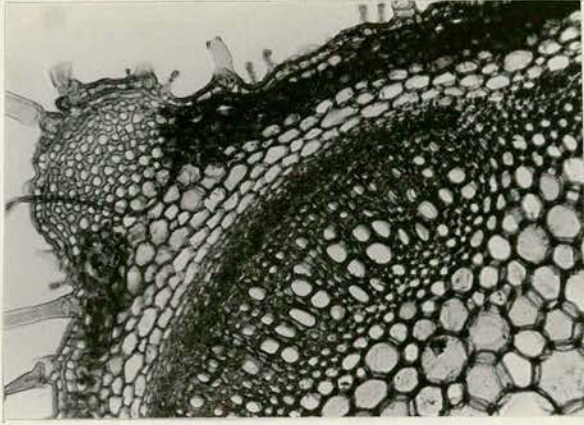
F

Pl. 9.

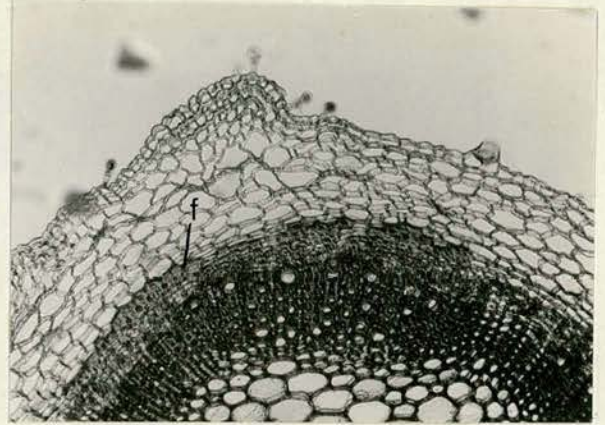
T.S. OF STEMS (A PORTION)

(Explanation in the text)

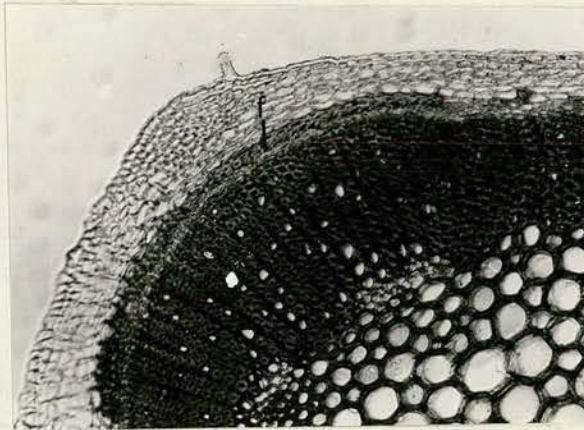
A - S. saxicola (x 125), pericyclic fibre absent); B - S. candida
(x 125); C - S. mucronata (x 140); D - S. acerosa (x 140);
E - S. fontqueri (x 140); F - S. spinosa (x 140).
(f - Pericyclic fibres forming bundle cap).



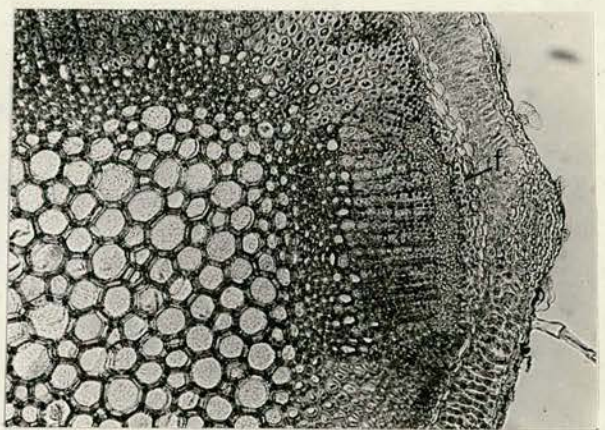
A



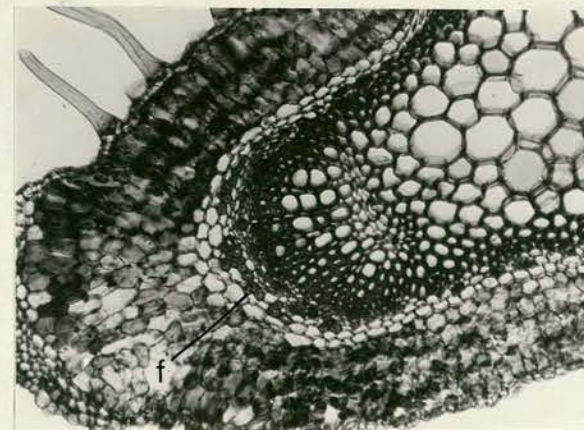
B



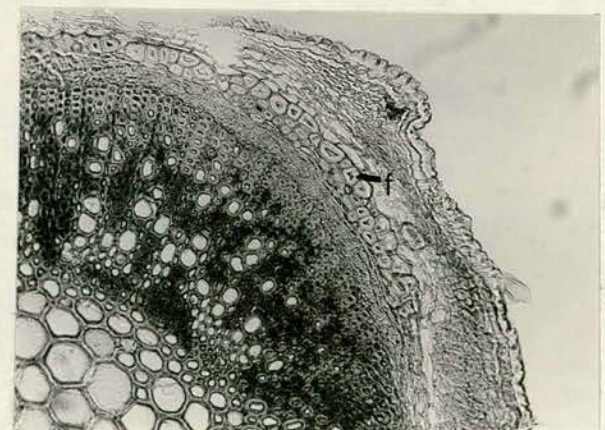
C



D



E



F

Stem: Briquet (1893) worked on stem and wood anatomy of several species of Stachys but their structures do not afford very significant taxonomic character. However, the woody suffruticose perennials belonging to different sections show more or less similar distribution of strengthening tissues which could be interpreted as convergence brought about by adaptation to similar ecological conditions. Pl. 19 shows the transverse sections of some of the stems of S. spinosa, S. mucronata, S. acerosa, S. fontqueri, S. candida and S. saxicola belonging to 5 sections, the last two being in the same. Basically similar anatomical characters are found but in S. saxicola an interesting variation has been noticed. The pericycle does not form any continuous fibrous layer surrounding the vascular cylinder, neither does it form fibrous bundle caps at the 4 angles of the stem, as has been found in related and unrelated species. The fibrous pericyclic layer usually gives support to the main stem at the time of secondary growth, but as it is not developed in the stem of S. saxicola, it may be one of the reasons of the plants fragility, breaking at the internodes when handled.

Petiole: Petiole anatomy provides good taxonomic character in delimiting subgenus Betonica from Stachys. Anatomical structure of the petiole varies from region to region, and so a constant comparable region has been chosen i.e. the distal end - just below the lamina.

The main bundle in both subgenera Stachys and Betonica forms an arc and the lateral traces are usually 1 on each side and more or less rounded in outline (Fig. 19, A,B,C,E). In S. macrantha the main bundle is composed of several confluent bundles (Fig. 19 A, Pl.7A,B). In S. lavandulifolia, S. arvensis, S. atherocalyx the lateral traces are more than 1 in each side (Fig. 19 D, F, and 20 G,H,J).

Fig. 19. T.S PETIOLES (DIAGRAMMATIC)

(Explanation in the text)

A - S. macrantha; B - S. macrostachya;

C - S. officinalis; D - S. alpina

E - S. betoniciflora; F - S. thirkei

(xylem - hatched, phloem - dotted and
collenchyma layer - ticked.)

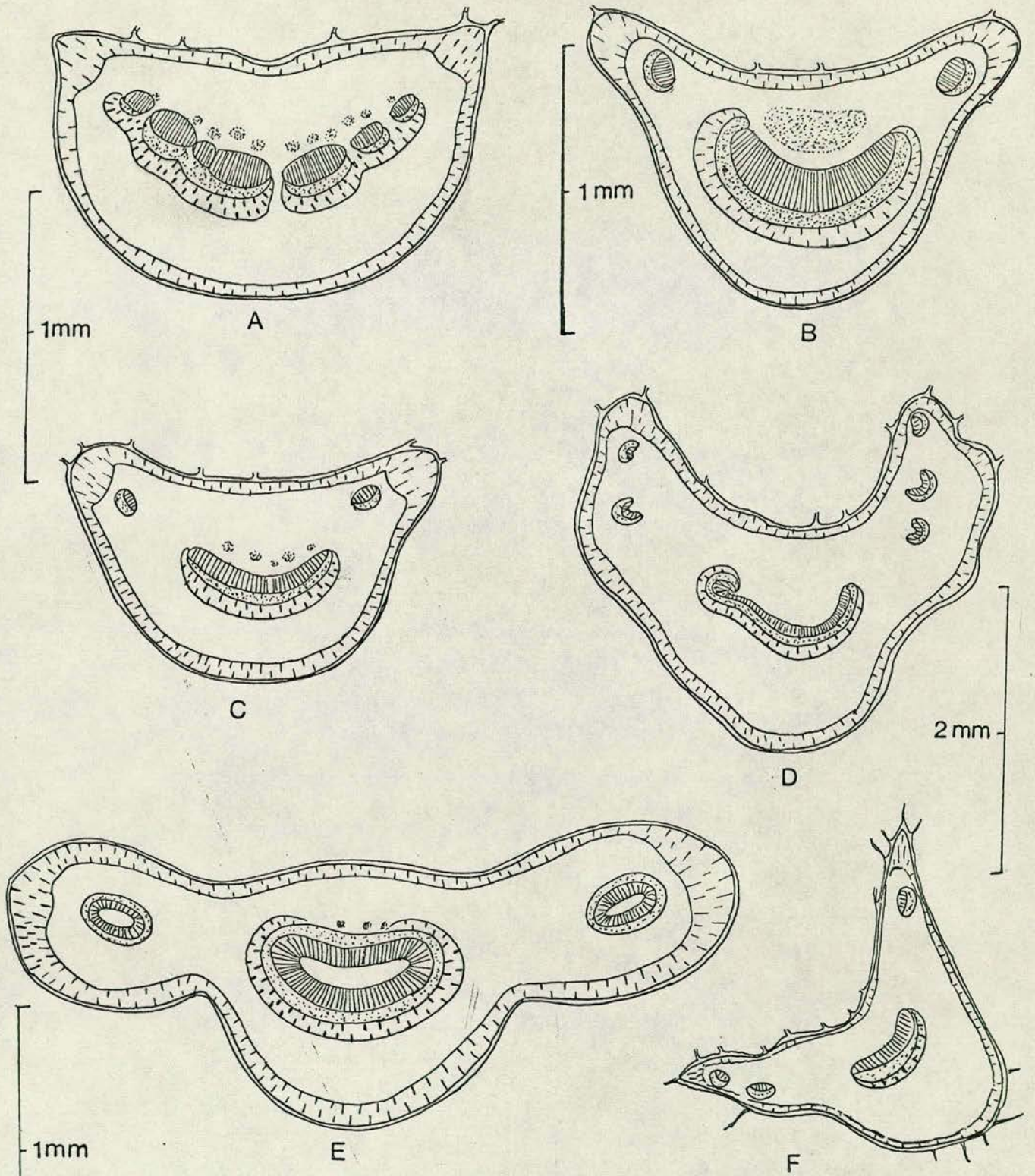


FIG. 19 T. S. OF PETIOLES (DIAGRAMMATIC)

Fig. 20. T.S OF PETIOLES (DIAGRAMMATIC)

(Explanation in the text)

G - S. atherocalyx; H - S. lavandulifolia;
I - S. fruticulosa; J - S. arvensis

(xylem - hatched, phloem - dotted and
collenchyma layer - ticked.)

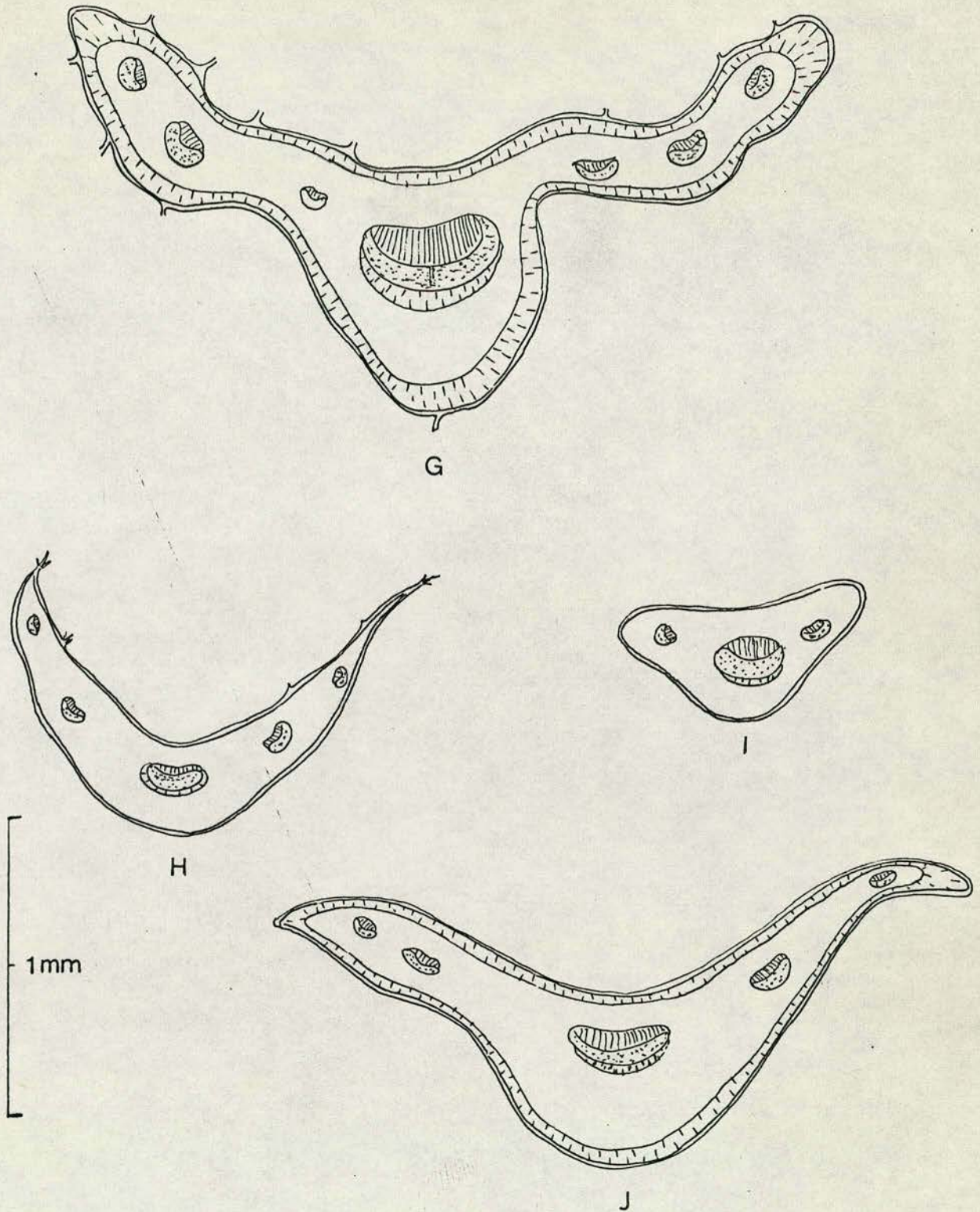


FIG. 20 T.S. OF PETIOLES (DIAGRAMMATIC)

The main interesting feature in subgenus Betonica is the presence of patches of phloem on the adaxial side (Fig. 19 A,B,C,E, Pl. 7) not found so far in the species of subgenus Stachys so far investigated. S. macrostachya (Betonica) has a massive continuous patch of adaxial phloem (Fig. 19 B, Pl. 7F) while in S. officinalis and S. macrantha the patches are not continuous. S. betoniciflora (Betonica) is unique in having concentric vascular bundles (Fig. 19 E, Pl. 7 C,D). Usually the vascular bundles are surrounded by a collenchymatous sheath, 2-3 layers in thickness. The hypodermis also bears 2-3 layered collenchymatous tissue just below the epidermis. The two corner flanks of the petiole are usually supported by 4-5 layers of collenchyma tissue.

Nutlets: The observation was mainly based on the characters of pericarp and was found to be satisfactory.

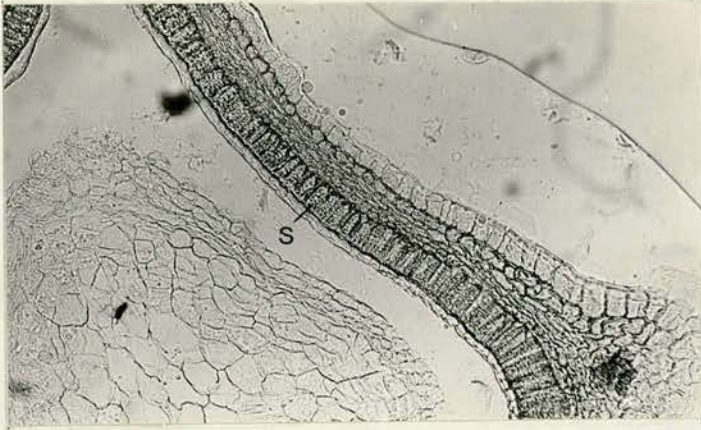
In cross-section the pericarp consists of 3 distinct layers. The outer layer is epicarp which is covered by cuticle. The epicarp is usually made up of a single layer of cells (Fig. 21 A,C,E,G, and 22 I,K,M) but sometimes more than one layer of cells are present e.g. S. saxicola and S. serbica (Fig. 22 P). In S. iberica and S. serbica the epicarp cells are found to have reticulation on their wall (Fig. 21 E, 22 P). Underneath the epicarp, there is a mesocarp which usually consists of several layers of dark cells. This is followed towards the innerside by a sclerenchymatous layer. This layer consists of an uppermost isodiametric or polygonal cells and a layer of very close-fitting, vertically arranged cells. These cells are highly thickened and the central lumen is almost obliterated. Following the sclerenchymatous layer, the endocarp usually consists of a single or double layer of cells, (Fig. 21, 22). After the pericarp comes the testa with few layers of cells, and finally comes the embryo. Wojciłochowska (1966) was able to key out some of the genera and species of the Labiatae on the basis of seed coat characters. Fig. 21 and 22

Pl. 10.

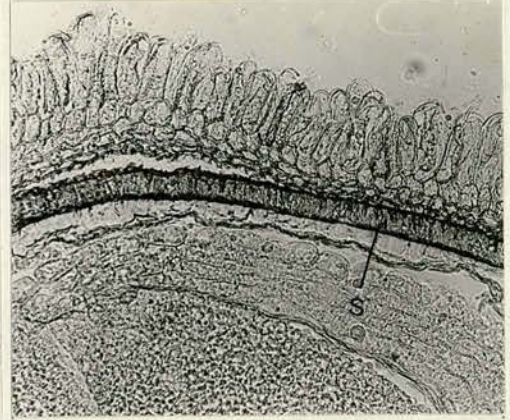
T.S. OF NUTLETS

(Explanation in the text)

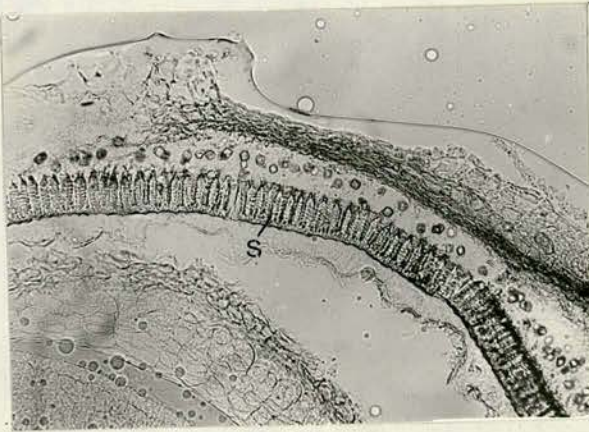
- A - S. fragillima (x 616, showing pericarp and embryo);
B - S. longiflora (x 616, a portion of pericarp and embryo);
C - S. brantii (x 550); D - S. brantii (x 1125, sclerenchyma layer magnified); E - S. euadenia (x 140, showing the outline of the section).
(s - sclerenchymatous layer).



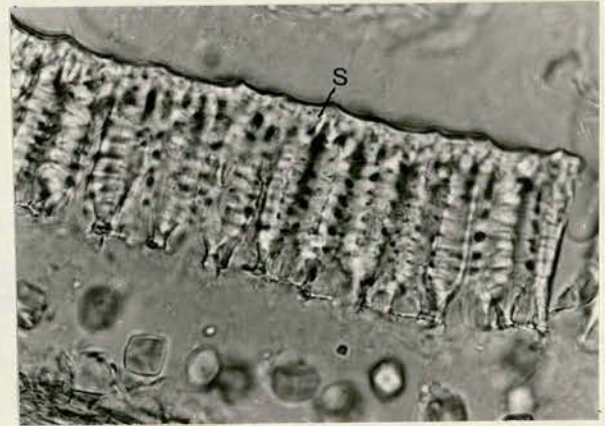
A



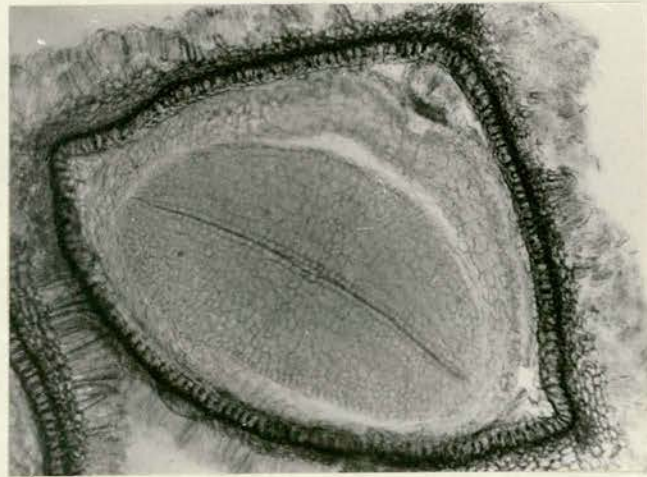
B



C



D



E

Pl. 11.

T.S. OF NUTLETS

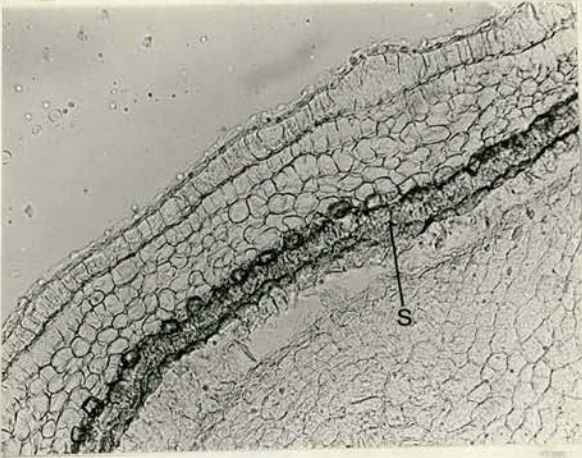
(Explanation in the text)

A - S. betoniciflora (x 616); B - S. iberica (x 550);

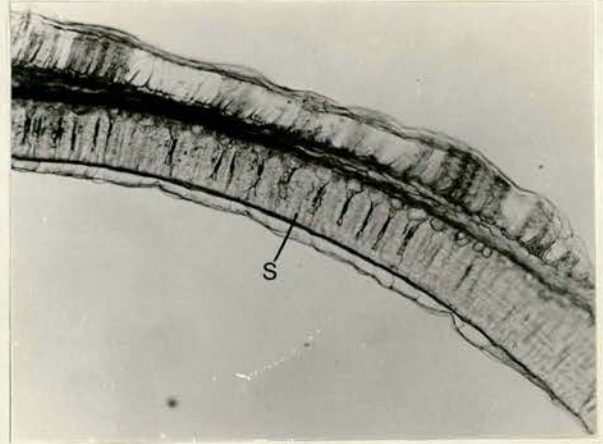
C - S. discolor (x 616); D - S. setifera (x 550);

E - S. serbica (x 550); F - S. trinervis (x 550).

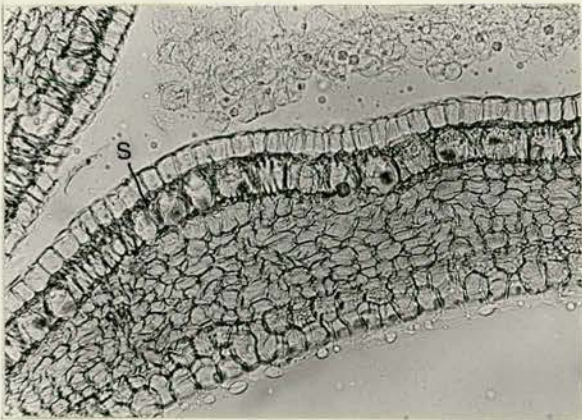
(s - sclerenchymatous layer).



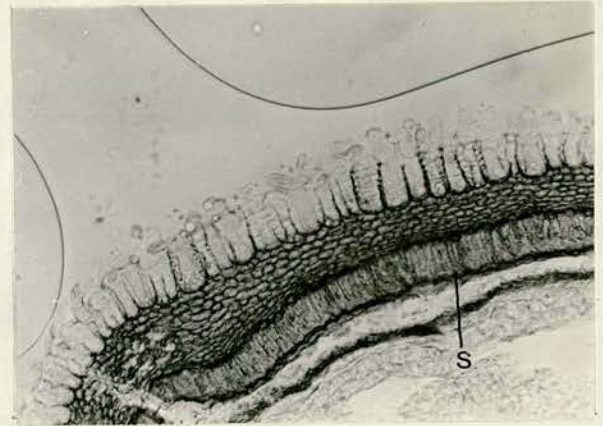
A



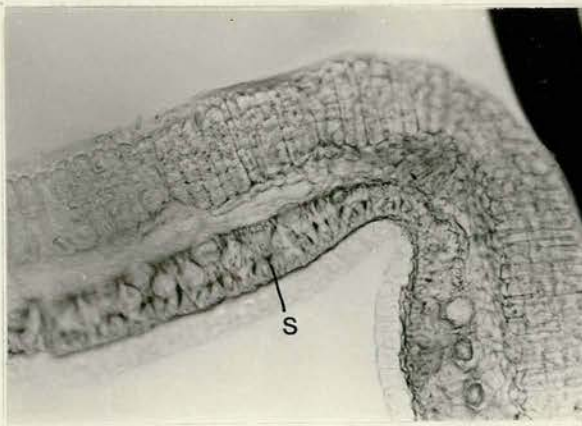
B



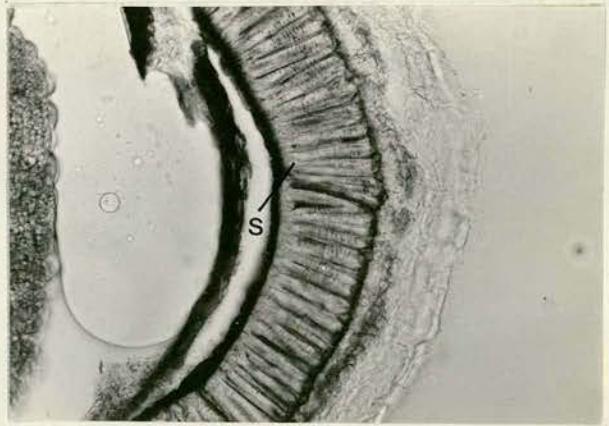
C



D



E



F

Fig. 21. ANATOMY OF NUTLETS (PERICARP ONLY)

(Explanation in the text)

A, C, E, G - Whole pericarp; B, D, F, H -

Sclerenchymatous layer and endocarp of pericarp.

A - B - S. graveolens; C - D - S. sylvatica;

E - F - S. iberica; G - H - S. longiflora

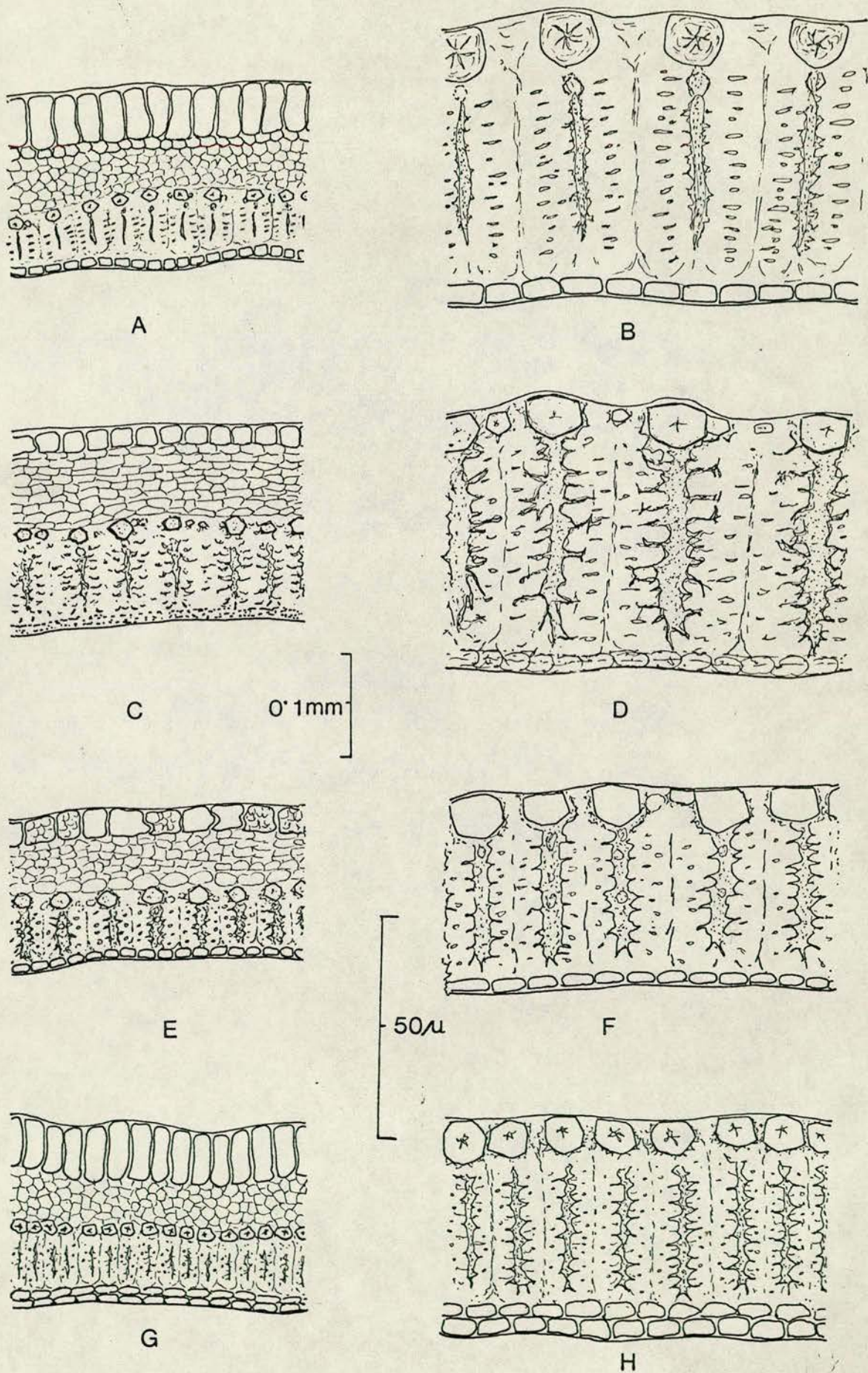


FIG. 21 ANATOMY OF NUTLETS (Pericarp only)

Fig. 22. ANATOMY OF NUTLETS (PERICARP ONLY)

(Explanation in the text)

I, K, M, P - Whole pericarp; J, L, N, Q -
Sclerenchymatous layer and endocarp of pericarp.

I - J - S. macrantha; K - L - S. officinalis;

M - N - S. betoniciflora; P - Q - S. serbica

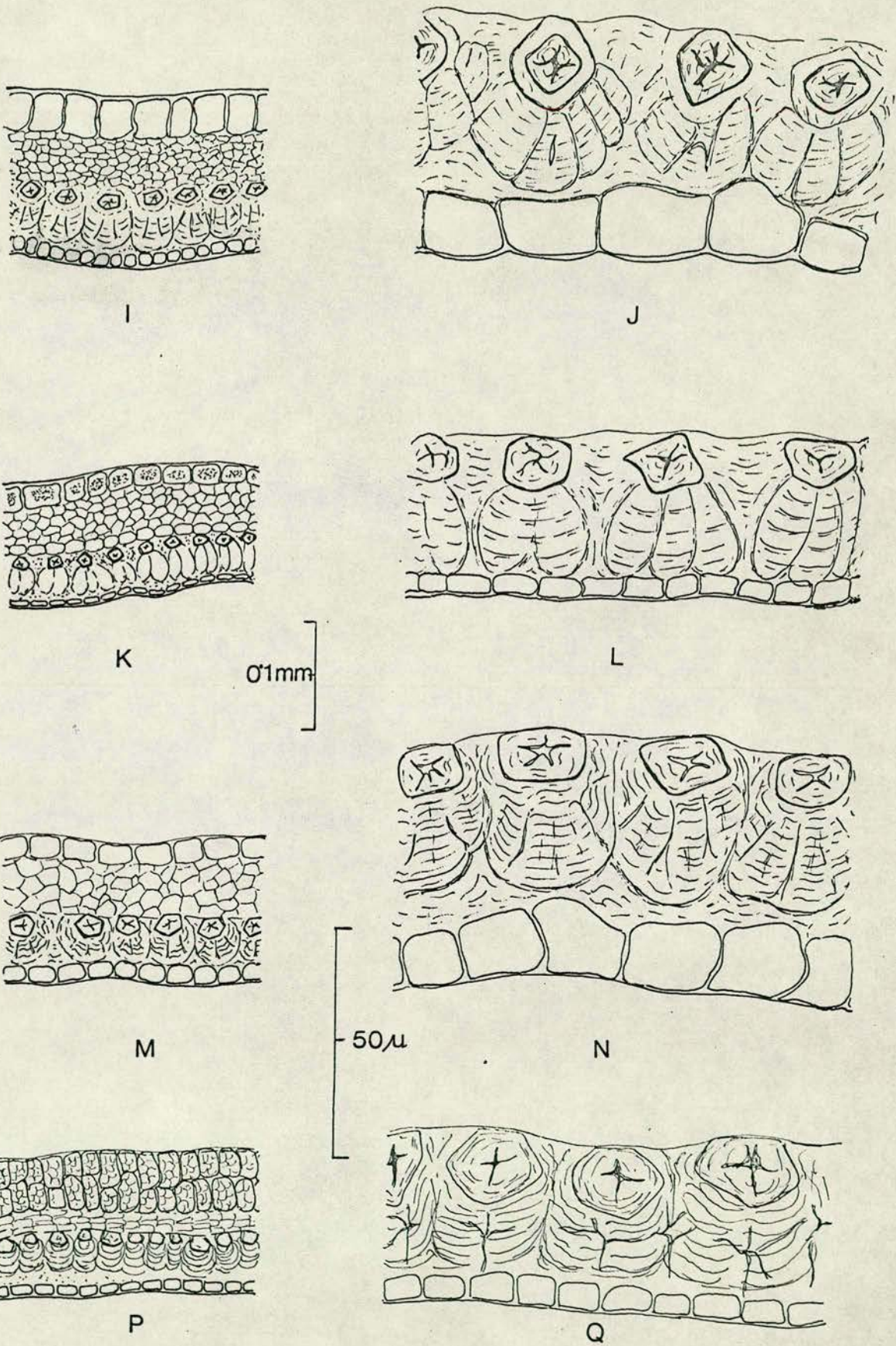


FIG. 22 ANATOMY OF NUTLETS (Pericarp only)

illustrate species of the genus Stachys, of which Fig. 21 represents the members of subgenus Stachys and Fig. 22, the subgenus Betonica. Apart from the differences in size and shape of the cells and the thickness of pericarp, (drawn under same magnification to facilitate comparison), there is obvious difference in the nature of the sclerenchymatous layer of the two subgenera. In subgenus Betonica this layer shows lamellate thickenings and the central lumen is almost completely obliterated (Fig. 22 J,L,N,Q) whereas in subgenus Stachys, pitted and scalariform type of thickenings are more conspicuous with a more prominent central lumen (Fig. 21 B,D,F,H). Moreover the vertical cells of this layer are narrower and more elongated than those of subgen. Betonica (Fig. 21, 22 and Pl. 10, 11). In S. longiflora, S. euadenia, S. graveolens of section Fragilicaulis, the epicarp layer consists of more elongated cells than other species, (Fig. 21 A,G, Pl. 10 B,E). Thus from a taxonomic standpoint, nutlet character was found to be useful in delimiting two subgenera. Besides that, some distinctive epicarp cells have been found in S. longiflora (Pl. 10B), S. serbica (Fig. 22 P), S. iberica (Fig. 21 E) and S. trinervis (Pl. 11 F) to distinguish them from other species.

C. DEVELOPMENT: STELLATE AND DENDROID HAIRS AND STOMATA

Method: For studying the development of hairs and stomata, fresh young leaves of some species of Stachys, growing the Royal Botanic Garden, Edinburgh, were fixed in acetic alcohol (1:3) for about 4 hours and then stored in 70% alcohol. The epidermis was peeled off carefully on a clean slide and gently squashed in 1% aceto-carmin. Staining becomes intensified when the slide was heated over a flame for 2-3 seconds; a temporary mount was made and the edge of the cover-slip was sealed with rubber solution. Camera lucida drawings were made and photographs taken from the preparation. In two cases, in S. trinervis and S. balansae, of which no fresh material was obtained, dried herbarium material was used. The dried youngest part of the leaves were soaked in boiling water and reconstituted. Epidermal peels were stained with 1% acetocarmine solution and the preparations were found to be useful for comparison with fresh material.

Development of hairs: Developmental stages of hairs have been studied from S. lavandulifolia and S. trinervis, the former from fresh and the latter from reconstituted herbarium material. In S. lavandulifolia the central ray develops first like a simple hair and the side rays appear one after another from the division of the basal cell of the central ray. The central ray is approximately 6-8 times longer before the side cells appear to be cut off from the basal cell (Fig. 23, m-p). As a result in a fully formed hair the terminal and lateral rays are found to arise from the basal stalk and the lateral rays are 3-10 times shorter than the terminal ray (Fig. 23, q). In S. trinervis all the rays develop more or less simultaneously, though the terminal ray cell is cut off first. The successive stages of growth are shown in figure (Fig. 23, a-e). There is no gap between the development of terminal and lateral rays, contrary to development in S. lavandulifolia.

Fig. 23. DEVELOPMENT OF STELLATE AND DENDROID HAIRS

(Explanation in the text)

D - Dendroid hair development in S. trinervis.

Five successive developmental stages (a-e) and fully formed hair (f).

S - Stellate hair development in S. lavandulifolia.

Four successive developmental stages (m-p) and fully formed hair (q)

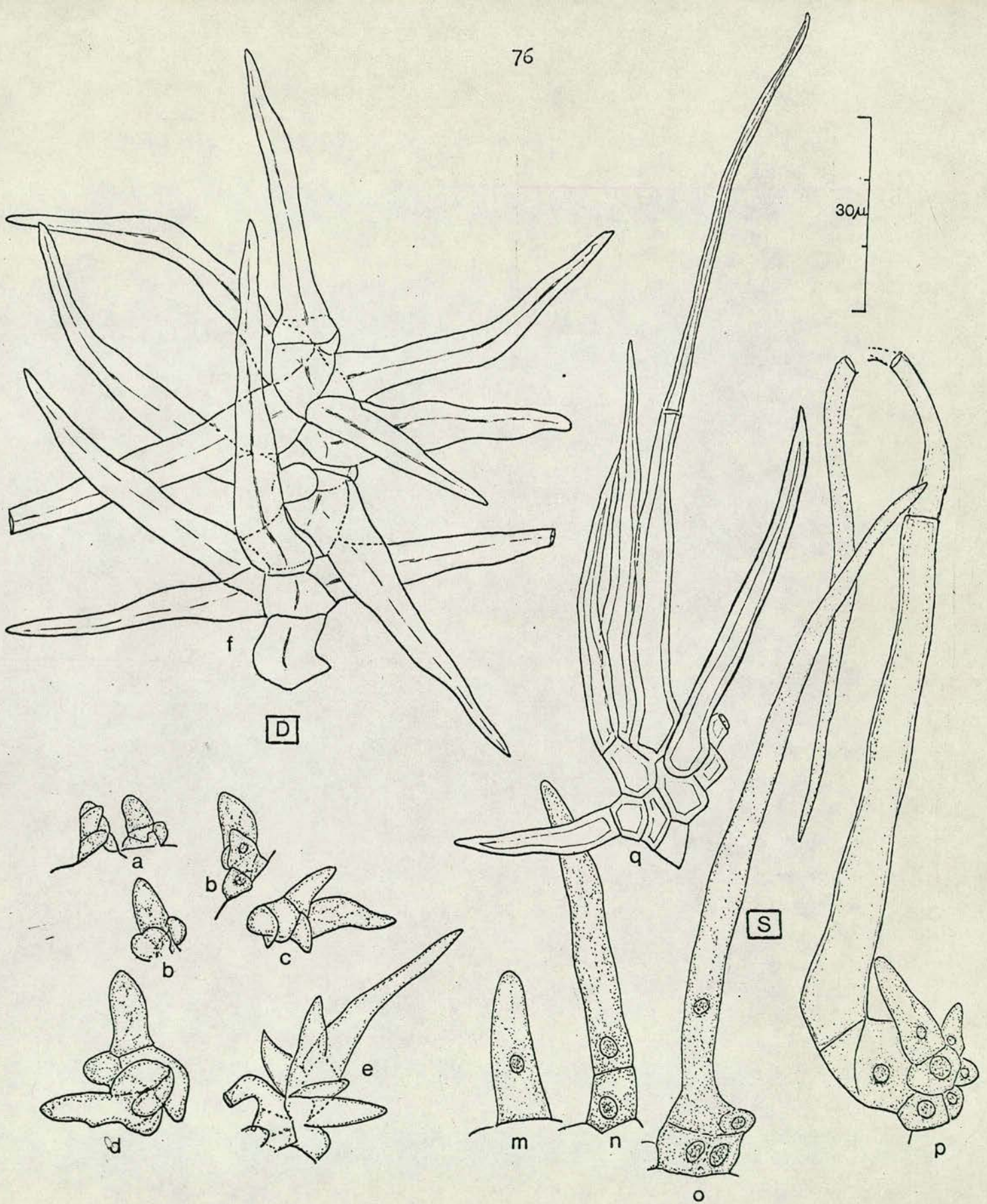


FIG. 23 DEVELOPMENT OF STELLATE & DENDROID HAIRS

In a fully formed hair all the rays appear to arise all over the surface of an elongated stalk without any gap and all the hairs attain more or less the same size (Fig. 23, f). Thus S. lavandulifolia and S. trinervis develop porrect-stellate and dendritic-echinoid hairs respectively. This study was found to be useful in delimiting these two species and subsequently the two sections Zietenia and Ambleia respectively.

Stomata: Solereder (1908) and Metcalfe & Chalk (1950) reported the occurrence of diacytic stomata in the Labiatae, but their development was not been followed. Pant & Mehra (1965) reported the mesogenous type of stomatal development in one species of Ocimum and Inamdar & Bhatt (1972) studied the nature and development stages of 33 species belonging to 17 genera of the Labiatae, but no studies have so far been made on Stachys.

More than 50 species belonging to different sections have been examined by me of which 5 species, S. pumila, S. citrina, S. alpina, S. macrostachya and S. lavandulifolia grown at Royal Botanic Garden, Edinburgh, and 1 species, S. balansae from dried herbarium material, have been studied for morphological development. The terminologies for development have been adopted from Pant & Mehra (1965).

Stomata occur on both surfaces of the leaves and usually more abundant on the lower surface, though in some species like S. macrantha, S. officinalis, S. alpina etc, the number of stomata is very few on the upper epidermis and abundant on the lower (Pl. 1 A, F; 3 B, C). No hypostomatic forms have been observed. The epidermal cells are either distinctly wavy, e.g. in S. alpina, S. setifera etc. (Pl. 1 B; 2 C), or more or less smooth quadrangular to polygonal in outline, e.g. S. scerosa, S. araxina, S. macrantha etc. (Pl. 1 E; 3 F, B). Stomata in most cases are diacytic, i.e. surrounded by 2 subsidiary cells, which in Stachys are unequal (Pl. 1, 2 & 3) and more or less distinguishable from other epidermal cells, as their cross walls lie at right angles to

Fig. 24. DEVELOPMENT OF STOMATA

(Explanation in the text)

A - Development of mesogenous diacytic stoma in
S. pumila (1-5)

B - Mesoperigenous development of stomata in
S. alpina forming anomocytic (1) and diacytic
stoma (2-5).

(sm - stomatal meristemoid; gmc - guard mother cell;
gc - guard cell; so - stomatal opening; p - perigenous
subsidiary cell; S₁ & S₂ - mesogenous subsidiary cells -
the numbers indicate successive formation).

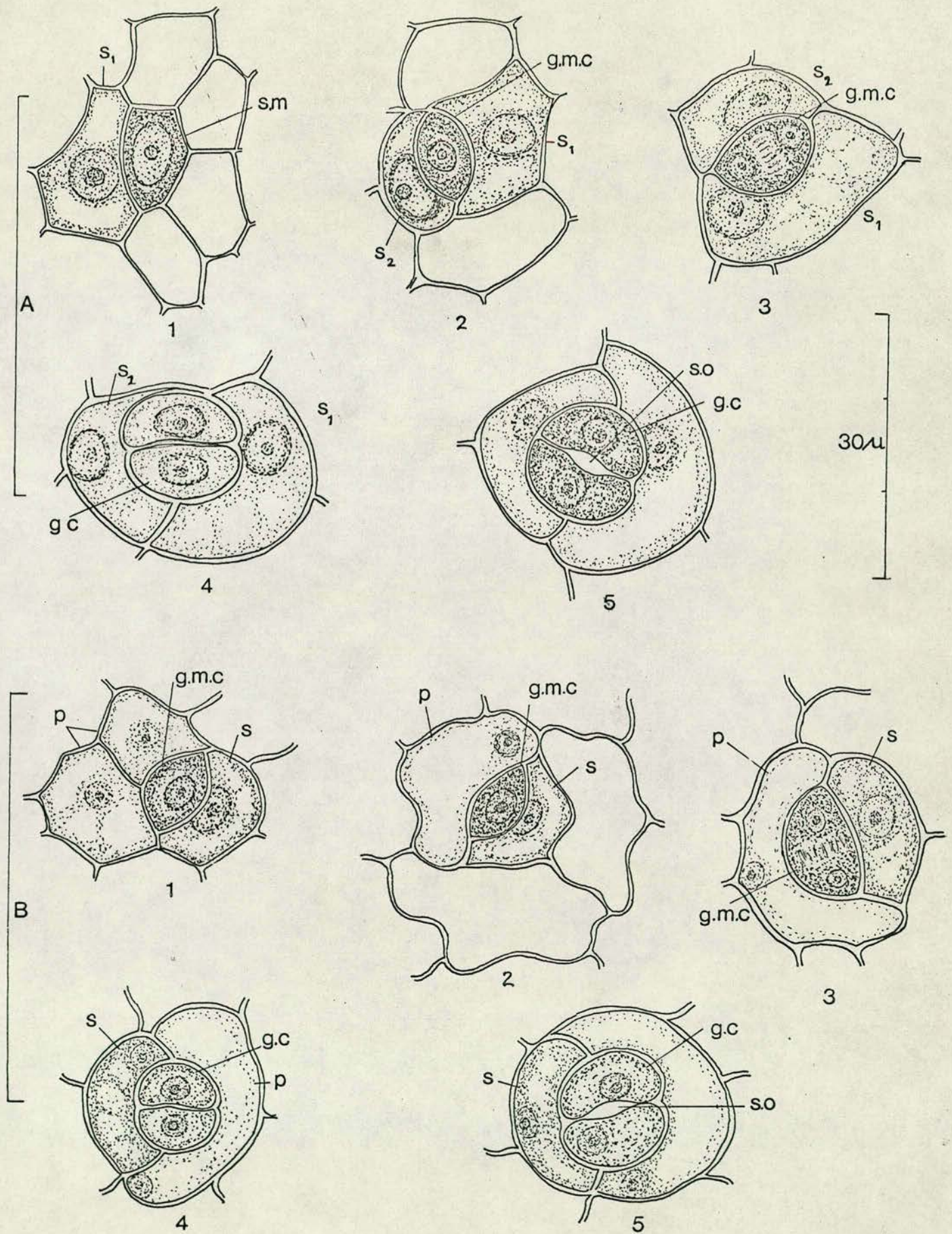


FIG. 24 DEVELOPMENT OF STOMATA

Fig. 25.

DEVELOPMENT OF STOMATA

(Explanation in the text)

C - Development of mesoperigenous and perigenous stomata
in S. balansae ssp. carduchorum

Stomatal meristemoid before division (1); meristemoid
dividing into one mesogenous subsidiary and guard mother
cell (2); mesoperigenous diacytic stoma surrounded by
perigenous and mesogenous subsidiary cells (3);
anomocytic stomata surrounded by perigenous subsidiary
cells (4-6).

D - Development of mesogenous and perigenous stomata in
S. citrina.

Mesoperigenous diacytic (1) and mesoperigenous anomocytic
stomatal development (2); perigenous anomocytic stomata
(3).

(sm-stomatal meristemoid; gmc - guard mother cell;

gc - guard cell; so - stomatal opening; p - perigenous
subsidiary cell; S - mesogenous subsidiary cell).

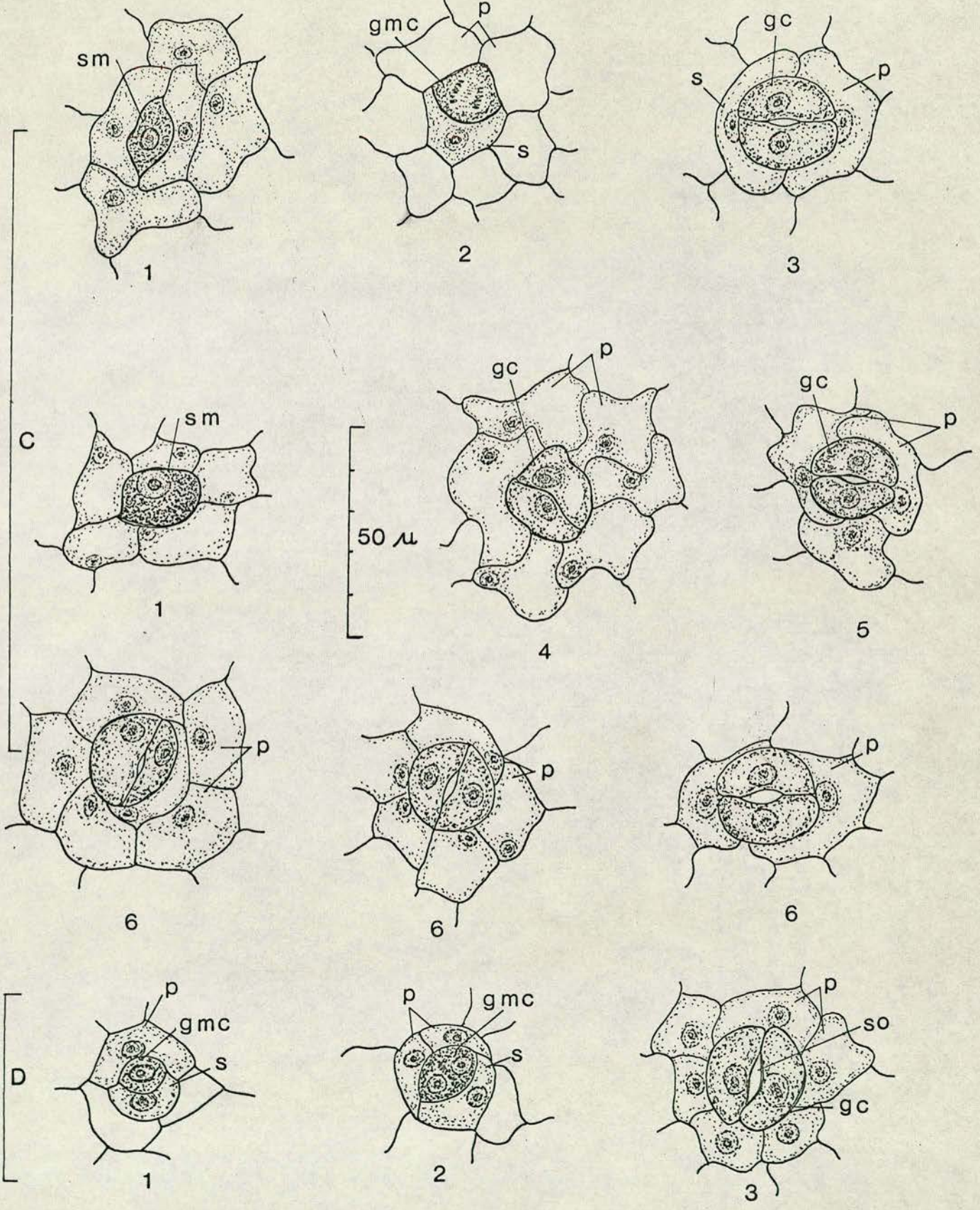


FIG. 25 DEVELOPMENT OF STOMATA

the wall of the guard cells. In some species these diacytic stomata are mixed with anomocytic stomata in which the cells surrounding the guard cells are not differentiated from other epidermal cells, e.g. S. citrina, S. balansae, S. alpina etc. (Pl. 1 A; 3 E). In some species, e.g. S. citrina and S. alpina, some of the stomata appear diacytic or anomocytic but one subsidiary cell is more distinct than the rest. In S. alpina, S. balansae etc. anomocytic stomata are more frequent than diacytic stomata, while in S. acerosa, S. araxina, S. pumila etc, typical diacytic stomata are more frequent. Contiguous stomata are of very rare occurrence and found in S. macrantha and S. araxina (Pl. 3 A, F) in very low frequency.

Development of stomata: A meristemoid or the primary stomatal initial is more or less lenticular and distinguished from the surrounding cells being denser in cytoplasmic content and with a prominent and deeply stained nucleus. Three different developmental phases have been noticed in different species of Stachys and are classified as follows:

- a) Mesodiacytic type: The stomatal meristemoid is divided into 3 cells, orientated in parallel, by 2 consecutive cutting faces parallel to their opposite walls (Fig. 24 A: 2-3). The plane of division is anticlinal to side walls. The middle cell is lenticular and more densely protoplasmic which is the guard mother cell (g.m.c.) surrounded by two subsidiaries, mesogenous in origin i.e. originated from the meristemoid. Then there is a last division in the g.m.c. at right angles to the plane of the two first divisions. A gap appears between the guard cells and the stomatal opening is formed. The resulting stomata is diacytic and mesogenous e.g. in S. citrina, S. pumila (Fig. 24 A: 1-5), S. lavandulifolia and S. macrostachya (Pl. 12, A-B, C-D).
- b) Perigenous anomocytic type: The meristemoid is transformed directly into a g.m.c. and no mesogenous subsidiary cells are formed. On the contrary, the

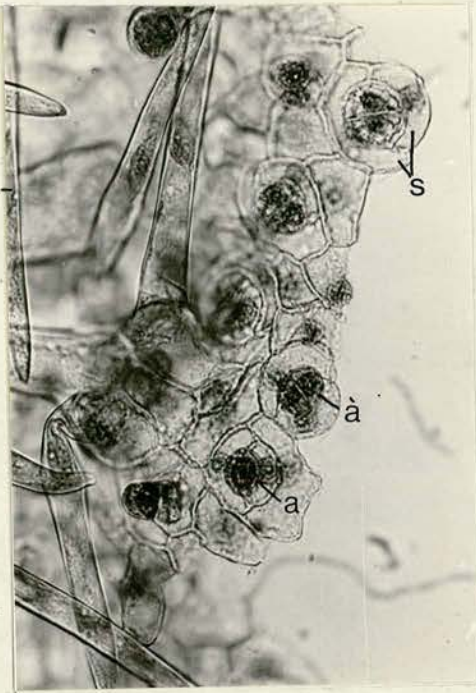
Pl.12.

DEVELOPMENT OF STOMATA

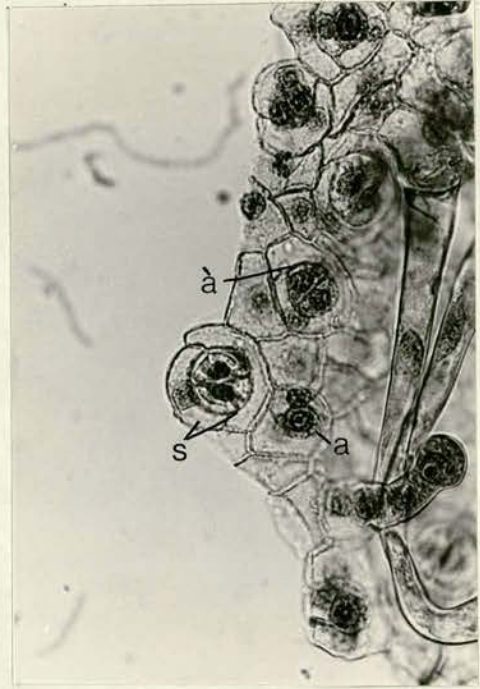
(Explanation in the text)

A - B - Developmental stages of diacytic stomata in S. lavandulifolia
(x 550); C - D - Developmental stages of diacytic stomata in
S. macrostachya (x 616).

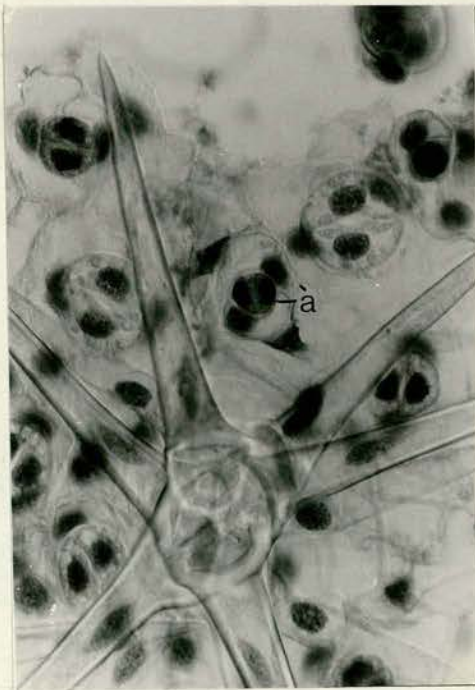
(a - guard mother cell; a - dividing guard mother cell;
b - meristemoid; c - subsidiary cells).



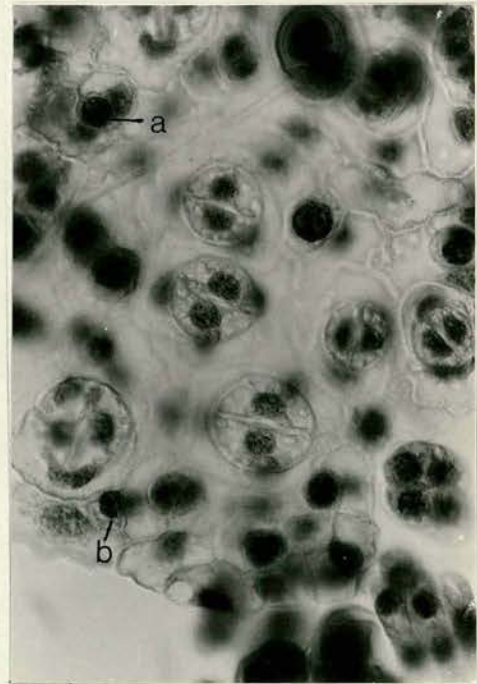
A



B



C



D

surrounding cells are not distinguishable from other epidermal cells and considered to be perigenous in origin. The g.m.c. divides by a single division to form 2 guard cells of the stoma. Examples are found more frequently in S. alpina, S. balansae (Fig. 25 C) and less frequently in S. pumila, S. citrina, etc. (Fig. 25 D).

c) Mesoperigenous diacytic and anomocytic type: The meristemoid divides by an anticlinal wall into one subsidiary cell of mesogenous origin and the other cell is directly transformed into a g.m.c. The cell or cells of the other side of g.m.c. is perigenous, i.e. not developed from the meristemoid and the number can be one or more than one. The g.m.c. divides into two guard cells whose wall is at right angles to the wall of the first division (Fig. 24 B: 3,4). The stoma thus formed is mesoperigenous in origin (Fig. 24 B). So the stoma, if surrounded by 2 subsidiaries on two sides, one mesogenous and the other perigenous, becomes diacytic (Fig. 24 B; 2-5); and if surrounded by more than two cells, 1 mesogenous and the rest perigenous, the stoma becomes anomocytic, e.g. S. alpina, S. balansae etc. (Fig. 24 B, 1).

In the species studied above though two types of stomata, anomocytic and diacytic, occur together, their frequency of distribution varies. In S. alpina, S. balansae etc. anomocytic stomata are more prevalent than the diacytic type in which the development is mesoperigenous, and perigenous, while in S. citrina, S. lavandulifolia, S. pumila etc. diacytic stomata or mesogenous origin predominate over anomocytic ones.

Enough species of Stachys have not been studied to evaluate the taxonomic significance of stomatal development.

D. POLLINATION AND FRUIT DISPERSAL

Pollination: Flowers in this genus are usually entomophilous and nototribic, i.e. pollen is normally transferred to the upper side of the pollinator's body. Bees, particularly bumble-bees, are claimed to be frequent pollinators (Knuth, 1909, Proctor & Yeo 1973). Müller (1883) and later Kugler (1955) noticed some species visited by hoverflies. Besides that, species like S. palustris, S. fontqueri etc. have been found to be pollinated by butterflies (Proctor & Yeo, 1973, Davis (obs!)) in addition to bees).

The construction of the flower favours pollination by bees and butterflies, i.e. insects with long probosces, as the nectary is situated at the bottom of relatively long corolla tube. The median lobe of the lower corolla lip forms a landing stage which is usually marked by honey guides, e.g. in S. sylvatica, S. palustris, S. annua etc. The upper corolla lip forms a hood protecting the stigma and the anthers. Flowers are either protandrous (S. recta, S. palustris, S. spectabilis, S. officinalis etc.) or show homogamy (S. macrantha, S. annua, S. arvensis etc.) as pointed out by Knuth (1909). He further suggested that the protandrous flowers are either strictly protandrous (S. recta) or not. In the latter case as a rule cross-pollination is probably achieved, but if it fails self pollination is automatic. Proctor & Yeo (1973) failed to establish how much outbreeding is actually taking place, but are of the opinion that there is no barrier to prevent self-pollination. However, they demonstrate ⁱⁿ that/a newly opened flower the stigma lies on the abaxial side of the anthers (away from the surface of dehiscence) and is not readily touched by visiting insects. After the shedding of pollen, the stigma bends down and is thus exposed below the stamens at the entrance to the flowers.

Development-stages (from young bud to mature and open flower) have been studied by me in S. officinalis, S. spectabilis and S. arvensis. In the first

Fig. 26. Developmental stages of flowers in

S. arvensis and S. officinalis

 (Explanation in the text)

A, a - d - Flower & flower buds of S. arvensis split open;
a - flower bud with undehisced anthers; b - c - bud with anterior
pair of anther dehisced; d - both pairs of anthers dehisced;
A - Fully formed flower. B, e - g - Flower and flower buds of
S. officinalis split open; e - flower bud with undehisced
anthers; f - anthers just dehisced; g - both pairs dehisced;
B - bud just opened (stigma at lower level); C - Mature flower
(stigma at higher level).

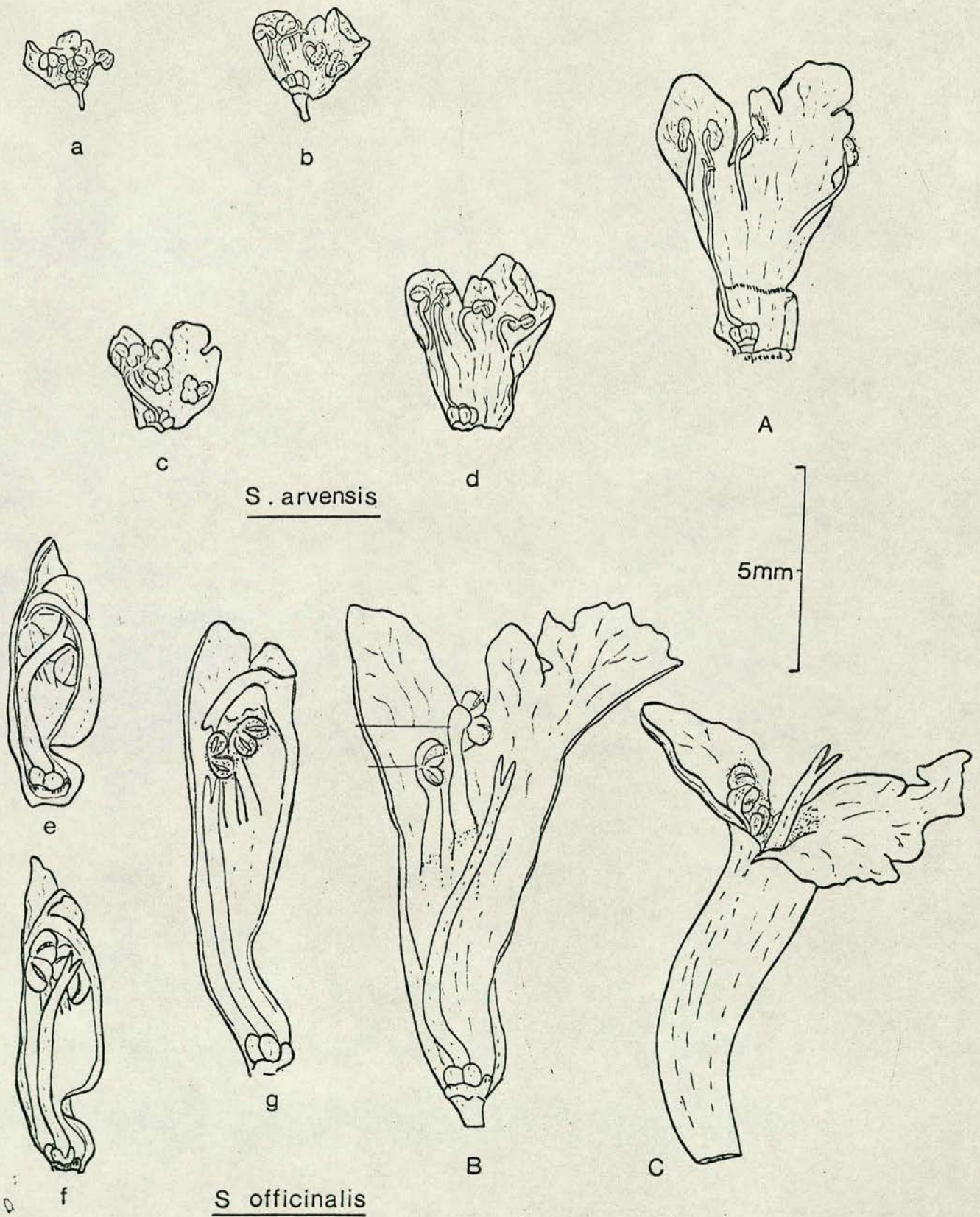


Fig. 26 Developmental stages of flowers

two species anthers dehisce while the flower is in the bud stage (just before opening) and the stigmatic lobes are at the same level as the anthers. After anthesis (when the anthers shrivel up), the stigma rises beyond the level of the anthers (Fig. 26). This behaviour points to protandry. According to Knuth and others, self-pollination may occur beforehand as the stigma is receptive at the same time as it passes between dehiscing anthers.

Automatic self-pollination is evident in S. arvensis where the flower is very inconspicuous in colour and size and the corolla remains almost hidden in the calyx. Developmental stages show that both pairs of anthers dehisce long before the opening of the flower, and the stigma lies in close contact with the anthers. There is no protrusion of the stigma at maturity, and automatic self-pollination takes place (Fig. 26). Seed output is normal in a single isolated plant which demonstrates self-compatibility.

Dispersal of fruits: The nutlets at maturity are surrounded by the persistent calyx, the mouth of which is often provided with a ring of dense hairs, e.g. S. satureioides, S. libanotica, S. pseudosideritis etc. In Sect. Satureioides and in the species S. pseudosideritis and S. annua, the mature calyx is constricted at the middle, enclosing the nutlets inside. The pedicels of the flowers as well as the whole inflorescence axis are quite tough, so that the fruiting calyces are less likely to be carried away by the direct action of the wind. On the other hand, too frequent dispersal may be obstructed by the hairs present at the calyx mouth, and the nutlets may thus be distributed at intervals by wind action. Spinescent calyx teeth (e.g. in S. germanica, S. cretica) may catch on to the fur of passing animals which could also help to shake out the nutlets. In cliff species seed dispersal may be aided by convection currents. In a few species (e.g. S. saxicola) mature calyces containing nutlets may become loosened from the inflorescence

axis and carried by the wind for some distance before the nutlets are all freed. In some desertic species, e.g. S. inflata, the fruiting calyx is very much inflated to form a more or less spherical structure and would facilitate wind dispersal of the nutlets if the calyx is finally deciduous.

The nutlets of Stachys are not well equipped with any mechanism for long-range dispersal. Though in the Subgenus Betonica and in some of the species of Subgenus Stachys like S. fragillima and S. trinervis the nutlets are provided with wings (Fig. 16, 17 A, H), they are inconspicuous in comparison to the size and weight of the fruit and could scarcely help in dispersal. Thus the diaspores usually remain in the immediate vicinity of the parent habitat.

However, whirl-winds are common in Anatolia, and carry a large amount of plant material and might deposit seeds miles away (Davis, in verbis). Finally, it is possible that in some annuals, the whole plant may behave as a tumbleweed, as the bushy structure of the plant body suggests, e.g. Sections Satureioides, Neurocalyx and S. pseudosideritis. Field observation is needed to verify this suggestion.

III. INFRAGENERIC CLASSIFICATION

A. INTRODUCTORY COMMENTS:

a. The status of *Betonica*

Following the history of the genus *Stachys* L. and *Betonica* L. and their infrageneric classifications (Ch. 1 p.6 & 7) and the controversies that arose about them from time to time, a new infrageneric (supraspecific) classification has been proposed here with the aim of reaching a more definite taxonomic conclusion. In accordance with classical taxonomic practice, herbarium materials have been utilised with individual species being the units of study. Data have largely been derived from inherent morphological characters, but geographical distribution has also been taken into consideration from herbarium and literature records. Grouping of the species was largely accomplished by overall resemblances and the recognition of character correlations, conforming to orthodox practice.

Throughout the whole history of classification of *Stachys*, differences in opinion have been expressed about the status of *Betonica*. To come to a stable conclusion, members of *Betonica* have been surveyed throughout the whole geographical range and compared with the nearest groups of *Stachys*, mainly on the basis of morphological and a few anatomical features. The variations of most of the diagnostic and differential characters are summarised in Table I. The '+' and '-' signs are assigned for presence or absence, and the signs in parenthesis for scarce occurrence.

The variation pattern within *Betonica* (which comprises only 9 species) can best be evaluated by comparing it with related sections of *Stachys*. The sections most closely related to *Betonica* are *Eriostomum* and to a lesser extent sections *Fragilicaulis*, *Infrarosularis* and *Olisia*. Besides that,

sections Ambleia and Zietenia of Stachys have also been compared as they resemble Betonica in ^a few characters. For the morphological characters most of the available species have been surveyed thoroughly, but for anatomical characters careful sampling has been done for 2-3 species of every section of Stachys, whereas in Betonica all the 19 species have been examined. Species examined for anatomical characters are used in Appendix A.

The Betonica group is characterised by prominent sterile rosettes, and usually unbranched flowering shoots arising from an axillary bud of the root stock (except for the annual S. serbica). Besides that, the leaf margins are deeply crenate to serrate.

In S. germanica s.l. and S. alpina of Sect. Eriostomum, such characters as unbranched flowering stems and in S. alpina deeply crenate-serrate leaves occur, thus breaking down the distinction. The floral leaves of Betonica usually become abruptly smaller from below upwards, but in S. (Betonica) betoniciflora the floral leaves become gradually smaller as in the other groups of Stachys. Besides that, the upper bractiform floral leaves, \pm constant in the Betonica group, have also been found in Sect. Olisia, Subsect Distantes (cf. S. aleurites and S. bombycina). In the general structure of the flowers, uniformity in both these groups has been observed, except in the nature of calyx and bracts, which are sessile with a broad and hardened base in Betonica, whereas in Stachys calyces have short or long pedicels and bracts are with a narrow and soft base. Besides these features, the presence of exannulate corolla, \pm constant in Betonica group (except in S. alopecuros), breaks down in some species (cf. S. longiflora, S. pinardii) of Stachys, and parallel anther loculi of Betonica have been found in some species of Sect. Ambleia

Table I.

Character variation in Subgenera and Sections of *Stachys* L.

Differential and Diagnostic Characters	Subgenus <i>Stachys</i>						Subgenus <i>Betonica</i>
	Sect. <i>Eriostomum</i>	Sect. <i>Infra-rosularis</i>	Sect. <i>Fragilicaulis</i>	Sect. <i>Amblyia</i>	Sect. <i>Zietenia</i>	Sect. <i>Oliria</i>	
1. Basal sterile rosettes	+-	+	-	-	+	(+)-	+
2. Flowering shoot in perennials lateral to rootstock	-	-	-	-	-	-	+
3. Flowering shoot usually unbranched	+(-)	+	-	-	(+)-	-	+(-)
4. Floral leaves bractiform above	-	-	-	-	-	-(+)	+
5. Floral leaves abruptly smaller above	-	-	-	-	+	+(-)	+(-)
6. Leaf margin distinctly crenate	+-	-	+-	-	-	-	+
7. Indumentum with stellate/dendroid hairs	-	-	-	+	+	-	+-
8. Flowers & bracts sessile with hard base	-	-	-	-	-	-	+
9. Corolla exannulate	-	-	(+)-	-	-	-	+(-)
10. Anther cells parallel to subparallel	-	-	-	+	-	-	+
11. Nutlet flattened trigonous with flat marginal wing	-	-	(+)-	-	-	-	+
12. Nutlets with apical lobes	-	-	-	-	-	-	+(-)
13. Nutlet sclerenchyma without pitted thickening	-	-	-	-	-	-	+
14. Leaf petiole with adaxial phloem	-	-	-	-	-	-	+

Key: '+' presence; '-' absence; (+ or -) scarce presence or absence

(cf. S. inflata, S. nivea etc.) where the anther cells are subparallel to almost parallel. The flattened trigonous nutlet with prominent marginal wings is a constant feature in Betonica, but this character is also found in S. fragillima of Sect. Fragilicaulis. The only diagnostic morphological feature in Betonica is the presence of sessile flowers and bracts with hardened base. Among anatomical features, the presence of ~~radial~~ ^{axial} phloem in the petiole and nutlets without pitted thickenings in the sclerenchyma are characters constant in Betonica, that have not been observed in Stachys. However, confirmation on these anatomical differences need much more extensive sampling. Stachys (excl. Betonica) is ^a large and a variable group, and the inclusion of Betonica will broaden its limits further. Mainly emphasising the number of differential characters which are of inconstant occurrence in one group (Stachys) but more constantly occurring in the other (Betonica), the separation of them at some taxonomic level seems justified. In view of the character states discussed above, the Betonica group is best treated as Stachys subgenus Betonica and the rest as subgenus Stachys. Placing of Betonica at co-ordinate sectional rank with other sections of Stachys is not satisfactory as the morphological gap between Betonica and Stachys s.str. is of a different order to those that distinguish the sections of the latter.

b. Sectional classification of Subgenus Stachys

Subgenus Stachys shows a wide range of variability difficult to define. In the previous sectional classifications of Bentham (1834, 1848) and Boissier (1879), weighting was apparently given to a few selected characters like annual/perennial habit, number of flowers and bracts per verticillasters; as a result the few sections recognised, such as Eriostachys, Stachyotypus, Zietenia,

Olisia etc. were mostly large and at least partly heterogenous assemblages of unrelated or distantly related species. Whereas if sections can be distinguished on the basis of several well correlated characters, they will evidently be of smaller size and more homogeneous with significant gaps between them (Davis & Heywood, p. 84, 1963). To achieve a phenetic classification which is likely to reflect monophyly, this second aim is more acceptable as long as it shows a rational compromise between "splitting" and "lumping". No doubt the wide range of form and structure in any group is the outcome of evolutionary history, but in Stachys, lacking a fossil record, we are ignorant of cladistic relationships. The resemblances between apparently related groups may either be due to patristic similarity or to convergence or even parallelism. But there is one approach that helps to overcome this shortcoming, i.e. to base our classifications on as many characters as possible: maximum attribute classification. Convergence tends to effect suites of characters influenced by the same environmental pressures; the more characters are used in constructing the groups (though not necessarily in diagnosing them), the more 'natural' they are likely to be i.e. the more they will reflect common ancestry instead of being the product of convergence.

With these considerations in mind, more large heterogeneous groups of previous taxonomists (cf. Sect. Zietenia and § Fruticulosae of Bentham, 1834 and Boissier 1879 respectively) have been split up into a few smaller and even monotypic sections and subsects. The large group "Fruticulosae" of Boissier was mainly erected on suffruticose habit, and a number of clearly unrelated species (cf. S. mucronata, S. spinosa, S. glutinosa, S. fruticulosa etc) were assembled in it. This habit is mainly an adaptation to xeric conditions (rocky substrata and drier climate) and/or to a long history of heavy grazing.

To cope with these adverse conditions, quite a number of unrelated species of the same and even different genera and families show similar modifications in habit, e.g. copious branching of the main flowering axis, correlated with a reduction in number of flowers per verticillaster (usually 1-2, rarely 4). My observation has been strengthened by examination of species with similar facies in the Labiate genera Teucrium (T. microphyllum from Crete and S. Greece, T. subspinosum from Sardinia) and Satureia (S. spinosa from Crete).

In the present classification Boissier's 'Fruticulosae' (1879) has been divided into one monotypic section Mucronata and 4 other fairly small sections (Candida, Swainsoniana, Thamnostachys and Aucheriana) and Sect. Olisia subsect. Spinosa (Monotypic). Following the same principle, 4 other monotypic sections, Roseostachys, Corsica, Neurocalyx and Zietenia have been recognised by segregating them from heterogeneous groups of previous classifications. When these monotypic sections are compared with other larger but relatively homogeneous sections like Sect. Eriostomum, Sect. Olisia and Sect. Ambleia, it is clear that both the smaller and larger groups are very distinct in their own right. Emphasis has been mainly laid on consistency of treatment, so that these larger and smaller groups reveal supposedly monophyletic relationships. On the other hand, inclusion of these smaller and monotypic sections in large but homogeneous ones will make the latter completely 'unnatural'. Treatment of these larger and smaller infrageneric groups as independent sections seems justified by the fact that they differ from one another in a similar order of magnitude.

c. Infrageneric categories

The infrageneric groups cannot be defined except in terms of the species

comprising them. The usage of the categories like subgenus, section, subsection etc. are subjective and very often traditional. Walters (1961) pointed out that it is subjective in the sense that what is a subgenus or section to one taxonomist may be a section or subsection to another, and traditional in the sense that the whole shape of angiosperm classification is more or less pre-determined by some historical and philosophical background from post-Linnean times. Taxonomists are reluctant to deviate from these traditional groupings. But accumulated evidence from different fields of approach demands that the traditional classifications sometimes need considerable modification in the light of new information.

d. Conclusions:

With these background informations on infrageneric classifications and the problems sought there in regarding the heterogeneity of the taxa, I have tried to find a solution in proposing a new classification with an intention to make it as natural as possible. My study is mainly centred on broad morphological survey of the genus coupled with literature information on geography. Almost all available species have been investigated (see appendix for list).

The genus has been broadly divided into two subgenera, viz. Stachys and Betonica, the former being divided into 19 sections and the latter into 2. The author accepts some of the main sectional names of Dumortier (1827) and Bentham (1834) on grounds of priority. The ranks of Boissier's (1879) subgroups of sections could not be accepted because he published them without a clear indication of the rank intended. (i.e. by '§' signs without indicating a formal rank). Some of them have been assigned sectional rank under

new authorship; others are given new names. The new 'subsections' and 'series' in Komarov's Fl. URSS 21 (1954) have remained invalid, not having been provided with Latin diagnoses or descriptions. In my account, all the species are classified to formal 'subsectional' level; below this, some informal 'series' have been recognised without any name. A key to all infrageneric groups has been provided and is followed later by descriptions, citations and other necessary information dealing with relationship of the groups. The infrageneric groups and species have been arranged and numbered in as natural a sequence as a linear arrangement allows. A chart showing the interrelationships of the infrageneric groups (Fig. 27) has been presented. They are arranged in relation to two axes, a horizontal axis which separates the annual groups from the perennial ones, and a vertical axis which divides the groups on the nature of bracts. Some amount of intermediacy inside the groups is shown by protrusion of the group boundaries. Besides that, a comparative table of present-day and a few important previous classifications, connected with the history of classification has also been included (Table 2). Latin diagnoses of the new sections, subsections and some unpublished combinations have been deferred. Those are listed in the index.

The main floristic works consulted for synonymy and geographical distributions are listed here in alphabetical order:

Bentham (1834, 1848), Boissier (1879), Dumortier (1827), Fiori & Paoletti (1903), Grossheim (vol. 7, 1967), Halácsy (vol. 2, 1902), Hayek (vol. 2, 1931), Heywood (vol. 3, 1972), Jahandiez & Maire (vol. 3 & 4, 1934, 1941), Koch, W. (1837), Komarev (vol. 21, 1954), Kotov (vol. 9, 1960), Parsa (vol. 4, 1949), Post ed Dinsmore (vol. 2, 1939), Quézel & Santa (vol. 2, 1963), Rechinger (1943), Reichenbach (1830) and others.

Fig. 27.

PHENETIC RELATIONSHIPS OF SUBGENERA

AND SECTIONS OF STACHYS

The subgenera and sections are arranged in their affinities and in relation to two axes. A horizontal axis separates annual and perennial taxa and a vertical axis divides conspicuously bracteate taxa from inconspicuously bracteate to ebracteate taxa. The size of the groups correspond to the size of the constituent taxa within it. Some amount of character intergradations have been shown by the projection of groups through two axes.

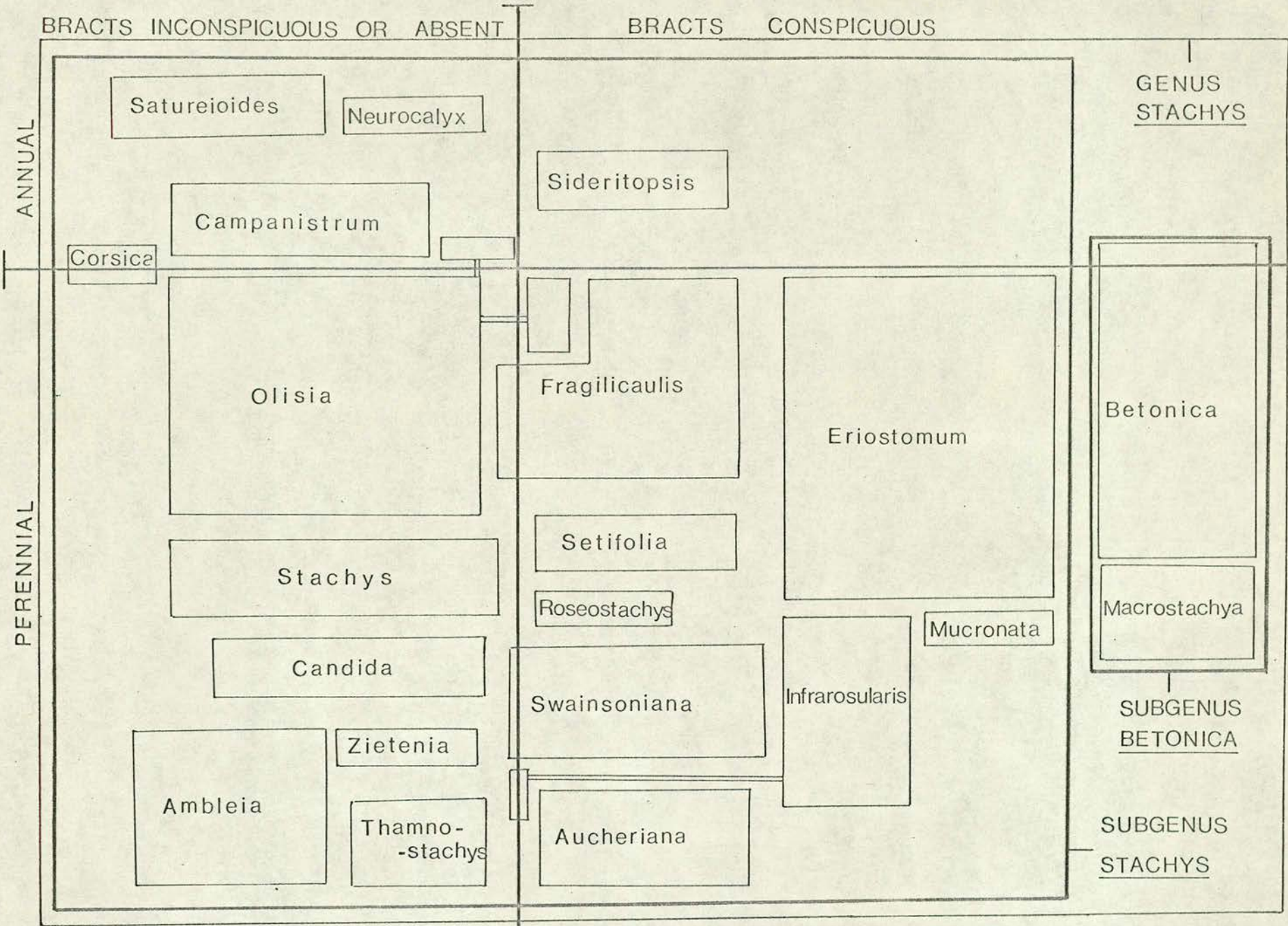


FIG. 27 PHENETIC RELATIONSHIPS OF SUBGENERA & SECTIONS OF STACHYS

Table 2

Comparative table of the present and some of the previous infrageneric c

Bhattacharjee, 1973	Bentham (1834)	Bentham (1848)	
Subgenus <u>Stachys</u> Sect. <u>Eriostomum</u>	- Sect. <u>Eriostachys</u> (Reich.) Benth.	-	Sect. excl.
Sect. <u>Acanthodonta</u> Bhattacharjee		Sect. <u>Zietenia</u> (Gled.) Benth. p.p.	Sect. § Fru
Sect. <u>Infrarosularis</u> Bhattacharjee	Sect. <u>Zietenia</u> (Gled.) Benth. p.p.		Sect. § Inf
Sect. <u>Fragilicaulis</u> Bhattacharjee		Sect. <u>Eriostachys</u> (Reich.) Benth. p.p., Sect. <u>Chamaesideritis</u> (Reich.) Benth. p.p. & Sect. <u>Stachyotypus</u> Benth. p.p.	Sect. § Fru § Rec
Sect. <u>Olisia</u> Dumort. (1827)	Sects. <u>Stachyotypus</u> Benth. p.p., <u>Olisia</u> Dum. p.p. <u>Chamae-</u> <u>sideritis</u> (Reich.) Benth. p.p. & <u>Zietenia</u> (Gled.) Benth. p.p.		Sects & <u>Oli</u>
Sect. <u>Swainsoniana</u> Bhattacharjee	Sects. <u>Zietenia</u> (Gled.) Benth. p.p. & <u>Olisia</u> Dum. p.p. excl. typ.	Sects. <u>Chilostachys</u> Benth. p.p. <u>Zietenia</u> (Gled.) Benth. p.p. <u>Stachyotypus</u> Benth. p.p. & <u>Olisia</u> Dum. p.p.	Sect. § Fru § Syl
Sect. <u>Candida</u> Bhattacharjee	Sect. <u>Stachyotypus</u> Benth. § <u>Ruderales</u> p.p.		Sect. § Fru
Sect. <u>Roseostachys</u> Bhattacharjee	-	-	Sect. § Mic
Sect. <u>Setifolia</u> Bhattacharjee	-	Sect. <u>Eriostachys</u> (Reich.) Benth. p.p.	Sects § Mic Stach § Syl
Sect. <u>Stachys</u>	Sect. <u>Stachyotypus</u> Benth. § <u>Genuineae</u> Benth. p.p. § <u>Ruderales</u> Benth. p.p.	Sect. <u>Stachyotypus</u> Benth. § <u>Elatae</u> Benth. § <u>Ruderales</u> Benth. p.p.	Sect. § Syl
Sect. <u>Campanistrum</u> (Habrl.) Reichenbach (1830)	Sect. <u>Stachyotypus</u> Benth. p.p. <u>Olisia</u> Dum. p.p.		Sect.
Sect. <u>Corsica</u> Bhattacharjee	Sect. <u>Stachyotypus</u> Benth. § <u>Oligantheae</u> Benth. p.p.	Sect. <u>Stachyotypus</u> Benth. § <u>Agrestes</u> Benth. p.p.	

meric classification of Stachys in Europe, N. Africa & S.W. Asia

Boissier (1879)	Briquet (1896)	Knorring (1954)
- Sect. <u>Eriostachys</u> (Reich.) Benth. excl. § <u>Micranthae</u> Boiss. p.p.	- Sect. <u>Eriostomum</u> (Hoffm. et Link) Briq. excl. § <u>Micranthae</u> Boiss.p.p. & § <u>Biflorae</u> Briq.	- Sect. <u>Eriostachys</u> Benth.
Sect. <u>Stachyotypus</u> Benth. § <u>Fruticulosae</u> Boiss. p.p.	Sect. <u>Eustachys</u> Briq. § <u>Infrarosulares</u> (Boiss.) Briq.p.p.	-
Sect. <u>Stachyotypus</u> Benth. § <u>Infrarosulares</u> Boiss. p.p.	Sect. <u>Eustachys</u> Briq. § <u>Infrarosulares</u> Boiss. p.p.	-
Sect. <u>Stachyotypus</u> Benth. §§ <u>Fragiles</u> Boiss. p.p. & §§ <u>Rectae</u> Boiss. p.p.	Sect. <u>Eustachys</u> Briq. § <u>Fragiles</u> Boiss. p.p.	Sect. <u>Stachyotypus</u> Benth. subsect. <u>Rectae</u> Knorr. p.p.
Sects. <u>Stachyotypus</u> Benth. p.p. & <u>Olisia</u> Dum. p.p.	Sect. <u>Eustachys</u> Briq. p.p.	Sects. <u>Stachyotypus</u> Benth. subsect. <u>Rectae</u> Knorr. p.p.
Sect. <u>Stachyotypus</u> Benth. §§ <u>Fruticulosae</u> Boiss. p.p. §§ <u>Sylvaticae</u> Boiss. p.p.	Sect. <u>Eustachys</u> Briq. §§ <u>Fruticulosae</u> Boiss. p.p. & §§ <u>Genuineae</u> Benth. p.p.	-
Sect. <u>Stachyotypus</u> Benth. § <u>Fruticulosae</u> Boiss. p.p.	Sect. <u>Eustachys</u> Briq. § <u>Fruticulosae</u> Boiss. p.p.	-
Sect. <u>Eriostachys</u> (Reich.) Benth. § <u>Micranthae</u> Boiss. p.p.	Sect. <u>Eriostomum</u> (Hoffm. & Link) § <u>Biflorae</u> Briq.	-
Sects. <u>Eriostachys</u> (Reich.) Benth. § <u>Micranthae</u> Boiss. p.p. & <u>Stachyotypus</u> Benth. § <u>Sylvaticae</u> Boiss. p.p.	Sects. <u>Eriostomum</u> (Hoffm. & Link) Briq. § <u>Micranthae</u> Boiss. & <u>Eustachys</u> Briq. § <u>Genuineae</u> Benth. p.p.	Sect. <u>Eriostachys</u> (Reich.) Benth. subsect. <u>Setiferae</u> Knorr.
Sect. <u>Stachyotypus</u> Benth. § <u>Sylvaticae</u> Boiss. p.p.	Sect. <u>Eustachys</u> Briq. § <u>Genuineae</u> Benth. p.p.	Sect. <u>Stachyotypus</u> Benth. subsects. <u>Sylvaticae</u> Knorr. & <u>Palustres</u> Knorr.
Sect. <u>Olisia</u> Dum.	Sect. <u>Eustachys</u> Briq. § <u>Olisiae</u> Briq. p.p.	Sect. <u>Olisia</u> Dum.
-	Sect. <u>Eustachys</u> Briq. § <u>Olisiae</u> Briq. p.p.	-

Table 2 (contd.)

Bhattacharjee, 1973	Bentham (1834)	Bentham (1848)	
Sect. <u>Thamnostachys</u> Kapeller (1961)	Sect. <u>Zietenia</u> (Gled.) Benth. p.p.		Sect. § Fru
Sect. <u>Aucheriana</u> Bhattacharjee	-	Sect. <u>Zietenia</u> (Gled.) Benth. p.p.	Sect. § Fru
Sect. <u>Zietenia</u> (Gled.) Benth. (1834)	Sect. <u>Zietenia</u> (Gled.) Benth. p.p.		Sect. § Inf
Sect. <u>Amblesia</u> Benth. (1834)	Sect. <u>Amblesia</u> Benth. p.p.	Sects. <u>Amblesia</u> Benth. & <u>Zietenia</u> Benth. p.p.	Sect. § Amb
Sect. <u>Sideritopsis</u> Bhattacharjee	-	-	Sect.
Sect. <u>Neurocalyx</u> Bhattacharjee	-	-	Sect.
Sect. <u>Satureioides</u> Bhattacharjee	-	Sect. <u>Olisia</u> Dum.	Sect.
Subgenus <u>Betonica</u> (L.) Bhattacharjee Sect. <u>Betonica</u> (L.) Bentham	Sects. <u>Betonica</u> (L.) Benth. & <u>Alopecuros</u> Benth. Sects. <u>Betonica</u> (L.) Benth. & <u>Alopecuros</u> Benth.	Genus <u>Betonica</u> L.	Genus →
Sect. <u>Macrostachya</u> Bhattacharjee	Sect. <u>Betonica</u> (L.) Benth. p.p.		→

Boissier (1879)	Briquet (1896)	Knorring (1954)
Sect. <u>Stachyotypus</u> Benth. § <u>Fruticulosae</u> Boiss. p.p.	Sect. <u>Eushys</u> Briq. § <u>Fruticulosae</u> Boiss. p.p.	Sect. <u>Stachyotypus</u> Benth. subsect. <u>Fruticulosae</u> Boiss. p.p. & <u>Zappanioides</u> Knorr.
Sect. <u>Stachyotypus</u> Benth. § <u>Fruticulosae</u> Boiss. p.p.	Sect. <u>Eushys</u> Briq. § <u>Fruticulosae</u> Boiss. p.p.	-
Sect. <u>Stachyotypus</u> Benth. § <u>Infrarosulares</u> Boiss. p.p.	Sect. <u>Eushys</u> Briq. § <u>Infrarosulares</u> Boiss. p.p.	Sect. <u>Stachyotypus</u> Benth. subsect. <u>Lavandulifoliae</u> Knorr.
Sect. <u>Stachyotypus</u> Benth. § <u>Ambleiae</u> Boiss. p.p.	Sect. <u>Eushys</u> Briq. § <u>Ambleiae</u> Boiss. p.p.	Sect. <u>Stachyotypus</u> Benth. subsect. <u>Inflatae</u> Knorr.
Sect. <u>Olisia</u> Dum.	-	-
Sect. <u>Olisia</u> Dum.	Sect. <u>Eushys</u> Briq. § <u>Olisariq.</u> p.p.	-
Sect. <u>Olisia</u> Dum.	Sect. <u>Eushys</u> Briq. § <u>Olisariq.</u> p.p.	-
Genus <u>Betonica</u> L. →	Sects. <u>Beica</u> (L.) Benth. & <u>Alopecurus</u> Benth →	Genus <u>Betonica</u> -
→	→	-

d. Classification of some morphological terms:

To avoid any misinterpretation some terms used in keys and descriptions and adopted later in the Turkish account are clarified below.

1. Basal leaves: When the leaves are arranged in a rosette at the base of the flowering or sterile shoots.
2. Cauline leaves: Leaves on the flowering stem; they are divided into lower and median cauline leaves.
3. Floral leaves: Leaves (called "bracts" by some authors) subtending the verticillasters.
4. Bracts and bracteoles: Subtended in the axils of flowers. For relative length of bracts and bracteoles in proportion to calyx, the length of the former is always measured from the base of the calyx and not from the point of their attachment, as it varies according to the variable length of the pedicel.
5. Verticillasters: The whole whorl or cluster of flowers at the node, in the axils of two opposite floral leaves. When the verticillasters is referred to as "1-flowered", it means that only one flower is present in the whole whorl, the other being suppressed; when "2-flowered", then one flower is present in the axil of each floral leaf (and so on).
6. Calyx: The whole length includes teeth, tube and mucro. The calyx is described as \pm regular when the teeth are \pm equal and the tube not oblique, i.e. not more curved on one side than the other (cf. Fig. 12 C, G, I). On the other hand, the calyx is referred to as sub-bilabiate or bilabiate according to the unequalness of upper and lower teeth and also in relation to the obliqueness of the tube and mouth.
7. Corolla: The exertion and inclusion of the corolla is always referable

to the corolla tube in relation to the calyx tube, unless it is specified otherwise. In very few instances (as in S. arvensis and S. pseudosideritis) the corolla, including tips and tube, is included in the whole calyx (including teeth).

8. Indumentum: Hair types have been used according to the definitions used by Stearn (1966) and Uphof (1962)

B. KEY TO SUBGENERA AND SECTIONS

1. Flowers sessile; flowers and bracts with broad and hardened base; lower cauline leaves deeply crenate-dentate; nutlets compressed trigonous with flattened lateral and apical winged margins, apical wing usually irregularly lobed II. Subgen. Betonica
2. Indumentum without stellate hairs; leaves usually broadly ovate-oblong or ovate Sect. 20. Betonica
2. Indumentum with stellate hairs at least on lower surface of leaves and inflorescence parts; leaves usually narrowly oblong-lanceolate Sect. 21. Macrostachya
1. Flowers pedicellate; flowers and bracts ^{with}/narrow and unhardened base; lower cauline leaves usually obscurely crenate to ± entire, rarely distinctly crenate; nutlets usually obovoid without flattened lateral and apical winged margins, apex not irregularly lobed I. Subgen. Stachys
3. Upper corolla lip densely sericeous-tomentose on outer surface, hairs usually exceeding the lip
4. Verticillasters 4-many flowered; calyx teeth not rigidly spinescent; flowering axis elongate, usually simple with few branches Sect. 1. Eriostomum
4. Verticillasters 2-flowered; calyx teeth rigid and stiffly spiny; flowering axis dwarf ^{di}/varicately branched and bushy Sect. 2. Mucronata
3. Upper corolla lip naked to sparsely hairy, hairs not exceeding the lip
5. Plants with creeping rhizomes, growing in damp places

6. Floral leaves spinescent; verticillasters with oblong acuminate bracts as long as or slightly shorter than calyx tube, stamens little exerted from corolla tube Sect. 5. Setifolia
6. Floral leaves not spinescent; verticillasters with inconspicuous and very few; short setaceous bracts as long as pedicels; stamens exerted as long as upper corolla lip Sect. 6. Stachys
5. Plants without creeping rhizomes, growing mainly in rocky habitats
7. Plants usually with conspicuous basal rosettes of sterile shoots, flowering axis usually unbranched, cauline leaves not more than 3-paired
8. Basal leaves ovate-elliptic to ovate-oblong, cordate to subcordate rarely cuneate at base; calyx teeth \pm half as long as calyx tube; indumentum without stellate hairs Sect. 3. Infrarosularis
8. Basal leaves oblong-lanceolate to oblanceolate, attenuate at base; calyx teeth 1.5-4 times longer than calyx teeth; indumentum with stellate hairs Sect. 18. Zietenia
7. Plants usually without basal rosettes of sterile shoots; when present, flowering axis conspicuously branched and cauline leaves at least more than 5-paired
9. Suffruticose perennials without basal rosettes
10. Flowering stems fragile at base; calyx tube and teeth herbaceous with blunt to softly spinescent tip Sect. 9. Fragilicaulis
10. Flowering stems not fragile at base; calyx tube and teeth non-herbaceous with mucronate or rarely blunt teeth

11. Indumentum with dendroid hairs, anther cells subparallel
 Sect. 19. Ambleia
11. Indumentum without dendroid or stellate hairs; anther
 cells divaricate
12. Stem floccose-tomentose to arachnoid with simple and crispulate
 eglandular hairs
13. Verticillasters with conspicuous ovate to ovate-lanceolate
 or lanceolate-subulate bracts as long as calyx or sometimes
 a little shorter Sect. 10. Olisia pp.
13. Verticillasters ebracteate or when bracts present very
 small, few and setaceous, as long as or shorter than
 pedicels
14. Verticillasters for the most part approximate in a dense
 spike; upper corolla lip entire or retuse Sect. 7. Candida
14. Verticillasters remote for the most part; upper corolla
 lip deeply emarginate Sect. 10. Olisia pp.
12. Stem adpressed-tomentose or pubescent, sometimes patently
 pilose with simple and straight eglandular and/or glandular hairs
15. Stem adpressed tomentose or pubescent, often eglandular
16. Flowering stem ending in stiff spines; verticillasters
 with herbaceous bracts with mucronate tips, as long as
 calyx tube; indumentum on stem long, sericeous-
 tomentose Sect. 10. Olisia pp.
16. Flowering stems not ending in spines; verticillasters
 with very small, setaceous bracts, \pm as long as pedicels;
 indumentum on stem not long, sericeous-tomentose

17. Stem sparsely puberulent; calyx tubular and \pm regular, inflated in fruit; calyx mouth glabrous Sect. 16. Thamnostachys
17. Stem adpressed-pubescent; calyx subcampanulate and \pm sub-bilabiate, not inflated in fruit; calyx mouth hairy Sect. 10 Olisia pp.
15. Stem patently pilose or hispid with glandular and eglandular hairs
18. Corolla tube included; calyx with blunt teeth, leaves sessile with cordate base Sect. 4. Roseostachys
18. Corolla tube exerted; calyx with pointed teeth; leaves petiolate with cordate to attenuate base
19. Stamens slightly exerted from the corolla tube; verticillasters remote; flowering stems ending in spinescent branches Sect. 17. Aucheriana
19. Stamens exerted, as long as the upper corolla lip; verticillasters approximate for the most part; flowering stems non-spinescent
20. Lower cauline leaves broadly ovate, 4-9 x 3-6cm, base distinctly cordate; verticillasters ebracteate or with very few and small setaceous bracts Sect. 6. Stachys pp.
20. Lower cauline leaves usually obovate to narrowly ovate-oblong or ovate-lanceolate, 1-5 x 0.5-2.5 cm, base attenuate to truncate rarely subcordate; verticillasters usually with conspicuous herbaceous bracts, as long as calyx or slightly less, rarely few and setaceous
..... Sect. 8. Swainsoniana

9. Annual or when perennial with basal rosettes (usually sterile at flowering time) or stems rooting at nodes
21. Stem shortly adpressed-pubescent or puberulent, sometimes with patent glandular hairs; calyx teeth triangular to lanceolate-subulate
22. Lower cauline leaves oblanceolate, attenuate at base; calyx urceolate in fruit, mouth densely hairy; always annual Sect. 15. Satureioides
22. Lower cauline leaves ovate-lanceolate to ovate elliptic, cordate to cuneate at base; calyx not urceolate in fruit, mouth sparsely hairy; annual or when perennial with basal rosettes of leaves Sect. 10. Olisia pp.
21. Stem patently pilose or hispid (ca 2mm) with glandular and eglandular hairs, rarely glabrescent; calyx teeth oblong to oblong-lanceolate
23. Calyx bilabiate and prominently nerved in fruit; lower cauline leaves obovate, attenuate^{to cordate}/at base; always annual
24. Plant glabrescent; verticillasters ebracteate; corolla lips exerted from calyx (tube and teeth) Sect. 14. Neurocalyx
24. Plant hispid to pilose; verticillasters bracteate; corolla lips included in calyx (tube and teeth) Sect. 13. Sideritopsis
23. Calyx sub-bilabiate, not prominently nerved in fruit; lower cauline leaves ovate to ovate-elliptic, cordate to subcordate at base; annual or perennial

25. Plant rooting at nodes, \pm perennial; verticillasters

2-flowered Sect. 12. Corsica

25. Plant not rooting at nodes, annual; verticillasters

\pm 6-flowered Sect. 11. Campanistrum

C. SYSTEMATIC ACCOUNT OF STACHYS AND ITS INFRAGENERIC GROUPS

- Genus STACHYS L., Gen. Pl. ed. 5: 253 (1754); Sp. Pl. 580 (1753);
 Benth., Lab. Gen. et Sp. 525 (1834); Benth. in DC., Prodr. 12:
 462 (1848) ex p.; Brig. in Engler & Prantl, Natürl. Pflazenfam.
 4(3a): 260 (1896)
 Incl. Betonica L., Gen. Pl. ed. 5: 250 (1754); Sp. Pl. (1753).

Annual and perennial herbs, sometimes suffruticose or rarely dwarf shrubs. Leaves simple, broadly ovate-cordate to lanceolate, petiolate or sessile. Verticillasters 2-20-flowered, dense or remote, with or without bracts and bracteoles. Pedicels present or absent. Calyx tubular to campanulate, 5-10-nerved, usually smooth, rarely ridged but never deeply sulcate, sub-bilabiate to \pm regular, rarely bilabiate; teeth 5, usually subequal, sometimes posterior 3 distinct from 2 anterior, not dilated at base. Corolla tube subexserted or exserted, rarely included in calyx tube and usually non-dilated towards mouth, annulate or rarely exannulate; limb bilabiate, upper lip erect to subpatent, concave, entire or emarginate, rarely strongly forked, lower lip trilobed, the median one largest and entire to emarginate. Stamens 4, ascendant, exserted from corolla tube, posterior pair usually shorter than anterior pair, rarely \pm at the same level and arising at a higher level than anterior pair inside corolla tube; filaments usually with few swollen hairs near the region of attachment with corolla tube, or naked; anthers bilocular, usually divaricate rarely sub-parallel to parallel. Style gynobasic, apex subequally bifid into subulate stigmas; nectaries 4-lobed, alternating with ovary lobes, anterior one largest. Nutlets dry, obovoid to oblong, sometimes flattened-trigonous, apex rounded, attachment small and basal, ventral ridge smooth or distinct.

Distribution of genus: Subcosmopolitan (excluding Australia); mainly centred in Mediterranean and S.W. Asia.

I Subgenus STACHYS

Syn: Zietenia Gleditsch, Syst. Plant. 185 (1764); Gled. in Mem. Acad. Berl. 22: 3 (1766)

Trixago Haller, Hist. Strip. indigenar. inch. 101 (1768);

Moench, Meth. Plant. 394 (1794); Hoffm. & Link, Fl. portug. 1: 102 (1809) non Trixago Stev. (1823) nec Rafin. (1836)

Galeopsis Moench, Meth. Plant 397 (1794), non L. (1753)

Tetrahitum Hoffm. & Link, Fl. portug. 1: 103 (1809)

Eriostomum Hoffm. & Link, Fl. portug. 1: 105 (1809)

Trixella Fourr. in Ann. Soc. Linn. Lyon. N.S. 17: 135 (1869).

Flowering stems usually branched. Leaves usually with weakly crenate to subentire margin; floral leaves gradually passing from larger to smaller sizes. Verticillasters (2)-4-20-flowered. Bracts few to numerous, sometimes absent, herbaceous to setaceous with narrowed and unhardened base. Pedicels (0,2)-1-10 mm. Calyx usually sub-bilabiate, rarely \pm regular to bilabiate; teeth \pm unequal; mouth hairy or glabrous. Corolla tube subexserted or exserted, rarely included, annulate or rarely exannulate. Anther cells divaricate or rarely subparallel. Nutlets obovoid to bluntly trigonous, rarely oblong-elongate, apex smooth rarely notched or apiculate in the middle, margin wing usually absent or rarely present near the base.

Petiole anatomy: Adaxial phloem usually absent in the vascular bundles.

(Fig. 20, Pl. 9).

Nutlet anatomy: Inner sclerenchymatous layer of mesocarp with scalariform to pitted unthickened areas. (Fig. 17, Pl. 11 & 12).

Distribution: Throughout the generic range.

Type: S. sylvatica L.

Sect. 1. ERIOSTOMUM (Hoffm. & Link) Dumort., Fl. Belgica 45 (1827)

Syn. Genus Eriostomm Hoffm. & Link, Fl. portug. 1: 105 (1809)

Sect. Eriostachys Benth., Lab. Gen. et Sp. 526 (1834)

Sect. Eriostomum (Hoffm. & Link) Briq. in Engl. & Prantl, Natürl. Pflanzenfam. 4(3a): 261 (1896).

Perennial, usually with basal sterile rosettes, not always persistent.

Flowering stems simple or rarely branched. Indumentum densely lanate to tomentose, rarely sparsely pilose or adpressed-pubescent. Basal leaves ovate to oblong-lanceolate, \pm crenate to subentire, cordate to attenuate at base and long petioled. Cauline leaves similar but smaller, shortly petioled to subsessile, gradually passing into \pm sessile floral leaves. Verticillasters (4-6)-12-20-flowered. Bracts numerous, ovate-lanceolate to linear-lanceolate, herbaceous, usually softly rarely stiffly spinescent-tipped. Pedicels 2-10 mm. Calyx sub-bilabiate to \pm regular, campanulate to tubular; teeth subequal, tip spinescent, mouth hairy. Corolla tube subincluded, annulate; upper corolla lip densely sericeous-tomentose on outer surface usually exceeding it. Nutlets obovoid, slightly winged near base, apex smooth.

Distribution: Europe, N. Africa, S.W. Asia, eastwards to C. Asia and Nepal. (Map 6).

Type: S. germanica L.

Key to subsections and series:

1. Calyx sub-bilabiate with unequal teeth; stem densely lanate-villose to adpressed-tomentose; glandular hairs present at least in some part of plant body
2. Lower cauline leaves oblong-spathulate and narrowed towards base, attenuate or rounded at petiole, rarely or few subcordate; stem adpressed-tomentose Subsect. Creticae
2. Lower cauline leaves ovate to ovate-lanceolate, rarely oblong-lanceolate, broader towards base, usually cordate, rarely subcordate to truncate at petiole; stem patently lanate-villose to densely pilose Subsect. Germanicae
3. Verticillasters 10-16-(-20)-flowered; bracts many, not spinescent at tip Series A.
3. Verticillasters 4-6-flowered; bracts few and spinescent at tip Series B.
1. Calyx \pm regular with \pm equal teeth; stem soft-pubescent; glandular hairs absent from plant body Subsect. Spectabiles

Subsect. Germanicae Bhattacharjee, subsect. nov.

Syn: Sect. Eriostachys Benth. § Germanicae Boiss., Fl. Or. 4: 715 (1879) p.p.

Sect. Eriostomum (Hoffm. & Link) Briq. § Germanicae (Boiss.), Briq. in Engler & Prantl, Natürl. Pflazenfam. 4(3a): 261 (1896) p.p.

Subsect. Lanatae Knorr. in Fl. URSS 21: 200 (1954) nom. invalid.

Stem patently lanate-villose or sometimes sparsely pilose. Lower cauline leaves usually ovate or ovate-lanceolate to oblong-lanceolate, broader towards base, cordate to subcordate, rarely truncate at base; leaf margin distinctly or rarely weakly crenate-dentate. Calyx sub-bilabiate, teeth unequal, glandular hairs usually present.

Distribution: Throughout the sectional range. (Map 6).

Type: S. germanica L.

Series A.

Stem lanate-villose. Bracts not spinescent at tip. Verticillasters 10-20-flowered. Calyx weakly nerved.

Distribution: Throughout the sectional range.

Type: S. germanica L.

Other species: S. sericophylla Halácsy, S. alpina L., S. balansae Boiss., S. ehrenbergii Boiss., S. rizehensis Bhattacharjee, S. huber-morathii Bhattacharjee, S. pinetorum Boiss., S. tournefortii Poiret, S. obliqua Waldst. & Kit., S. acutifolia Link, S. heraclea All., S. sibirica Link, S. persica Gmel., S. hissarica Rgl., S. floccosa Benth., S. tschatkalensis Knorr.

Series B.

Stem sparsely and patently pilose to hispid. Bracts stiffly spinescent at tip. Verticillasters (2)-4-6-flowered. Calyx strongly nerved.

Distribution: S.W. Anatolia, Lebanon, N. & W. Syria.

Type: S. libanotica Boiss.

Other species: S. sericantha Davis

Subsect. Creticae Bhattacharjee, subsect. nov.

Syn: Sect. Dasystoma C. Koch in Linnaea 21: 685 (1848) p.p. § Germanicae
Boiss., Fl. Or. 4: 715 (1879) p.p.

Subsect. Lanatae Knorr. in Fl. URSS 21: 200 (1954) nom. invalid.

Stem usually densely adpressed-tomentose, rarely sparse. Lower cauline leaves oblong-spathulate narrowed towards base, attenuate to rounded, rarely subcordate at petiole; leaf margin obscure crenulate to subentire. Calyx sub-bilabiate, teeth unequal, glandular hairs usually present.

Distribution: Whole of Mediterranean Europe, Turkey, Iran, Caucasias and C. Asia. (Map 6).

Type: S. cretica L.

Other species: S. tmolea Boiss., S. thirkei C. Koch, S. byzantina C. Koch.
S. macrotricha Rech. fil.

Subsect. Spectabiles Bhattacharjee, subsect. nov.

Syn: Sect. Eriostachys Benth. § Germanicae and § Micrantheae
Boiss., Fl. Or. 4: 715 (1879) p.p.

Subsect. Spectabiles Knorr. in Fl. URSS 21: 202 (1954) nom. invalid.

Stem shortly adpressed-pubescent. Lower cauline leaves ovate-lanceolate to ovate, rounded to subcordate at base rarely cuneate, leaf margin weakly to distinctly crenate-serrate. Calyx ± regular, teeth equal, eglandular.

Distribution: S.W. Asia (Lebanon, N. Syria, Turkey, Iran, Caucasias and Afghanistan). (Map 6).

Type: S. spectabilis Choisy

Other species: S. viticina Boiss., S. longispicata Boiss., S. huetii Boiss.,
S. bayburtensis Bhattacharjee & Huber-Morath.

Sect. Eriostomum is a fairly homogeneous section in its overall character resemblances, and has a wide range of distribution throughout Europe, Asia and part of N. Africa. Mostly the members grow in damp and moist places, bearing characteristic herbaceous stems with basal sterile rosettes, but sometimes xeromorphic characters have been evolved in response to drier or exposed conditions (e.g. S. cretica). On the whole the section apparently contains a larger assemblage of primitive characters than other groups of Stachys (cf. Table 3, p. 113). From a phylogenetic viewpoint the group may stand near or be derived from a more generalised ancestral stock. For convenience of use and sake of naturalness, this large section is divided into 3 subsections of which subsect. Spectabiles is mainly oriental and Irano-Turanian in distribution, while the other two, subsect. Creticae and subsect. Germanicae, grow widely throughout Europe and Asia. The former covers two phytogeographical regions (Mediterranean and Irano-Turanian) and the latter occurs in three, viz. Euro-Siberian, Mediterranean and Irano-Turanian regions. Series B. of subsect. Germanicae is restricted to the E. Mediterranean sub-region.

On the basis of character distribution, the affinities of this section can be traced on one hand to the monotypic Sect. Mucronata and to Sect. Infrarosularis on the other (Table 3, p. 113), but there are sufficient differences to maintain them as 3 different sections. In respect to characters 2, 3 and 7, Sect. Eriostomum largely agrees with both Sect. Mucronata and Sect. Infrarosularis, whereas in characters 7, 10, 11, 12 and 13 it agrees more closely with Sect. Mucronata and in 5, 8 and 9 with Sect. Infrarosularis.

Sect. Eriostomum also resembles subgen. and Sect. Betonica in several Betonica characters that are present in all or some species of Sect. Eriostomum (cf. Table 1, Ch. IIIA). This resemblance may have persisted from a common ancestral stock.

Table 3. Morphological character variation in 3 sections of Stachys L.

CHARACTERS	SECT. <u>MUCRONATA</u>	SECT. <u>ERIOSTOMUM</u>	SECT. <u>INFRAROSULARIS</u>
1. Herbaceous perennial in habit	-	+-	-
2. Basal rosettes present	+	+-	+
3. Leaf indumentum adpressed sericeous tomentose	+	+(-)	(+)-
4. Cauline leaves several paired	-	+	-
5. Flowering stem usually unbranched	-	+	+
6. Verticillasters 10-20-flowered	-	+(-)	+-
7. Bracts conspicuous, herbaceous \pm as long as calyx	+	+	+(-)
8. Bract tip not spinescent	-	+(-)	+
9. Calyx sub-bilabiate with shortly spinescent tip	-	+(-)	+
10. Calyx mouth hairy	+	+	-
11. Corolla subincluded	+	+(-)	-
12. Upper corolla lips sericeous tomentose outside, hairs exceeding it	+	+	-
13. Nutlets obovoid with slight basal wings	+	+	-

Key: + present, - absent, +- more or less equally present, +(-) mostly present, (+)- mostly absent.

Sect. 2. MUCRONATA Bhattacharjee, sect. nov.

Syn. Sect. Zietenia Benth., Lab. Gen. et Sp. 531 (1834) p.p. excl. typ.

Sect. Stachyotypus Benth. § Fruticulosae Boiss., Fl. Or. 4: 716
(1879) p.p.

Sect. Eustachys Briq. § Fruticulosae (Boiss.) Briq. in Engler
and Prantl, Natürl. Pflanzenfam. 4(3a): 264 (1896) p.p.

Dwarf,

Dwarf, suffruticose perennials with basal sterile rosettes. Flowering stems divaricately branched. Indumentum densely lanate to tomentose eglandular. Basal leaves oblong, crenulate, cuneate to truncate at base, long-petioled. Cauline leaves few, \pm inconspicuous, sessile, similar to but smaller than basal leaves, Floral leaves sessile, shorter than verticillasters. Verticillasters 2-flowered. Bracts lanceolate to terete, herbaceous, spinescent at tip, \pm as long as calyx tube. Pedicels 5-10 mm, becoming 12-14 mm and harder in fruit. Calyx \pm regular, campanulate with strong veins; teeth equal, strongly spiny; mouth densely hairy. Corolla tube subincluded, annulate; upper lip sericeous-tomentose on outer side exceeding it. Nutlets obovoid, slightly winged near base. Monotypic.

Distribution: S. Greece (E. Crete and Karpathos). (Map 6).

Type: S. mucronata Sieber.

In some distinct morphological characters like bushy divaricate habit, strongly nerved and stiffly spiny calyx, 2-flowered verticillasters with very long and hard pedicels, this monotypic section is unique and isolated in itself. In respect to these characters, Sect. Mucronata shows resemblance to some other isolated sections, like Aucheriana, Thamnostachys and subsect. Spinosa of Sect. Olisia. These apparent similarities could probably be due

to convergence, because the characters mentioned above are liable to be influenced by extreme environmental conditions. Strong correlation with other morphological characters which are more stable in nature, like presence of basal rosettes, subincluded corolla tube, densely sericeous-tomentose upper corolla lip, densely hairy calyx mouth, and lanate-tomentose indumentum, suggests an affinity with the section Eriostomum (Hoffm. & Link) Dumort. (Table 3).

Sect. 3. INFRAROSULARIS Bhattacharjee, sect. nov.

Syn. Sect. Zietenia Benth. in DC., Prodr. 12: 486 (1848) p.p. excl. typ.

Sect. Stachyotypus Benth. § Infrarosulares Boiss., Fl. Or. 4: 716 (1879) p.p.

Sect. Eustachys Briq. § Infrarosulares (Boiss.), Briq. in Engler and Prantl, Natürl. Pflanzenfam. 4(3a): 265 (1897) p.p.

Suffrutescent perennials with basal sterile rosettes, saxatile. Flowering stems \pm unbranched. Indumentum greyish-tomentose, sometimes patently pilose eglandular and/or glandular. Basal leaves ovate-oblong to elliptic, obscurely crenate, cordate to cuneate at base, long petioled. Cauline leaves few (2-3 paired), shortly petioled to sessile, similar to but smaller than basal leaves, gradually passing into smaller and sessile to sessile floral leaves. Verticillasters 4-12-(-16)-flowered. Bracts few, lanceolate to linear, herbaceous to setaceous, as long as calyx tube or smaller, not spinescent. Pedicels 1-6 mm. Calyx \pm regular to sub-bilabiate, subcampanulate to tubular; teeth \pm unequal, tip softly spinescent; mouth without hairy ring. Corolla tube subexserted to exserted; upper lip sparsely hirsute on outer surface but not exceeding the lip. Nutlets obovoid to \pm oblong, base not winged.

Distribution: South and adjacent E. Anatolia. (Map 3).

Type: S. rupestris Mont. & Auch.

Other species: S. cataonica Huber-Morath & Bhattacharjee, S. petrokosmes Rech. fil., S. amanica Davis, S. pumila Banks & Sol. S. citrina Boiss.

This section forms a coherent group of closely allied chasmophytes of the eastern Mediterranean region, probably endemic to Anatolia. Its taxonomic position is quite isolated though some phenetic resemblances can be traced with the widely distributed Sect. Eriostomum. The distinctness of this rosulate section of chasmophytes is in marked contrast with the close relationship of the taxa within it. This may have resulted from alternating phases of isolation and hybridization, in the manner described by Ehrendorfer (1958) for "fossil hybrid swarms" in Galium. Biosystematic studies are needed.

Sect. 4. ROSEOSTACHYS Bhattacharjee, sect. nov.

Syn. Sect. Eriostachys Benth. § Micrantheae Boiss., Fl. Or. 4: 715
(1879) p.p.

Sect. Eriostomum (Hoffm. & Link) Briq. § Biflorae Briq. in Engler
& Prantl, Natürl. Pflanzenfam. 4(3a): 262 (1896).

Suffrutescent perennials without basal sterile rosettes, saxatile.
Flowering stems branched. Indumentum patently hispid glandular and eglandular.
Lower cauline leaves ovate-elliptic, crenate, apex obtuse, cordate to subcordate at base, sessile. Median cauline and floral leaves same as lower cauline but smaller upwards. Verticillasters (2-)-4-(6)-flowered, remote. Bracts lanceolate, herbaceous, as long as calyx, tip blunt. Pedicels 2-6 mm. Calyx tubular, teeth subequal, blunt tipped. Corolla tube included; upper and lower lips

thick and fleshy with dense short adpressed hairs outside. Nutlets obovoid.

Monotypic.

Distribution: Libya (Cyrenaica). (Map 4).
(Desf.)

Type: S. rosea/Boiss.

This monotypic *S.* Mediterranean section is quite distinct and isolated in some of its characters like saxatile suffrutescent habit, sessile leaves, blunt and thick calyx teeth, completely included corolla tube and thick densely hairy corolla lips. An affinity may be traced to some extent with Sect. Setifolia with which it shares bracteate and few flowered verticillasters but otherwise remains quite distinct by the above mentioned distinguishing characters. The infrasectional name "Biflorae" of Briquet (1896) is not acceptable (or valid) in that the number of flowers per verticillaster on the same inflorescence axis varies from 2-6, more frequently the number being 4.

Sect. 5. SETIFOLIA Bhattacharjee, sect. nov.

Syn. Sect. Eriostachys Benth. in DC., Prodr. 12: 466 (1848) p.p.

Sect. Eriostachys Benth. § Micrantheae Boiss., Fl. Or. 4: 715
(1879) p.p.

Sect. Stachyotypus Benth. § Sylvaticae Boiss., op. cit. (1879) p.p.

Sect. Eriostomum (Hoffm. & Link) Briq. § Micrantheae (Boiss.), Briq.
in Engler & Prantl, Natürl. Pflanzenfam. 4 (3a): 262 (1896) p.p.

Sect. Eriostachys Benth. subsect. Setiferae Knorr. in Fl. URSS 21:
211 (1954) nom. invalid.

Perennials with long rhizomes. Basal sterile rosettes absent. Flowering stems elongate, simple, usually unbranched, rarely branched above. Indumentum patently hispid to subpatent or adpressed soft pubescent eglandular or glandular.

Lower cauline leaves lanceolate, serrate, apex acute, subcordate to truncate at base, shortly petioled. Median cauline and floral leaves similar but smaller than lower cauline ones, sessile and usually spinescent at tip. Verticillasters 4-6-flowered, \pm remote. Bracts lanceolate, herbaceous with spinescent tip, rarely few, setaceous, as long as or slightly less than calyx tube. Pedicel 1-2 mm. Calyx \pm regular, subcampanulate; teeth subequal, subpatent to patent, mucronate tipped. Corolla tube subexserted, saccate, incompletely annulate. Nutlets obovoid, apiculate with prominent ventral rib. Distribution: N. Iraq, Turkey, Caucasia, Iran to Afghanistan. (Map 4). Type: S. setifera C.A. Mey.

Other species: S. iragensis Bhattacharjee, S. menthoides Kotschy & Boiss.

This section is related to Sect. Stachys in having a similar type of habit, lanceolate, shortly petioled to subsessile leaves and few-flowered verticillasters, but differs in various other features such as, stamens slightly exserted from corolla tube, floral and usually cauline leaves with sharp spinescent tip, and large and conspicuous, mucronate-tipped bracts. Considering all these distinguished characters, it is kept distinct from Sect. Stachys. Boissier (1879) treated two species, S. setifera and S. menthoides, under two different sections, Eriostachys and Stachyotypus respectively, mainly emphasizing the woody and herbaceous nature of the flowering stem, which seems a very unnatural treatment. Overall resemblances show these two species to be closely allied.

Sect. 6. STACHYS

Syn. Sect. Stachyotypus Dumort., Fl. Belg. 45 (1827)

Sect. Stachyotypus Benth., Lab. Gen. et Sp. 527 (1834)

Sect. Eustachys Briq. in Engler & Prantl, Natürl. Pflanzenfam. 4 (3a): 262 (1896).

Mesophytic or suffrutescent perennials, with or without long rhizomes. Basal sterile rosettes absent. Flowering stems elongate, simple, usually unbranched, rarely branched above. Indumentum patently hispid sometimes sub-patent to adpressed-pubescent, glandular and eglandular. Lower cauline leaves ovate-lanceolate, serrate to crenate-serrate, apex acute, cordate to truncate at base, petiolate to subsessile. Median cauline and floral leaves similar but smaller upwards, sessile and herbaceous, rarely soft-spinescent at tip. Verticillasters 4-6-(10)-flowered. Bracts small, 0.5-1.5 mm, setaceous. Pedicels 0.5-1.5 mm. Calyx sub-bilabiate, subcampanulate to campanulate; teeth subequal, spinescent tipped. Corolla tube exserted, saccate, annulate. Stamens extended as long as upper corolla lip. Nutlets obovoid, apex round, ventral rib faint.

Distribution: Temperate Eurasia and N. America, S. Africa (?). (Map 4).

Type: S. sylvatica L.

Key to subsections:

1. Plant with long rhizomes, growing in damp (and often shady) places; corolla tube saccate towards base Subsect. Sylvaticae
1. Plant without rhizomes, growing in rock crevices; corolla tube not saccate Subsect. Circinatae

Subsect. Sylvaticae Bhattacharjee, subsect. nov.

Syn. Sect. Stachyotypus Benth. § Genuinae Benth., Lab. Gen. et Sp.

527 (1834) and § Elatae Benth. in DC. Prodr. 12: 468 (1848)

Sect. Stachyotypus Benth. § Sylvaticae Boiss. Fl. Or. 4: 715 (1879).

Plant perennating by long, creeping rhizomes growing in damp places. Floral leaves not spinescent-tipped. Calyx teeth lanceolate-subulate. Corolla tube saccate at base.

Distribution: Throughout the sectional range. (Map 4).

Type: S. sylvatica L.

Other species: S. hydrophila Boiss., S. palustris L.

Subsect. Circinatae Bhattacharjee, subsect. nov.

Syn. Sect. Stachyotypus § Ruderales Benth., Lab. Gen. et Sp. (1834) p.p.

Plant without rhizomes, growing in rock crevices. Floral leaves softly spinescent. Calyx teeth ovate-triangular to lanceolate. Corolla tube not saccate.

Distribution: Spain and N.W. Africa. (Map 4).

Type: S. circinata L'Herit.

Other species: S. guyoniana de Noé, S. durandiana Coss., S. mialhesii de Noé.

Subsect Sylvaticae of Sect. Stachys has affinity with Sect. Setifolia as mentioned before. On the other hand, Subsect. Circinatae shows certain resemblances with Sect. Swainsoniana, particularly in suffruticose habit, long exserted stamens, and patently hispid stem indumentum.

Sect. 7 CANDIDA Bhattacharjee, Sect. nov.

Syn: Sect. Stachyotypus Benth. § Ruderales Benth., Lab. Gen. et Sp.
528 (1834) p.p.

Sect. Stachyotypus Benth. § Ambleiae Boiss., Fl. Or. 4: 716 (1879) p.p.
Briq.

Sect. Eustachys Briq. § Ambleiae Boiss./in Engler & Prantl, Natürl.
Pflanzenfam 4 (3a): 265 (1896) p.p.

Suffruticose perennials without sterile basal rosettes, saxatile. Flowering

stems dwarfish, branched. Indumentum densely floccose-tomentose with long curly eglandular hairs. Lower cauline leaves ovate-orbicular, rarely oblanceolate, margin subentire, cordate or rounded, rarely attenuate at base, petiolate. Median and floral leaves similar but smaller than lower cauline leaves, shortly petioled to subsessile or sessile. Verticillasters 4-8-flowered, congested into a dense spike. Bracts inconspicuous, few or absent altogether. Pedicels 2-3 mm. Calyx \pm regular, subcampanulate, teeth subequal, blunt to softly spinescent. Corolla tube subexserted. Nutlets round, obovoid, slightly winged near base.

Distribution: Greece and Morocco. (Map 1).

Type: S. candida Bory & Chaub.

Other species: S. chrysantha Boiss., S. iva Griseb., S. spreitzenhoferi Heldr., S. saxicola Coss. & Bal., S. maweana Bal.

The section shows an affinity with Sect. Swainsoniana in the nature of corolla shape, congested inflorescences and long exserted stamens. S. saxicola is a characteristic N.W. African endemic, showing marked disjunction from the rest of the related species endemic to Greece. This species is particularly characterised by the fragility of the older portion of its flowering stems.

Sect. 8. SWAINSONIANA Bhattacharjee, sect. nov.

Syn. Sect. Zietenia Benth., Lab. Gen. & Sp. 531 (1834) p.p. excl. typ.

Sect. Stachyotypus Benth. § Fruticulosae Boiss. Fl. Or. 4: 716 (1879) and § Sylvaticae Boiss. Fl. Or. 4: 715 (1879) p.p.

Sect. Eustachys Briq. § Fruticulosae (Boiss.) Briq. in Engler & Prantl, Natürl. Pflanzenfam. 4 (3a): 264 (1896) p.p.

Suffruticose perennials without basal rosettes of sterile shoots, saxatile. Flowering stems dwarf or elongate, branched. Indumentum patently pilose to hispid glandular and eglandular. Lower cauline leaves obovate to ovate, attenuate or rotund to subcordate, subsessile to petiolate. Median cauline and floral leaves similar but smaller than lower cauline leaves, sessile to shortly petioled. Verticillasters (4)-6-(10)-flowered. Bracts linear-lanceolate, herbaceous, as long as calyx tube or smaller, sometimes caducous. Pedicels 2-5 mm. Calyx sub-bilabiate to bilabiate, subcampanulate to campanulate; teeth subequal to unequal. Corolla subexserted, upper corolla lip naked to sparsely hairy outside. Nutlets obovoid, slightly winged at base. Distribution: Balkan peninsula (Greece, Albania, Yugoslavia, Bulgaria). (Map 5).

Type: S. swainsonii Benth.

Key to subsections and series

1. Leaves obovate with attenuate base, rugose in texture; habit dwarfish c(5)-16-(20) cm Subsect. Swainsonianae
1. Leaves ovate-oblong to ovate-lanceolate with rounded to subcordate base, not rugose in texture; habit elongate c (20)-30-55 cm Subsect. Decumbentes
2. Calyx sub-bilabiate, teeth subequal, lanceolate-subulate with long setulose tip Series A.
2. Calyx bilabiate, teeth unequal, lanceolate, spinescent tipped Series B.

Subsect. Swainsonianae Bhattacharjee, subsect. nov.

Stem dwarfish c. 5-16-(20) cm. Leaves rugose, obovate with attenuate base, subsessile.

Distribution: Greece. (Map 5).

Type: S. swainsonii Benth.

Other species: S. suboica Rech. fil., S. spruneri Boiss. ex Benth.,
S. ionica Halacsy.

Subsect. Decumbentes Bhattacharjee, subsect. nov.

Stem elongate c. (20)-30-55 cm. Leaves not rugose, ovate to ovate-lanceolate with rounded or subcordate base, petiolate.

Distribution: Central, E. and W. part of ^{the} Balkan Peninsula. (Map 5).

Type: S. decumbens Pers.

Series A.

Calyx sub-bilabiate, densely hairy; teeth lanceolate subulate with long setulose tip.

Distribution: Greece, Bulgaria and Yugoslavia.

Type: S. decumbens Pers.

Other species: S. canescens Bory & Chaub, S. plumosa Griseb. S. panagaea Phitos

Series B.

Calyx bilabiate, \pm glabrescent; teeth lanceolate with glabrescent and spinescent tip.

Distribution: Eastern and central part of ^{the} Balkan Peninsula.

Type: S. anisochila Vis.

Other species: S. menthiifolia Vis.

Subsect. Decumbentes has some affinity with Subsect Circin~~atae~~ of Sect. Stachys and Subsect. Rectae of Sect. Olisia in habit, corolla and stamen structure. The other Subsection Swainsonianae on the other hand is more strongly related to Sect. Candida. The whole section is characterised by its suffruticose and saxatile habit, being mostly restricted to rock crevices.

Sect. 9. FRAGILICAULIS Bhattacharjee, sect. nov.

Syn. Sect. Chamaesideritis (Reich.) Benth. and Stachyotypus Benth. in DC. Prodr. 12: 472-283 (1848) p.p.

Sect. Stachyotypus Benth. § Rectae Boiss. and § Fragiles Boiss., Fl. Or. 4: 716 (1879) p.p.

Sect. Eustachys Briq. § Rectae Boiss., and § Fragiles Boiss., Briq. in Engler & Prantl, Natürl. Pflanzenfam. 4 (3a): 263 (1896)

Sect. Stachyotypus subsect. Fragiles Rech. fil. in Bot. Jahrb. 71: 526 (1941).

Suffrutescent perennial without basal rosettes of leaves, saxatile.

Flowering stems fragile below, erect or pendent, branched. Indumentum patently pilose, rarely subpatent. Lower cauline leaves orbicular to ovate, rarely ovate-lanceolate, crenate-dentate to crenate, cordate to subcordate at base, petiolate to sessile. Median cauline leaves similar but smaller, shortly petioled to sessile. Verticillasters (2-) 6-10 (-16)-flowered. Bracts few or caducous, linear-lanceolate to linear, herbaceous to setaceous, as long as calyx tube or smaller. Pedicels 2-6 mm. Calyx ± regular, infundibuliform to subcampanulate, herbaceous; teeth subequal, usually blunt ~~to~~ softly spinescent-tipped, rarely spinescent (S. viscosa Mont. et Auch.). Corolla tube

exserted, annulate or exannulate. Nutlets obovate, trigonous, with or without marginal wing, apex apiculate to notched.

Distribution: On rocks and cliffs of S.W. and East Anatolia, N. Iraq and W. Iran. (Map 4).

Type: S. benthamiana Boiss.

Key to subsections and series:

1. Bracts inconspicuous, very few, setaceous, as long as pedicel (c. 1-3 mm), sometimes caducous; nutlets oblong, apiculate Subsect. Fragiles
1. Bracts conspicuous, several, herbaceous, sometimes setaceous, as long as or slightly shorter than calyx tube (c. 2-6 mm); nutlets obovoid, apex smooth or rarely notched Subsect. Multibracteatae
2. Bracts herbaceous, patently pilose; stem patently pilose to hispid Series A.
2. Bracts setaceous, glabrescent; stem subpatent to retrorse-pubescent Series B.

Subsect. Multibracteatae Bhattacharjee, subsect. nov.

Syn. Sect. Stachyotypus Benth. § Rectae Boiss., Fl. Or. 4: 716 (1879) p.p.

Bracts conspicuous, herbaceous, rarely setaceous c. 2-6 mm. Calyx teeth oblong-lanceolate to triangular, usually blunt, rarely soft-spinescent. Nutlets obovoid, slightly winged near base, rarely with apical wing.

Distribution: E. Anatolia, N. Iraq and W. Iran. (Map 4).

Type: S. benthamiana Boiss.

Series A.

Stem patently pilose to hispid. Bracts herbaceous, pilose, as long as calyx tube or slightly less (c. 4-6 mm).

Distribution: S.E. Anatolia, N. Iraq and W. Iran.

Type: S. fragillima Bornm.

Other species: S. lanigera Rech. fil., S. graveoleus Nábelek, S. glechomifolia Nábelek, S. brantii Benth., S. megalodonta Bornm.

Series B.

Syn. Sect. Stachyotypus Benth. § Rectae Boiss., Fl. Or. 4: 716 (1879) p.p.

Stem retrorsely pubescent. Bracts setaceous, glabrescent c. 2-4 mm.

Distribution: Throughout the range of subsect. Multibracteatae

Type: S. benthamiana Boiss.

Other species: S. ballotiformis Vatke, S. kurdica Boiss., S. viscosa Mont & Auch., S. laetivirens Rech. fil., S. asterocalyx Rech. fl., S. subnuda Mont. & Auch.

Subsect. Fragiles Rech. fil., in Engl. Bot. Jahrb. 71: 526 (1941)

Syn. Stachyotypus § Fragiles Boiss., Fl. Or. 4: 716 (1879)

Bracts inconspicuous, few and setaceous, c. 1-3 mm, sometimes caducous.

Calyx teeth triangular to triangular lanceolate, tip softly spinescent.

Nutlets oblong-elliptic and apiculate, without marginal and apical wing.

Distribution: S.W. Anatolia. (Map 4).

Lectotype: S. longiflora Boiss.

Other species: S. euadenia Davis, S. pinardii Boiss., S. yenyürükensis Bhattacharjee & Huber-Morath.

Sect. Fragilicaulis, particularly subsect. Multibracteatae shows a relationship with Sect. Olisia Subsect. Rectae, while Subsect. Fragiles has an affinity with some species of sect. Swainsoniana in habit, flower and verticillaster characters. In overall resemblances the whole section forms a coherent group. Boissier (1879) kept the species in two separate groups, viz. § Rectae and § Fragiles under Sect. Stachyotypus. Later Rechinger (1941), considering multiple character correlation, put the species together in one group, subsect. Fragiles which seems to be a very reasonable treatment. The members of subsect. Fragiles in their account are restricted to characteristic, often shady cliff communities and are at present more or less in a phase of contraction. On the other hand, subsect. Multibracteatae is more widely distributed growing more often in xerophytic communities particularly in sloping rocks. Intermediates often occur where two of these taxa are in contact, suggesting that hybridisation is occurring.

Sect. 10. OLISIA Dumort., Fl. Belgica, 44 (1827).

Syn. (a) Campanistrum (Habl.) Reichb., Fl. Exo. Germ. I: 318 (1830).

Sect. Pseudosideritis W. Koch, syn. Fl. Germ. ed I: 569 (1837) p.p.

Suffruticose to fruticose perennials, rarely biennials or annuals, with or without basal rosettes of leaves, xerophytic. Flowering stems erect to procumbent, branched. Indumentum adpressed-tomentose to pubescent, rarely floccose-tomentose. Basal leaves ovate-elliptic to orbicular, cordate to cuneate at base, long petioled, either passing gradually or abruptly into cauline leaves. Lower cauline leaves ovate-lanceolate to oblanceolate, cuneate to attenuate at base, gradually passing into smaller and sessile floral leaves.

Bracts usually few, setaceous, c. 1-3 mm, rarely herbaceous, lanceolate and spinescent tipped, c. 6-8 mm long. Calyx sub-bilabiate, narrowly campanulate; teeth subequal with aristate tip; calyx mouth with or without a ring of hairs. Corolla tube subexserted, annulate, rarely exannulate (S. inanis). Nutlets smooth, obovoid, slightly winged at base.

Distribution: Mainly Mediterranean area of Europe and Asia Minor, extending into Iran and Caucasia. (Map 2).

Type: S. annua L.

Key to subsections and series:

1. Verticillasters with conspicuous, herbaceous, ovate-lanceolate to lanceolate bracts, c. 6-8 mm, densely hairy
2. Verticillasters 1-2-flowered; stem sericeous tomentose to glabrescent, hairs straight
3. Flowering stems divaricately branched ending in stiff spines; stem densely sericeous-tomentose; basal rosette absent
..... Subsect. Spinosae
3. Flowering stems not divaricately branched and not ending in spines; stem \pm glabrescent with few short and adpressed hairs; basal rosette present Subsect. Rosulatae Series A.
2. Verticillasters 6-10-(16)-flowered; stem floccose-tomentose to arachnoid, hairs curly Subsect. Distantes
1. Verticillasters with few, inconspicuous, linear and setaceous bracts c. 1-3-(4)- mm, scarious to sparsely hairy
4. Stem retrorsely adpressed-pubescent; fruiting calyx usually gibbous at base, lower teeth usually curved inwards towards mouth Subsect. Annuae

4. Stem antrorsely adpressed-pubescent, rarely floccose-tomentose;
fruiting calyx not gibbous at base, lower teeth erect or recurved
5. Plant with basal rosettes of leaves; distinct from cauline leaves; basal
leaves ovate-elliptic to \pm rotund, cordate to truncate at base
..... Subsect. Rosulatae Series B.
5. Plant without basal rosettes of leaves; lower cauline leaves
oblanceolate to ovate-lanceolate, cuneate to attenuate
at base Subsect. Rectae
6. Stamens exerted more than half way along the upper corolla lip
7. Stem adpressed-pubescent; upper corolla lip entire
to retuse Series B.
7. Stem densely floccose-tomentose; upper corolla lip deeply
forked Series A.
6. Stamens little exerted from the corolla tube, less than
half way along upper corolla lip Series C.

Subsect. Rectae Bhattacharjee, subsect. nov.

Syn. Sect. Chamaesideritis Benth., Lab. Gen. et Sp.: 530 (1834)

Sect. Pseudosideritis W. Koch, Syn. Fl. Germ. ed. I. 569 (1837) p.p.

Sect. Stachyotypus Benth. \S Rectae Boiss., Fl. Or. 4: 716 (1879) p.p.

Sect. Stachyotypus Benth. subsect. Rectae Knorr. in Fl. URSS

21: 220 (1954) nomen invalidum

Suffrutescent, elongate, erect or procumbent perennials without basal sterile rosettes. Indumentum antrorsely adpressed pubescent, rarely floccose-tomentose. Lower cauline leaves oblanceolate to ovate-lanceolate with cuneate to attenuate base. Bracts few, inconspicuous, linear and setaceous, glabrous to sparsely hairy c. 1-3 mm.

Distribution: Throughout the range of section. (Map 2).

Type: S. recta L.

Series A.

Stem densely floccose-tomentose. Upper corolla lip deeply forked.

Stamens exerted more than half way along upper corolla lip. (Monotypic).

Distribution: N. Morocco.

Type: S. fontqueri Pau.

Series B.

Stem sparsely adpressed-pubescent to glabrescent. Upper corolla lip entire to retuse. Stamens exerted more than half way along of the upper corolla lip.

Distribution: Throughout the range of the section.

Type: S. recta L.

Other species: S. atherocalyx C. Koch, S. leucoglossa Griseb., S. arenaria Vahl., S. beckeana Dörfler & Hayek, S. tetragona Boiss., S. virgata Bory & Chaub., S. albanica Markgr.

Series C.

Stem sparsely adpressed-pubescent to glabrescent. Upper corolla lip \pm retuse. Stamens little exerted from corolla tube, less than half way along the upper corolla lip.

Distribution: N. Western part of ^{the} Balkan Peninsula, Turkey, Crimea and Caucasia.

Type: S. iberica Bieb.

Other species: S. angustifolia Bieb., S. sparsipilosa Huber-Morath & Bhattacharjee.

Subsect. Distantes Bhattacharjee, subsect. nov.

Syn. Sect. Stachyotypus Benth. § Ruderales Benth. in DC., Prodr. 12: 472
(1848) p.p.

Sect. Stachyotypus Benth. § Rectae Boiss., Fl. Or. 4: 716 (1879) p.p.

Suffrutescent, elongate and erect perennials without basal sterile rosettes. Indumentum floccose-tomentose to arachnoid. Lower cauline leaves ovate to ovate-lanceolate with rounded to cuneate base. Bracts conspicuous, lanceolate, herbaceous, spinescent tipped as long as or slightly less than calyx.

Distribution: S.W. Anatolia, Lebanon and W. Syria. (Map 2).

Type: S. distans Benth.

Other species: S. aleurites Boiss., S. bombycina Boiss.

Subsect. Annuae Bhattacharjee, subsect. nov.

Syn. Sect. Stachyotypus Benth. § Infrarosularès Boiss., Fl. Or. 716
(1879) p.p.

Subsect. Maritimae Knorr. in Fl. URSS 21: 230 (1954) nom. invalid.

Suffrutescent erect or procumbent perennials, biennials or annuals, with or without basal sterile rosettes. Indumentum sparse or dense, retrorsely adpressed pubescent. Basal and lower cauline leaves ovate-elliptic to rhomboid-lanceolate, rarely oblanceolate, cordate to crenate at base. Bracts few, linear-setaceous, c. 1-2.5 mm, glabrous to setose.

Distribution: Throughout the range of the section. (Map 2).

Type: S. annua L.

Other species: S. maritima Gouan, S. parolinii Vis., S. talyschensis Kapeller, S. mouretii Batt. & Pit.

S. maritima, S. parolinii and S. talyschensis are constant perennials in this group, whereas S. mouretii and S. annua have annual, biennial and perennial forms.

Subsect. Rosulatae Bhattacharjee subsect. nov.

Syn. Sect. Stachyotypus Benth. § Rectae Boiss., Fl. Or. 4: 716 (1879) p.p.

Suffrutescent, erect perennials or biennials with basal rosettes of leaves. Indumentum sparsely pubescent to puberulent, sometimes glabrescent.

Basal leaves ovate-elliptic, cordate to crenate at base. Bracts few, inconspicuous, setaceous, 1-2 mm or less, sometimes herbaceous and spinescent-tipped and as long as calyx tube.

Distribution: Anatolia and Syria. (Map 2).

Type: S. diversifolia Boiss.

Series A.

Stem \pm glabrescent with few short and adpressed hairs. Flowering axis not divaricately branched from the middle but rarely with few branches towards apex or simple. Bracts herbaceous, lanceolate, spinescent tipped as long as calyx tube. Calyx tube widely campanulate. (Monotypic).

Distribution: S. Anatolia and W. Syria.

Type: S. diversifolia Boiss.

Series B.

Stem \pm puberulent to glabrescent. Flowering axis divaricately branched throughout. Bracts setaceous, \pm 1 mm. Calyx tubular.

Distribution: E. Anatolia.

Type

Type: S. inanis Hausskn. & Bornm.

Other species: S. munzurdagensis Bhattacharjee

Subsect. Spinosa Bhattacharjee, subsect. nov.

Syn. Sect. Zietenia (Gled.) Benth., Lab. Gen. et Sp. 531 (1834)

Sect. Stachyotypus Benth. ^S Fruticulosae Boiss., Fl. Or. 4:
716 (1879) p.p.

Armed, much branched, dome-shaped shrublet, without sterile basal rosettes; xerophytic. Indumentum adpressed-sericeous-tomentose. Lower cauline leaves oblanceolate, attenuate at base. Bracts herbaceous, spinescent tipped, as long as calyx tube or more, densely hairy. (Monotypic).

Distribution: Crete. (Map 2).

Type: S. spinosa L.

Sect. Olisia is a widely variable section having its greatest diversity in the Mediterranean region of Europe and Anatolia. The section is here divided into 5 subsections and a few informal series. As a whole the section shows affinities with Sect. Fragilicaulis, particularly with Subsect Multi-bracteatae, Ser. B. and also with Sect. Swainsoniana, Subsect. Decumbentes Ser. B. From the first it differs in not having fragile bases of flowering stems and in its ovate-cordate median cauline leaves; from the latter it is distinguished by having adpressed-pubescent indumentum and a + regular to sub-bilabiate calyx. The distinction of Subsect. Spinosa and Subsect. Rectae Ser. A. from other subsections are more or less pronounced in their unique habit and indumentum nature, but they come closer to Sect. Olisia than to other sections in two diagnostic characters, adpressed-tomentose indumentum and

oblong lanceolate leaves. Subsect Annuae has some closely related but tremendously variable species within it (of particular mention is S. annua) which could be interpreted as a species complex. Its closest relative is S. maritima growing on sand-dunes, it may have evolved from a maritime ecotype of S. annua (or its precursor). Cytotaxonomic and biosystematic investigations are needed to confirm their taxonomic status.

Sect. 11. CAMPANISTRUM (Habl.) Reihb., Fl. Exc. Germ. 1: 318 (1830)

Syn. Sect. Stachyotypus Benth. § Agrestes Benth., Lab. Gen. et Sp. 529 (1834) p.p.

Sect. Olisia Dumort. sensu Boiss., Fl. Or. 4: 716 (1879) p.p.

Procumbent to erect annuals, branched divaricately above soil level. Indumentum patently pilose to hispid, dense or sparse, rarely glabrescent with aculeate hairs. Lower cauline leaves ovate to ovate-elliptic; crenate, cordate at base, long-petioled. Median cauline and floral leaves similar but gradually becoming oblong-lanceolate, cuneate at base, shortly petioled to sessile; floral leaves subentire to entire, softly spinulescent at tip. Verticillasters ± 6-flowered. Bracts few, setaceous, 2-5 mm. Pedicels 2-4 mm. Calyx widely campanulate, sub-bilabiate; teeth subequal, shortly mucronate to long-spinous-tipped; mouth with ring of hairs. Corolla tube subexserted or sometimes included, annulate; upper corolla lip entire or forked. Nutlets obovoid.

Distribution: Europe, N. Africa, W. Anatolia; introduced in America. (Map 1).

Type: S. arvensis (L.) L.

Key to subsections:

1. Calyx teeth lanceolate-subulate with long spinulose tip, hairy throughout; upper corolla lip deeply forked Subsect. Ocymastrum
1. Calyx teeth oblong-lanceolate or ovate-triangular with short glabrous spinescent tip; upper corolla lip entire to emarginate Subsect. Arvenses

Subsect. Ocymastrum Bhattacharjee, subsect. nov.

Syn: Sect. Olisia Dumort. Sensus Benth., Lab. Gen. et Sp. 529 (1834) p.p.

Calyx teeth lanceolate-subulate with long spinulose tip, hairy throughout.

Upper corolla lip deeply forked.

Distribution: N. Africa, and W. Mediterranean Europe; recorded from Crete and Lebanon. (Map 1).

Type: S. ocymastrum (L.) Briq.

Other species: S. brachyclada de Noé, S. durioei de Noé

Subsect. Arvenses Bhattacharjee, subsect. nov.

Calyx teeth oblong-lanceolate to ovate-triangular with short and glabrous mucronate tip. Upper corolla tip entire to retuse.

Distribution: Throughout the range of the section. (Map 1).

Type: S. arvensis (L.) L.

Other species: S. spinulosa Sibthorp & Sm., S. arabica Hornem., S. marrubifolia Viv.,
S. milanii Petr.

The affinity of Sect. Campanistrum, particularly subsect. Arvenses, is with Sect Corsica and to some extent with Sect. Stachys from both of which it

differs in several distinguishing characters. From Sect. Corsica it is usually distinguished by its annual and erect to procumbent habit, 4-8-flowered verticillasters, and short-pedicelled flowers. From Sect. Stachys it differs in its annual habit and shorter stamens and in not having a creeping perennating rhizome. On the other hand Subsect. Ocymastrum resembles Sect. Olisia Subsect Rectae in its erect to ascendant habit, \pm oblanceolate median cauline leaves and few setaceous bracts, but is readily distinguished by having patently pilose indumentum, annual habit, and distinctly ovate-cordate lower cauline leaves. On the whole, those four sections, Stachys, Corsica, Olisia, Subsect. Rectae and Sect. Campanistrum are all inter-related in one way or another.

Sect. 12. CORSICA Bhattacharjee, sect. nov.

Syn: Sect. Stachyotypus Benth. § Oligantheae Benth., Lab. Gen. et Sp.
529 (1834) p.p.

Sect. Stachyotypus Benth. § Agregates Benth. in DC., Prodr. 12: 477
(1848) p.p.

Sect. Stachyotypus Briq. § Olisiae Briq. in Engler & Prantl, Natürl.
Pflanzenfam. 4 (3a): 266 (1896) p.p.

Low growing perennials or sometimes annuals, rooting at nodes with slender creeping branches. Indumentum sparsely and patently pilose. Leaves ovate to ovate-elliptic, small, margin wavy or with 2-3 broad crenations, cordate at base. Verticillasters 2-flowered, remote. Bracts absent or very small, setaceous c. 1mm. Pedicels 2-5 mm. Calyx \pm regular, campanulate, teeth \pm equal, oblong-acuminate with mucronate tip. Corolla tube exerted, annulate; upper corolla lip emarginate to retuse. Nutlets obovoid. (Monotypic).

Distribution: Corsica and Sardinia. (Map 5).

Type: S. corsica Pers.

Sect. Corsica is exceptional in its slender repent perennial habit which is probably adapted to growth on moist rock surfaces. Briquet (1901, p.74) in his treatment on Corsican plants, probably misunderstood its life form, referring to it as annual and assumed that S. corsica, the only representative of Sect. Corsica was very distinct from S. arvensis and S. marrubiifolia of Sect. Campanistrum. He compared it with some analogous species from Madagascar and S. Africa, presumably S. lyalii and S. serrulata respectively. These two species are indeed very similar to the Corsican plant in their slender, repent to decumbent habit, 2-flowered, remote verticillasters and characteristic ovate, few-crenate leaves. Bentham (1834) put all those above mentioned species within the section Stachyotypus § Oliganthae together with a few more S. African and American species (S. aethiopica, S. eriantha etc.), weighting the habit and verticillaster characters.

This isolated endemic species of Corsica and Sardinia has been considered by Briquet as "paleogenic". It is evident that the Tyrrhenian islands have been isolated from the mainland since the upper Tertiary (late Miocene? cf. Wills, 1951). The apparent similarities of S. corsica to the above mentioned species may have resulted from convergent evolution, as has been suggested by Briquet. This suggestion receives some support from S. eriantha in Mexico, which is similar in vegetative habit to S. corsica but differs from it markedly in inflorescences and floral characters. On the other hand the Mediterranean species S. arvensis and S. marrubiifolia approach Sect. Corsica in the shape of the calyx teeth and in leaf shape and margin, but look very different in general facies. As it is impossible to be sure of the true affinities of S. corsica, it seems best to treat it as a monotypic section.

Sect 13. SIDERITOPSIS Bhattacharjee, sect. nov.Syn. Sect. Olisia Dumort. sensu Boiss., Fl. Or. 4: 716 (1879) p.p.

Annuals. Flowering stems erect, usually divaricately branched from base. Indumentum densely and patently pilose to hispid. Lower cauline leaves broadly obovate to ovate, serrate to crenate-serrate, cordate to attenuate at base, petiolate to subsessile. Median cauline and floral leaves gradually becoming smaller, ovate to ovate-lanceolate, distantly serrate to subentire, cuneate at base and mucronate tipped. Verticillasters 4-6-flowered. Bracts linear to lanceolate, herbaceous, spinulescent to mucronate-tipped, as long as or slightly less than calyx tube. Pedicels 2.5-6 mm. Calyx sub-bilabiate to bilabiate, campanulate; teeth unequal, oblong acuminate, mucronate, strongly nerved; calyx mouth with dense ring of hairs. Corolla tube sub-included. Nutlets round to obovoid.

Distribution: Anatolia, Lebanon, W. Syria and Palestine. (Map 5).

Type: S. pseudosideritis Huber-Morath & BhattacharjeeOther species: S. obscura Boiss., S. zoharyana Eig.

This section shows affinity with Sect. Campanistrum, but is readily distinguished by having \pm bilabiate and prominently nerved calyx with long pedicels, herbaceous bracts as long as calyx tube, and densely hispid to pilose indumentum. The type species was erroneously described under the genus Sideritis Sect. Hesiodea as Sideritis balansae Boiss. (Fl. Or. 4: 707, 1878). Detailed floral study reveals its correct status under the genus Stachys (see p.324)

Sect 14. NEUROCALYX Bhattacharjee, sect. nov.Syn. Sect. Olisia Dumort. sensu Boiss., Fl. Or. 4: 716 (1879) p.p.Sect. Eustachys Briq. § Olisiae Briq. in Engler & Prantl, Natürl. Pflanzenfam, 4 (3a): 266 (1896) p.p.

Xerophytic annuals. Flowering stems erect to procumbent, low growing, simple or divaricately branched, glabrescent with very few glandular hairs and sessile glands. Lower cauline leaves obovate, serrate, attenuate at base, gradually passing into similar but smaller median cauline and floral leaves.

Verticillasters 4-6-flowered, remote, ebracteate. Pedicels 2-3 mm. Calyx bilabiate, campanulate; teeth unequal, oblong-acuminate, mucronate and strongly nerved; mouth glabrous. Corolla subexserted; upper corolla lip entire to retuse. Nutlets obovoid. (Monotypic).

Distribution: W. Syria, Palestine and Lebanon. (Map 5).

Type: S. neurocalycina Boiss.

The Section has more affinity with Sect. Saturioïdes and less with Sect. Sideritopsis. It differs from the former in having a + bilabiate calyx and glabrescent plant body. From the latter it is distinguished by its ebracteate verticillasters, subexserted corolla tube and glabrescent plant body.

Sect. 15. SATUREIOIDES Bhattacharjee, sect. nov.Syn. Sect. Olisia Dumort. sensu Benth. in DC., Prodr. 12: 481 (1848) p.p.Sect. Eustachys Briq. § Olisiae Briq. in Engler & Prantl, Natürl. Pflanzenfam. 4 (3a): 266 (1896) p.p.

Annual. Flowering stems erect, low growing, divaricately branched from

base upwards. Indumentum puberulent to pruinose, glandular, sometimes sparsely and patently pilose above. Lower cauline leaves oblanceolate, crenate-dentate to \pm entire, attenuate at base, subsessile, gradually passing into shorter and \pm sessile median cauline and floral leaves. Verticillasters 4-6-flowered, ebracteate. Pedicels 0.2-0.5 mm. Calyx \pm regular, tubular; teeth \pm equal, triangular-subulate, tip aristate; mouth with dense hairy ring. Corolla tube exserted. Nutlets obovoid.

Distribution: Anatolia and N. provinces of Iraq and Syria (Mesopotamia). (Map 5).

Type: S. satureioides Mont. & Auch.

(Benth.)

Other species: S. ramosissima Mont. & Auch., S. burgsdorffioides Boiss.,
S. melampyroides Hand.-Mazz.

The section shows affinity with the monotypic annual Section Neurecalyx, from which it differs in having puberulent to sparsely pilose indumentum, \pm regular calyx and densely hairy ring at calyx mouth.

Sect 16. THAMNOSTACHYS Kapeller, Monogr. Ser. A Syst. Geogr. Rast. (Tiflis)
4: 30 (1961)

Syn. Sect. Zietenia Benth., Lab. Gen. et Sp. 531 (1834) p.p. excl. typ.

Sect. Stachyotypus Benth. \S Fruticulosae Boiss., Fl. Or. 4: 716
(1879) p.p.

Sect. Eustachys Briq. \S Fruticulosae (Boiss.), Briq. in Engler &
Prantl., Natürl. Pflanzenfam. 4 (3a): 264 (1896) p.p.

Sect. Stachyotypus Benth. subsect. Fruticulosae (Boiss.) Knorr. in
Fl. URSS 21: 225 (1954) nom. invalid.

Dwarf fruticulose shrubs without basal sterile rosettes. Flowering stems

branched or unbranched, not spinescent at apex. Indumentum sparsely adpressed-puberulent, usually eglandular. Lower cauline leaves oblanceolate, crenate to subentire, attenuate at base, subsessile to sessile, gradually passing upwards into similar but smaller median cauline and floral leaves. Verticillasters 2-flowered, remote. Bracts very small, setaceous, 2-3 mm. Pedicels 2-5 mm. Calyx \pm regular, tubular, inflated in fruit; teeth erect subequal, shortly mucronate; mouth glabrous. Corolla tube subexserted, upper corolla lip usually narrowed upwards. Nutlets obovoid.

Distribution: N.E. Anatolia, Transcaucasia and N.W. Iran (Iranian Azerbaijan).

(Map 5).

Type: S. fruticososa Bieb.

Key to Subsections:

1. Flowering stems erect and usually unbranched above; leaves oblanceolate, verticillasters remote Subsect. Fruticosae
1. Flowering stems diffuse, sometimes repent, usually with axillary branches; leaves obovate; verticillasters congested in a terminal spike or head Subsect. Paulinae

Subsect. Fruticosae Bhattacharjee, subsect. nov.

Syn. Sect. Stachyotypus \S Fruticosae Boiss., Fl. Or. 4: 716 (1879) p.p.

Sect. Stachyotypus subsect. Fruticosae (Boiss.) Knorr, in Fl.

URSS 21: 225 (1954) non. invalid.

Flowering stems without dwarf axillary shoots, never repent. Leaves oblanceolate. Verticillasters remote, \pm distributed throughout the flowering axis.

Distribution: Throughout the range of the section. (Map 5).

Type: S. fruticulosa Bieb.

Other species: S. grossheimii Kapeller, S. araxina Kapeller, S. sosnowskyi Kapeller.

Subsect. Paulinae Bhattacharjee, subsect. nov.

Syn. Sect. Stachyotypus subsect. Zappanioides Knorr. in Fl. URSS 21:
229 (1954) nom. invalid.

Flowering stems without dwarf axillary shoots, sometimes repent. Leaves obovate. Verticillasters congested into a terminal globose head or spike. (Monotypic).

Distribution: W. Transcaucasia (Talysch) (Map 5).

Type: S. pauli Grossheim.

This section shows affinity with Sect. Aucheriana on one side and with Sect. Olisia subsect. Rectae on the other. From the first it is distinguished by having non-spinescent flowering shoots, \pm tubular calyx inflated in fruit and glabrous at mouth. From the latter it differs in having puberulent indumentum with \pm straight and dwarf fruticulose habit, 2-flowered verticillasters and tubular calyx.

Sect. 17. AUCHERIANA Bhattacharjee, sect. nov.

p.p. excl. typ.;

Syn. Sect. Zietenia Benth., Lab. Gen. et Sp. 531 (1834) / in DC. Prodr.
12: 486 (1848)

Sect. Stachyotypus Benth. \S Fruticulosae Boiss., Fl. Or. 4: 716
(1879) p.p.

Sect. Eustachys Briq. § Fruticulosae (Boiss.), Briq. in Engler & Prantl.,
 Natürl. Pflanzenfam. 4 (3a): 264 (1896) p.p.

Dwarf shrubs without basal rosettes. Flowering stems branched and usually spinescent above. Indumentum patently pilose, sparse or dense, rarely glabrescent. Lower cauline leaves lanceolate, entire, attenuate at base gradually passing into smaller and spinescent tipped median cauline and floral leaves. Verticillasters 2-4-flowered, remote. Bracts linear to lanceolate, herbaceous rarely setaceous, as long as calyx tube or smaller, spinescent tipped. Pedicels 5-8 mm. Calyx ± regular and campanulate; teeth subequal, as long as calyx tube; mouth usually with dense ring of hairs, rarely glabrous. Corolla tube sub-exserted. Stamens slightly exserted from corolla tube. Nutlets obovoid. Distribution: Iran and Corsica. (Map 1).

Type: S. aucheri Benth.

Other species: S. pilifera Benth.; S. ixodes Boiss., S. acerosa Boiss.,
S. multicaulis Benth., S. glutinosa L.

Sect. Aucheriana shows affinity with Sect. Thamnostachys on one side, and sect. Zietenia on the other. It differs from the former having ± spinescent flowering axes, patently pilose indumentum with copious glandular hairs, and conspicuously bracteate verticillasters. From Zietenia it is distinguished in not having stellate-haired indumentum and non-spinescent flowering stems. The only species growing in Corsica, Sardinia and Italy is S. glutinosa which is widely disjunct from the rest of the species, all growing in Iran. Their overall resemblances suggest true affinity rather than one that has arisen by convergence of different stocks. I could find no W. Mediterranean species which show as close a morphological relationship

to S. glutinosa as do the Iranian species S. acerosa, S. multicaulis, S. aucheri etc. The major disjunction may have resulted from the extinction of all linking groups.

Sect 18. ZIETENIA (Gled.) Benth., Lab. Gen. & Sp. 558 (1834)

Syn. Genus Zietenia Gleditsch, Syst. Plant. 185 (1764).

Sect. Stachyotypus Benth. ^S Infrarosulares Boiss., Fl. Or. 4:
716 (1879) p.p.

Sect. Eustachys Briq. ^S Infrarosulares (Boiss.), Briq. in Engler
& Prantl., Natürl. Pflanzenfam. 4 (3a): 265 (1896) p.p.

Sect. Stachyotypus Benth. subsect. Lavandulifoliae Knorr. in
Fl. URSS 21: 228 (1954) nom. invalid.

Suffruticose perennials with basal sterile rosettes, xerophytic.

Flowering usually unbranched with 2-3-paired cauline leaves. Indumentum sparsely to densely pilose to tomentose mixed with unequal-armed stellate hairs. Basal leaves lanceolate to oblanceolate, weakly serrate to entire; attenuate at base, subsessile. Cauline leaves similar but smaller than basal leaves, entire, sessile. Floral leaves ovate-lanceolate to ovate, entire, sessile, apex acuminate and not spinescent. Verticillasters \pm 6-flowered, remote or \pm approximate. Bracts few, inconspicuous, linear, 0.5-1 mm, pilose. Pedicels 2-2.5 mm. Calyx \pm regular, subcampanulate; teeth subequal, 1.5-6 times longer than tube, patently pilose, tip soft herbaceous; mouth with weak hairy ring. Corolla tube included. Stamens slightly exserted from corolla tube. Nutlets ovoid with faint rings near base. (Monotypic).

Distribution: Anatolia, Iran, Caucasia and Afghanistan. (Map 1).

Type: Zietenia orientalis Gled. (= S. lavandulifolia Vahl.).

The section shows an affinity with Sect. Aucheriana, particularly with the species S. ixodes Boiss. from which it differs in having stellate hairs in the indumentum, non-spinescent and larger calyx teeth, included corolla tube, and inconspicuously bracteate verticillasters. It also shows certain resemblances with Sect. Ambleia Ser A, from which it differs in the nature of indumentum, larger and patently pilose calyx teeth and included corolla tube. Considering overall resemblances, the systematic position of this section is intermediate between the two mentioned above.

Sect. 19. AMBLEIA Benth., Lab. Gen. et Sp. 563 (1834).

Syn: Sect. Stachyotypus Benth. \S Ambleiae Boiss., Fl. Or. 4: 716 (1879) p.p.

Sect. Eustachys Briq. \S Ambleiae (Boiss.), Briq. in Engler & Prantl, Natürl. Pflanzenfam. 4 (3a): 265 (1896) p.p.

Suffruticose perennials without basal sterile rosettes, xerophytic. Flowering stems branched or unbranched. Indumentum densely or sparsely adpressed tomentose with dendroid hairs. Lower cauline leaves ovate to oblong-lanceolate or lanceolate, entire, attenuate to cuneate at base, subsessile to sessile. Floral leaves similar but smaller, blunt to spinescent at apex. Verticillasters 2-6-flowered. Bracts lanceolate to linear, herbaceous, as long as or less than calyx tube. Pedicels 0.5-3 mm. Calyx \pm regular, tubular to campanulate; teeth subequal, blunt or spinescent tipped; fruiting calyx sometimes inflated; mouth with ring of hairs. Corolla tube exerted to subexserted. Stamens slightly exerted from corolla tube; anthers usually cells/subparallel. Nutlets obovoid to oblong.

Distribution: E. Egypt, Sinai, Palestine, Lebanon, Syria, N. Iraq, E. Anatolia, Iran, Transcaucasia, Afghanistan; and in Cape Province of S. Africa. (Map 3).

Lectotype: S. inflata Benth.

Key to Series (excl. S. Africa):

1. Calyx teeth lanceolate-subulate, tip spinescent
 2. Leaves densely felted, ovate-orbicular Series B.
 2. Leaves not densely felted, lanceolate Series A.
1. Calyx teeth triangular to oblong-lanceolate, tip blunt
and obtuse Series C.

Series A.

Syn. Sect. Zietenia (Gled.) Benth. in DC. Prodr. 12: 489 (1848) p.p.
excl. typ.

Leaves lanceolate; leaf indumentum not thickly felt forming. Calyx teeth lanceolate-subulate, tip spinescent.

Distribution: Throughout the range of the section, excepting S. Africa.

Type: S. tomentosa Benth.

Other species: S. palestina L., S. aegyptiaca Pers., S. laxa Boiss.,

S. turcomanica Trautv., S. demawendica Bornm.

Series B.

Leaves ovate to orbicular; leaf indumentum thickly felt-forming.

Calyx teeth lanceolate-subulate, spinescent tipped. (Monotypic).

Distribution: N. Iraq.

Type: S. kotschyii Boiss.

Series C.

Syn. Sect. Stachyotypus subsect. Inflatae Knorr. in Fl. URSS 21: 231
(1954) nom. invalid.

Leaves ovate to lanceolate; indumentum on leaf densely felted. Calyx teeth triangular to oblong-lanceolate, blunt and not spinescent at tip.

Distribution: Throughout the sectional range, excepting S. Africa.

Type: S. inflata Benth.

Other species: S. obtusicrena Boiss., S. nivea Labill., S. trinervis Ait.

This section is rather isolated in its relationship with other sections of Stachys. If it is considered that the stellate indumentum has been replaced by the dendroid indumentum in course of evolution (or vice versa), a certain affinity can be traced with Sect. Zietenia. Considering other morphological characters of Sect. Ambleia, Series A, particularly S. tomentosa Benth., shows the closest similarity with Sect. Zietenia, from which it differs in having shorter calyx teeth and different indumentum type. Probably these two sections have been derived from a common stock and diversified later in the process of evolution becoming ecogeographically separated.

Subgenus BETONICA (L.) Bhattacharjee, stat. nov.

Syn. Genus Betonica L. Gen. Pl. ed 5: 250 (1754); Sp. Pl. ed 1: 573
(1753); Benth. in DC. Prodr. 12: 459 (1848); Boiss., Fl.
Or. 4: 749 (1879); Knorr. in Fl. URSS 21: 237 (1954)

Flowering stems unbranched. Leaves usually deeply crenate-dentate.

Upper floral leaves abruptly becoming smaller than the lower most pair.

Verticillasters 16-20-flowered. Bracts numerous, oblong-lanceolate to ovate-lanceolate, scarious or herbaceous, spinescent-tipped with broad and hardened base. Calyx sessile, \pm regular, tubular; teeth \pm equal, lanceolate-subulate, spinescent tipped, mouth hairy. Corolla tube exerted usually exannulate, rarely annulate (*S. alopecuros* (L.) Benth.); anther cells subparallel to parallel. Nutlets flattened and sharply trigonous, apex usually irregularly lobed, rarely smooth; marginal and apical wing distinct; ventral rib prominent. Petiole anatomy: Adaxial phloem usually present in the vascular bundle. (Fig. 19, Pl. 8) Nutlet anatomy: Inner sclerenchymatous layer of mesocarp without pitted unthickened area (Fig. 22, & Pl. 11 & 12). Distribution: Europe, N. Anatolia, Caucasias, N. Iran to Central Asia. (Map 3). Type: *S. officinalis* (L.) Trev.

Sect. 20. BETONICA (L.) Benth., Lab. Gen. et Sp. 532 (1834)

Syn. Sect. Alopecuros Benth. op. cit. (1834); Briq. in Engler & Prantl, Natürl. Pflanzenfam. 4 (3a): 260 (1896).

Herbaceous perennials, rarely annual (*S. serbica* Pancic). Basal leaves ovate to ovate-oblong. Indumentum with simple hairs and usually bicelled glands. Corolla tube exannulate rarely annulate (*S. alopecuros* (L.) Benth.). Distribution: Throughout the subgeneric range. Type: *S. officinalis* (L.) Trev.

Other species: *S. alopecuros* (L.) Benth., *S. monieri* (Gouan) P.W. Ball, *S. macrantha* (C. Koch) Stearn, *S. serbica* Pancic.

Sect. 21. MACROSTACHYA Bhattacharjee, sect. nov.

Herbaceous perennials. Basal leaves oblong-lanceolate. Indumentum with simple and stellate hairs and sometimes bicelled glands. Corolla tube exannulate.

Distribution: Balkan peninsula, N.E. Anatolia, Caucasus and Transcaucasia, N. Iran to C. Asia. (Map 3).

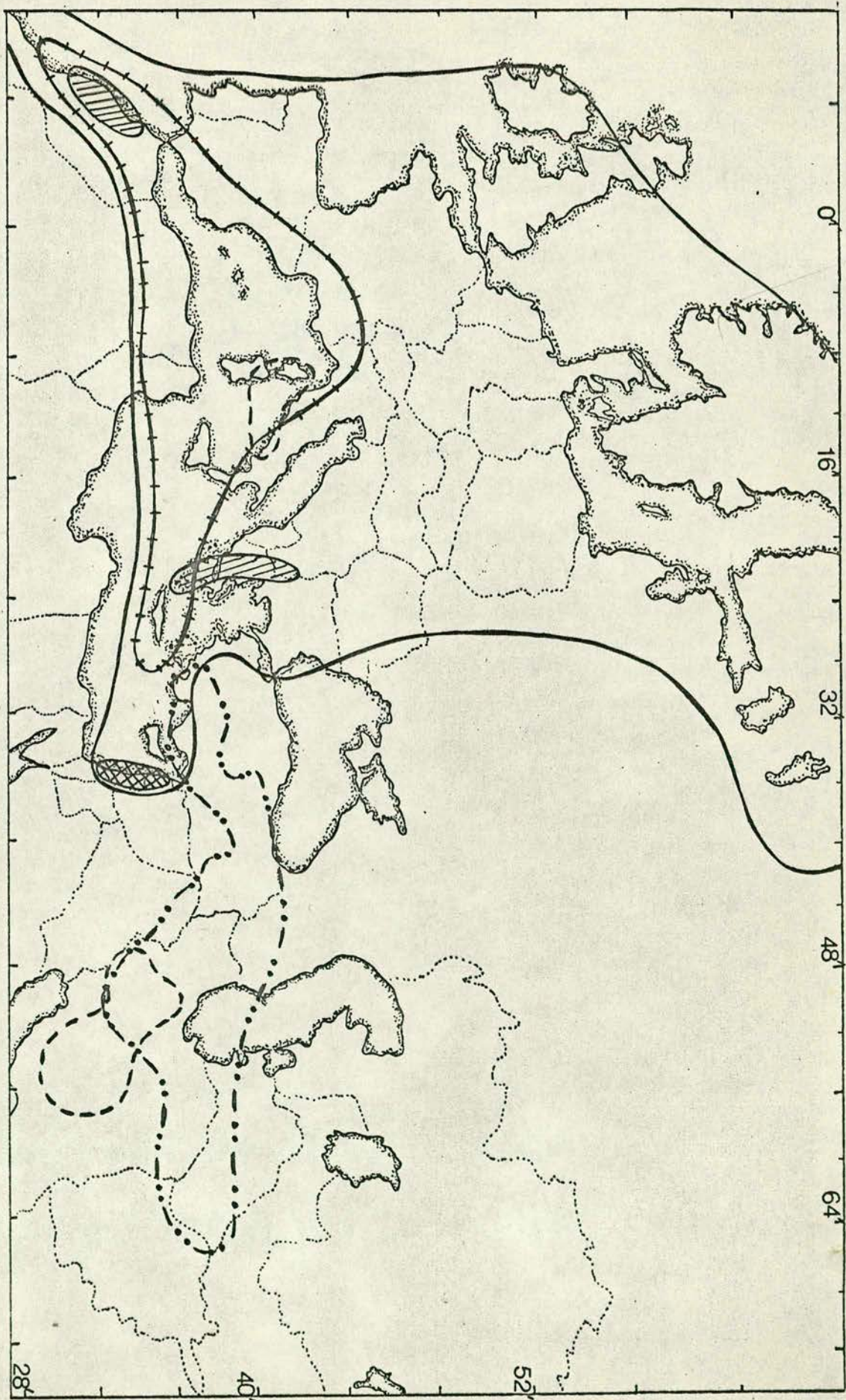
Type: S. macrostachya (Wend.) Briq.

Other species: S. discolor Benth., S. scardica (Griseb.) Hayek, S. betoniciflora Rupr.

Sect. Betonica and Sect. Macrostachya, under the subgenus Betonica, are closely allied to each other but the former is distinguished by its shape of leaf and nature of indumentum from the latter. The subgenus shows affinity with Sect. Eriostomum in its outward appearance and general habit, but is distinguished from it by several morphological characters (cf. Table I).

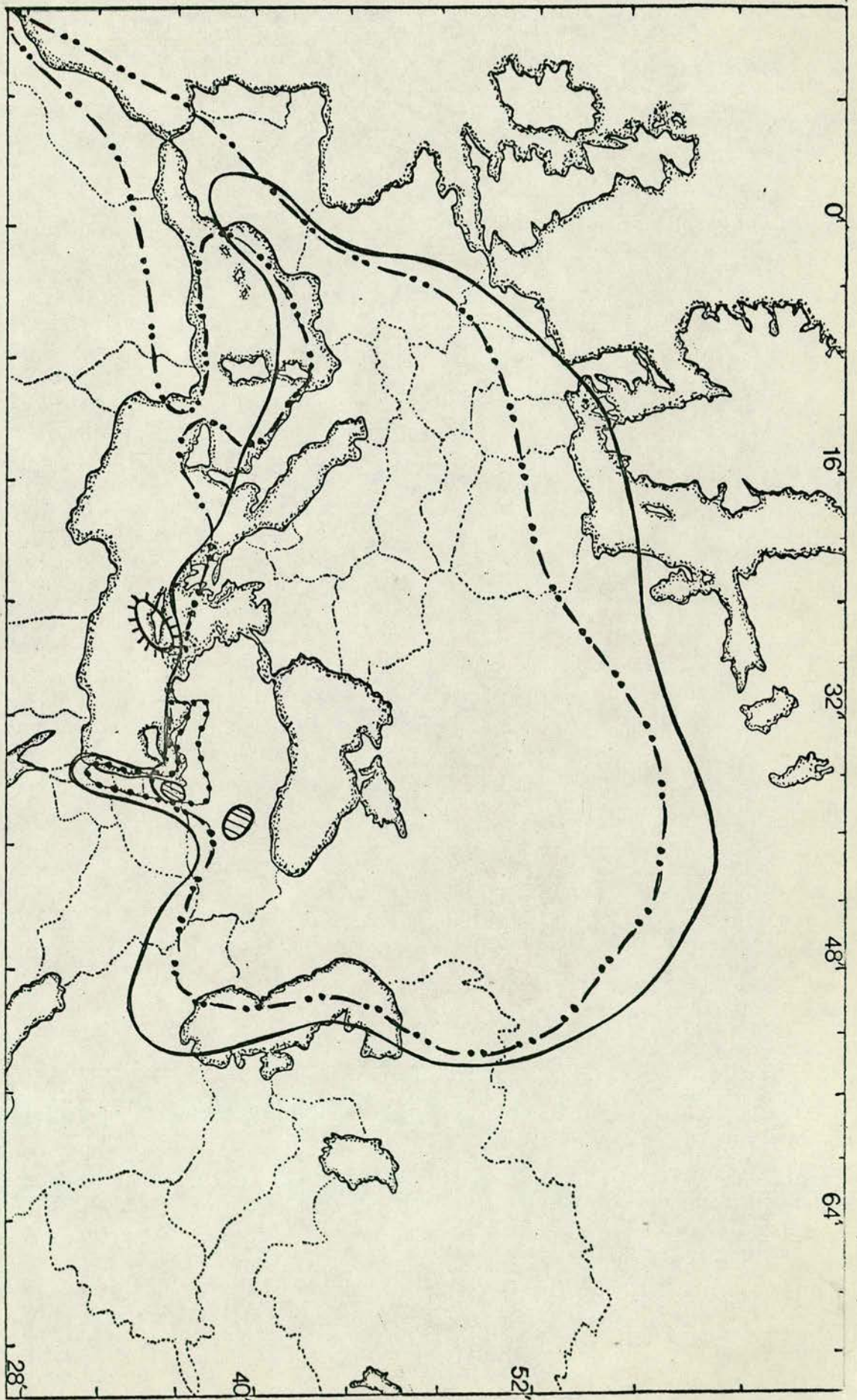
Previously Betonica was divided by Bentham (1834, 1848) into two groups, Betonica and Alopecuros. In the group Alopecuros Bentham put two species S. alopecurus and S. jacquinii mainly on the characters of yellow coloured corolla and annulate corolla tube. Now these two species have been sunk into a single species S. alopecuros.

In the present account the two sections Betonica and Macrostachya are considered on two other correlated characters. Each section has at least 4 species. Besides that, S. serbica, an annual species from the Balkan peninsula, treated by Fl. Europea (1972) in an annual section, has been put for the first time in Subgenus Betonica Section Betonica considering overall character resemblances.




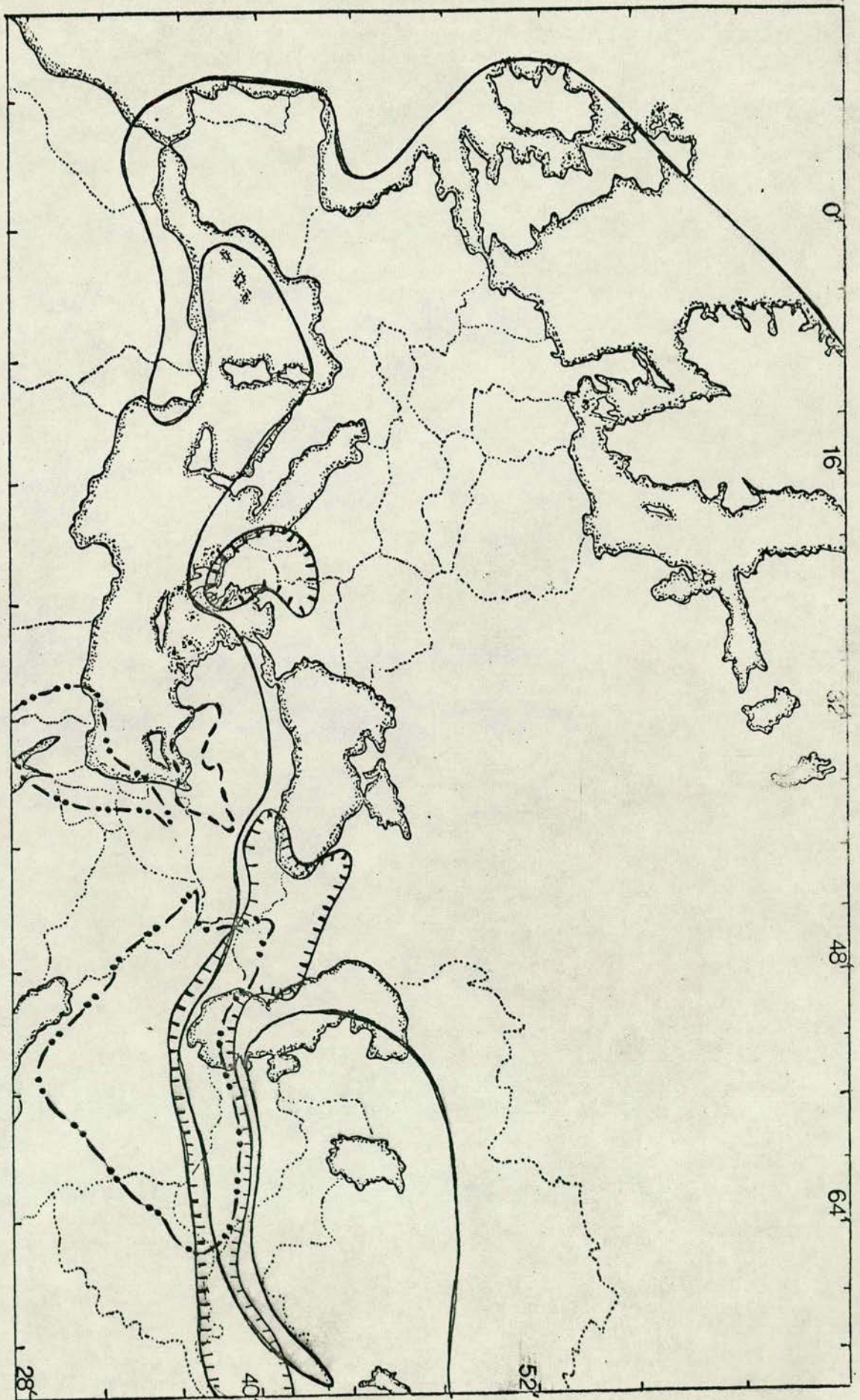
Map 2. Distribution of Stachys Sect. Olisia:

--- Subsect. Rectae; — Subsect. Annuae; ☀ Subsect. Spinosae;
 ▨ Subsect. Rosulatae; - - - Subsect. Distantes






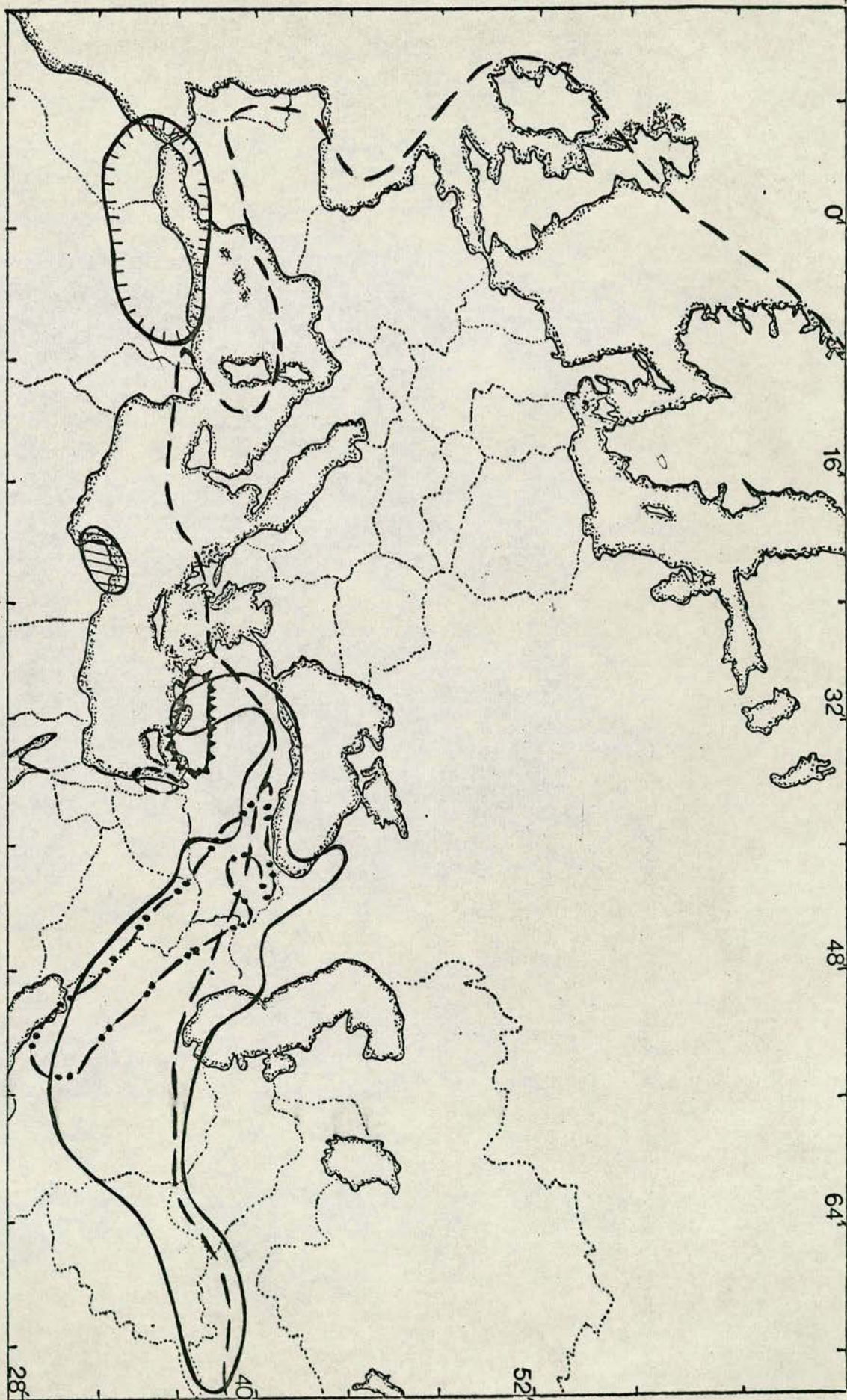
Map 3. Distribution of Sections of Stachys:

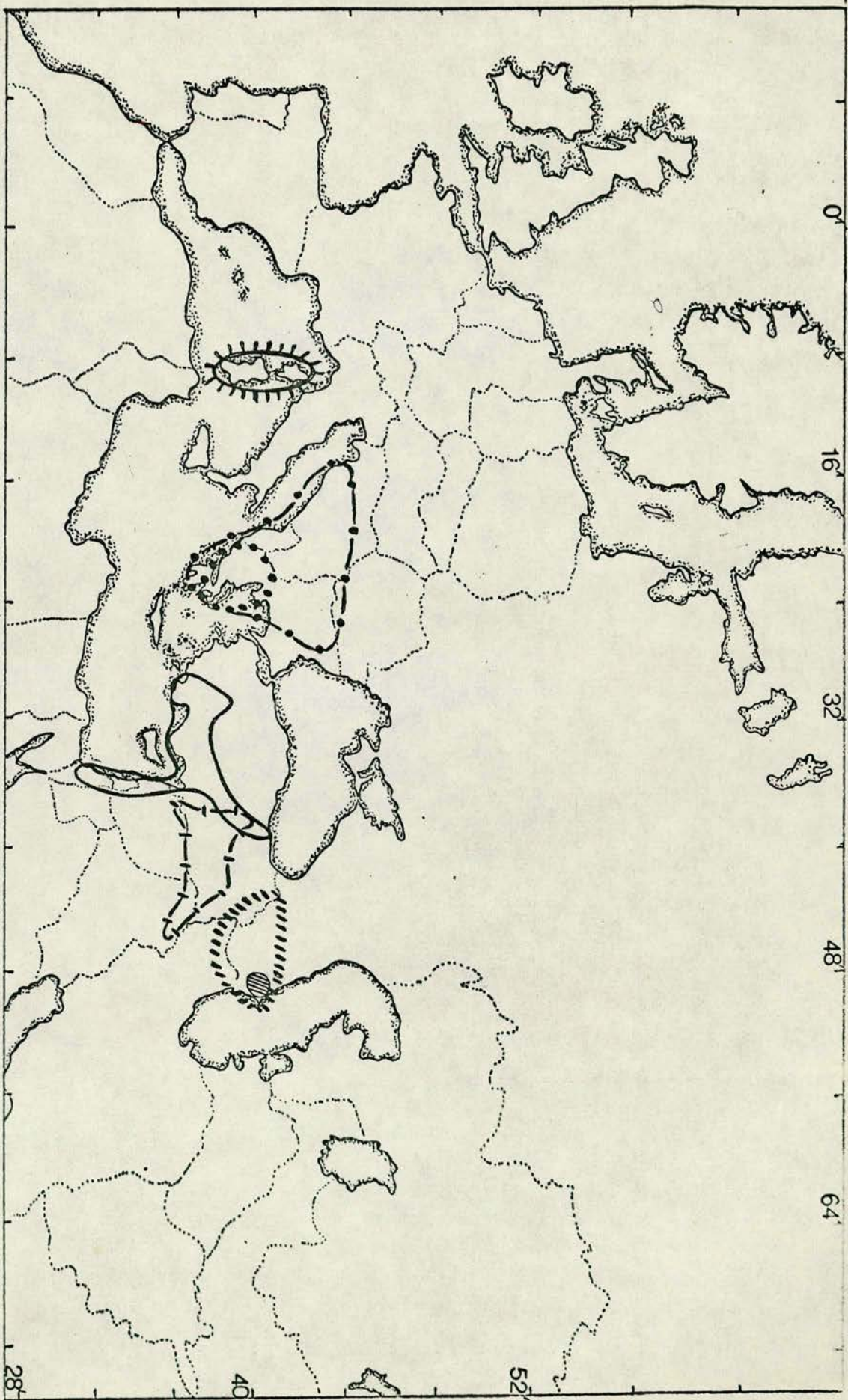
— Sect. Betonica;  Sect. Macrostachya; - · - · - Sect. Amblyia;
 - - Sect. Infrasulcaria



Map 4. Distribution of Sections and Subsections of Stachys:

- - Sect. Stachys subsect. Sylvaticae;  Subsect. Circinatae; — Sect. Setifolia;
 Sect. Roseostachys;  Sect. Fragillicaulis Subsect. Fragiles;
 - · - · Subsect. Multibracteae




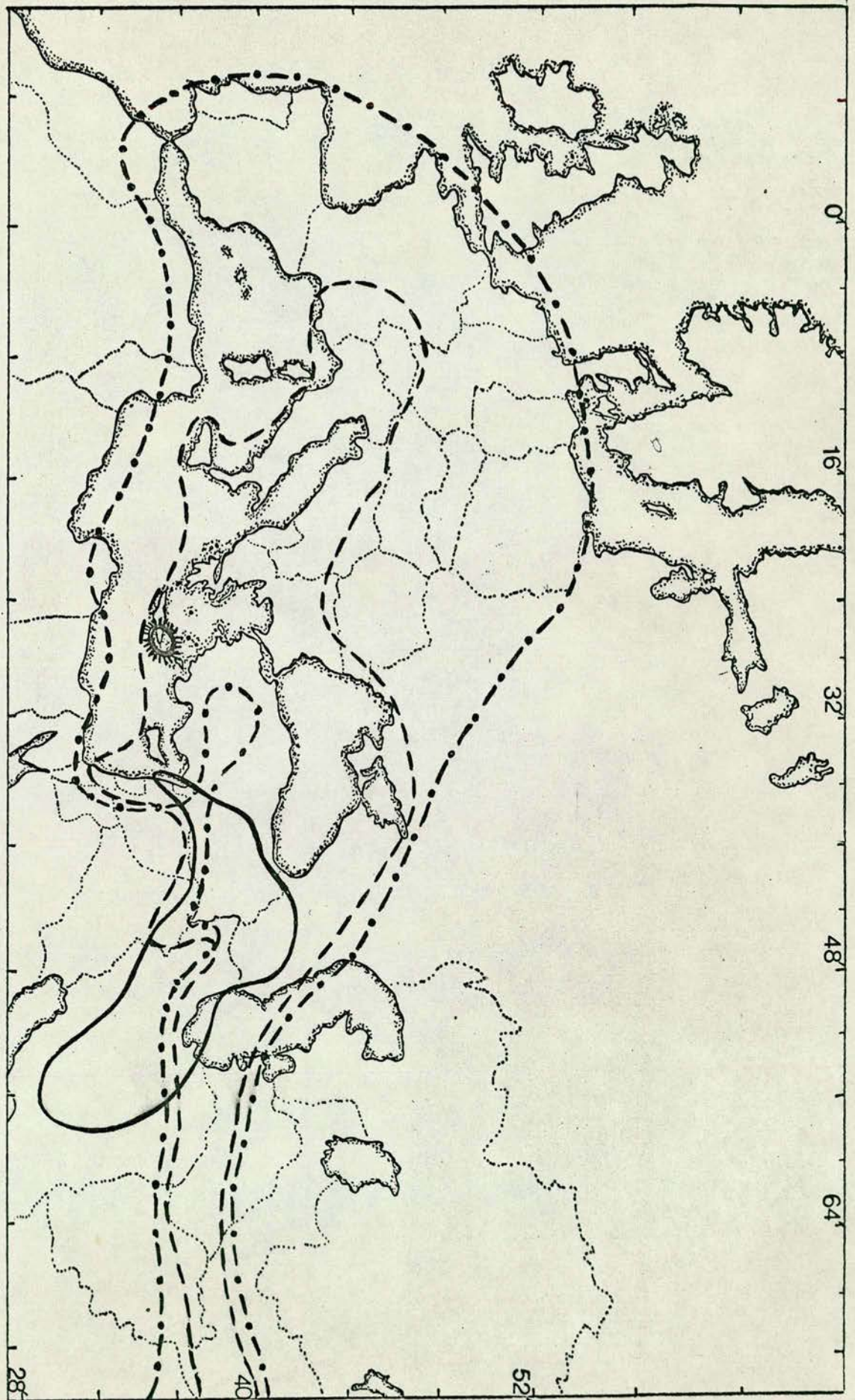


Map 5. Distribution of Sections and Subsections of Stachys:

- ☀ Sect. Corsica; Sect. Swainsoniana Subsect. Swainsonianae; .
 - · - · Subsect. Decumbentes; — Sect. Sideritopsis; -|-|- Sect. Satureioides;
 // // Sect. Thamnostaehys subsect. Fruti-
culosae ; ◐ subsect. Paulinae.

Map 6. Distribution of Sections and Subsections of Stachys:

--- Sect. Eriostomum Subsect. Germanicae; --- Subsect. Creticae;
 — Subsect. Spectabiles;  Subsect. Mucronata



D. CYTOLOGICAL EVIDENCE FROM AVAILABLE LITERATURE

In comparison to the large size of the genus, cytological information is rather scanty. Out of 150 species considered in this account, the chromosome numbers of only 29 species, belonging to 12 of my 24 sections are recorded in the literature. They are tabulated in Table 4 and the available references are also cited. Most of the counts have been made from European material. Few species from N. America, Africa and S.W. Asia have been reported. Only 2 cytologically examined species, S. lavandulifolia and S. setifera, are confined to the S.W. Asian countries and neither of them are endemic to Turkey. Some chromosome counts have been made from first meiotic metaphase (Lang 1940, Morton 1973, and others), while others are exclusively based on somatic metaphase stage (Strid 1965). Using data presented in Table 4, the distribution of haploid numbers in the cytologically known species is given in Table 5.

From Table 4 some suggestions can be made. $x = 8$ is a very important base number of the genus; 16 out of 29 taxa are diploids, tetraploids, hexaploids or octaploids of this number. $n = 5$ is an unusual low number and has possibly been derived from ^ahigher number during adaptation to weediness: it occurs in a specialised annual species (S. arvensis). $n = 17$ may have been produced by dibasic allopolyploidy, with $n = 8$ and 9 parents; on the other hand, it may be derived by ascending dysploidy from $n = 16$ or by descending dysploidy from $n = 18$. The occurrence of dysploidy in the evolution of Stachys is demonstrated in the existence of $n = 15$ and 16 in Sect. Eriostomum and $n = 8$ and 9 within the species S. officinalis of subgenus Betonica.

Morton (1973) gives the ploidy level of S. sylvatica and S. palustris as $x = 8$ and $x = 6$ respectively. (Table 4.) regarding the base number of S. sylvatica as $x = 8$ and of the closely related S. palustris as $x = 17$. He suggests that high base numbers such as $x = 15$ and 17 are secondary in origin and have

Table 4. Available chromosome counts of *Stachys* species.
Data compiled from Fedorov (1969), Ornduff (1967-69), Moore (1970-72).

Species	Section	Diploid number	Probable Ploidy level	References & Citations
<i>S. alpina</i>	Eriostomum	30	4	Lang 1940
<i>S. germanica</i>	-	30	4	"
<i>S. byzantina</i>	-	30	4	"
<i>S. terekensis</i>	-	32	4	Matbeeba 1968
<i>S. mucronata</i>	Mucronata	30	4	Strid 1965
<i>S. setifera</i>	Setifolia	34	4	Lang 1940
<i>S. palustris</i>	Stachys	64, 96, 102	8, 12, 6 (Morton, for 102)	Rohweder 1937; Wulff 1938; Lang 1940, 1954; Morton & Gill 1973
<i>S. sylvatica</i>	-	64	8 (Morton)	Morton 1973
<i>S. mialhesii</i>	-	20	2	Lang 1940
<i>S. euboica</i>	Swainsoniana	34	4	Strid 1965
<i>S. swainsonii</i>	-	34	4	"
<i>S. menthifolia</i>	-	34	4	Lang 1940
<i>S. angustifolia</i>	Olisia	24	2?	"
<i>S. iberica</i>	-	24	2?	"
<i>S. recta</i>	-	32, 34, 48	4, 6	Polya 1949; Lang 1940; Favarger 1959; Delay 1947
<i>S. annua</i>	-	34	4	Lang 1940
<i>S. maritima</i>	-	34	4	"
<i>S. arvensis</i>	Campanistrum	10, 20	2, 4	Strid 1965; Wulff 1939
<i>S. marrubifolia</i>	-	16	2	Contandriopoulos 1957
<i>S. ocymastrum</i>	-	18	2	Lang 1940; Larsen 1960
<i>S. corsica</i>	Corsica	16	2	Contandriopoulos 1957
<i>S. glutinosa</i>	Aucheriana	32	4	"
<i>S. lavandulifolia</i>	Zietenia	34	4	Lang 1940
<i>S. alopecuroides</i>	Betonica	16	2	"
<i>S. monieriana</i>	-	16	2	"
<i>S. macrantha</i>	-	32	3	"
<i>S. officinalis</i>	-	16, 18	2	Rohweder 1937; Lang 1940; Gadolle & Klipphur 1968
<i>S. scardica</i>	-	16	2	Lang 1940
<i>S. macrostachya</i>	Macrostachya	16, 48	2, 6	Lang 1940; Delay 1947

Table 5. Distribution of haploid number in the cytologically known species of *Stachys* L. (based on data given in Table 4).

Note: Species with more than one chromosome number are scored for each number

Haploid no.	5	8	9	10	12	15	16	17	24	32	48	51	Total no. of species
No. of species	1	7	2	2	2	4	4	8	2	2	1	1	29

resulted from allopolyploidy. In recognition of this it seems logical to go one step further than Morton and consider plants with $2n = 30$ and 34 as tetraploids rather than diploids and they have been classed as such in Table 4. The high ploidy level of S. sylvatica and S. palustris coincides with wide distribution and may also be related to their ability to hybridisation.

Subgenus Betonica is found to be consistent in having $x = 8$, the majority of the species being diploid. This relative uniformity in chromosome number fits with the naturalness of the group. The Cretan monotypic endemic section Mucronata has $2n = 30$ which in correlation with other morphological characters (cf. Ch. III, p.115) supports its affinity with Sect. Eriostomum. On the other hand, S. setifera ($2n = 34$) treated under Sect. Eriostachys by Boissier (equalling Sect. Eriostomum in the present classification), has been separated from it. Difference in chromosome number as well as dissimilarity in morphological characters support this separation. The low chromosome number of S. mialhesii ($2n = 20$) suggests that its inclusion in Sect. Stachys needs reconsideration.

It must be emphasised, however, that there are no counts for 11 sections, and that none of the endemic Turkish taxa has been cytologically examined.

E. ECOGEOGRAPHY AND ENDEMISM

Ecology: A brief survey of ecological habitat is a requirement before attempting to visualise the pattern of geographical distribution. Though a wide range is occupied by the genus, the greater part of the Stachys (at least in the Mediterranean - S.W. Asia) grows on various types of rocky substrate. These species occur on exposed mountain slopes, on sloping or vertical rocks, often on shady cliffs and in gorges, rarely on screes. These saxatile habitat conditions have had a profound influence on the evolution of general habit and life forms; related species usually grow in similar habitats. The plants are most frequently chamaephytes with a \pm woody base and relatively small leaves. Limestone rock is the usual substratum but igneous and serpentine rocks are not infrequent.

Exclusively xerophytic habitat conditions are met with in 11 sections of subgenus Stachys. In the sections Infrarosularis, Fragilicaulis subsect. Fragiles from Turkey, Swainsoniana and Candida from the Balkan peninsula, Roseostachys from Cyrenaica and Stachys subsect. Circinatae from N. Africa and S.W. Europe, the majority of the species inhabit cliffs and crevices of limestone rocks. They are usually woody based chamaephytes and from a taxonomical and geographical viewpoint are very much isolated. Their isolated position gives the impression that they are relict elements of Tertiary or Pleistocene times that have found shelter in these regions during periods of climatic fluctuation.

A different xerophytic habit is found in sections Mucronata and Olisia subsect. Spinosa from Crete and Karpathos islands, Aucheriana from Iran, Corsica and Italy, and Thamnostachys from Iran and Transcaucasia. These are cushion-chamaephytes; they grow in mountain steppes and rocky slopes, and form an important local constituent of dwarf tragacanthic vegetation.

Their typical bushy habit and divaricate branches with spinescent to spiny tips or stiffly spiny calyx teeth and their reduced verticillasters give the impression that these characteristic features have been selected out by severe climatic conditions (arid and windy) coupled with persistent grazing.

Besides these sections, Sedilias, Sect. Zietenia and Sect. Ambleia from S.W. Asia, Sect. Olisia from Europe and S.W. Asia, and Sect. Fragilicaulis subsect. Multibracteatas are erect, woody-based chamaephytes occurring widely in open rocky steppes, screes and desertic conditions.

The monotypic section Corsica from the islands of Corsica and Sardinia deserve mention in this context. It has a slender repent habit and perennates by means of trailing stoloniferous stems. This unique habit is probably related to its long evolutionary history on moist rocky substrate.

The other important habitat conditions are found in 3 sections of Subgenus Stachys and 2 of Subgenus Betonica. They are predominantly mesophytic sections whose species grow in moist or shady places, e.g. in woodland, scrub, near water courses and in lush meadows, many of them extending into the Euro-Siberian region. The plants usually characterised by their tall herbaceous stems with well scattered and usually large leaves. Perennation occurs by rhizomes which give rise to flowering shoots every year. Sect. Stachys subsect. Sylvaticae and Sect. Setifolia have no basal sterile shoots, whereas Sect. Eriostomum, Sect. Betonica and Sect. Macrostachya are characterised by having basal sterile shoots (cf. Ch. II, A). According to Raunkiaer's (1934) life forms, these mesophytes are hemi-cryptophytic. Some of the species of these mesophytic sections grow in drier conditions and have dense indumentum cover. Examples are S. byzantina and S. cretica of Sect. Eriostomum, S. scardica and S. discolor of Sect. Macrostachya.

Finally there are some annual sections which either grow in littoral plains or in open arid regions. They do not actually face upto extreme environmental conditions as they are essentially drought evaders due to their shorter life cycles. Exclusive annual sections are found in Sect. Campanistrum from Europe and S.W. Asia, Satureioides, Neurocalyx and Sideritopsis from S.W. Asia. The altitudinal limits of the genus vary from sea-level to 3600 m (S. subnuda), though the majority grows between 500-2500 m.

Distribution: The distribution pattern of any genus is useful in the sense that it gives hints for the reconstruction of its evolutionary history, when a fossil record is entirely lacking. The present discussion deals with general aspects of distribution within the genus, with the main purpose of determining the centre of its maximum morphological diversity, and thereby its present centre(s) of speciation.

The main distribution patterns of all the 21 sections have been discussed briefly in the systematic account after each description and are supplemented by distributional maps (Maps 1-6). The northern limit of the genus is occupied by S. palustris and S. sylvatica, reaching to 69°-70° N in Norway and Fennoscandia. S. arvensis and S. officinalis come next to them, extending to 64° and 62° N respectively. In the South, East and Western side, the limit of the genus is beyond the area considered here.

The sections Eriostomum, Olisia, Betonica and Macrostachya are widely distributed throughout Europe, Asia and N. Africa, while sections Stachys and Campanistrum are far wider, extending even to the New World. Sections Setifolia and Zietenia (monotypic) are also fairly widely distributed in Turkey, Transcaucasia and Iran, extending upto Central Asia (Tien Shan). A very characteristic distribution pattern is noticed in the Sect. Ambleia, a section remarkable for its dendroid-tomentose indumentum. This section is

well represented in arid S.W. Asia, particularly in Iran; it extends eastwards to Afghanistan and S. eastwards to Egypt (S.aegyptica) but is very sparse in Turkey and Caucasia, only being represented in the N.E. and Southern frontiers respectively by S. inflata, a very widely distributed species. S. of Egypt, the section is represented in Ethiopia by the species S. schimperi, S. hypoleuca etc. and then jumps to S. Africa in the province of Transval, Natal, Malawi etc., where about a dozen species occur. Sections Mucronata, Roseostachys, Corsica and Neurocalyx are monotypic endemic groups restricted to different parts of the Mediterranean region. Sections Sideritopsis, Infra-rosularis, Fragilicaulis and Satureioides are mainly distributed in Turkey, though some of the species extend into surrounding countries like Iran, Iraq, Syria and Lebanon. Sections Candida and Swainsoniana have fairly restricted distribution in the Balkan peninsula, but one species of Sect. Candida is confined to Morocco (S. saxicola). Of the remaining two sections Sect. Thamnostachys is restricted to the border of S. Caucasus, N. Iran and N.E. Turkey, while Sect. Aucheriana is mainly restricted to Iran but one of its species S. glutinosa, grows in Corsica, Sardinia and W. Italy.

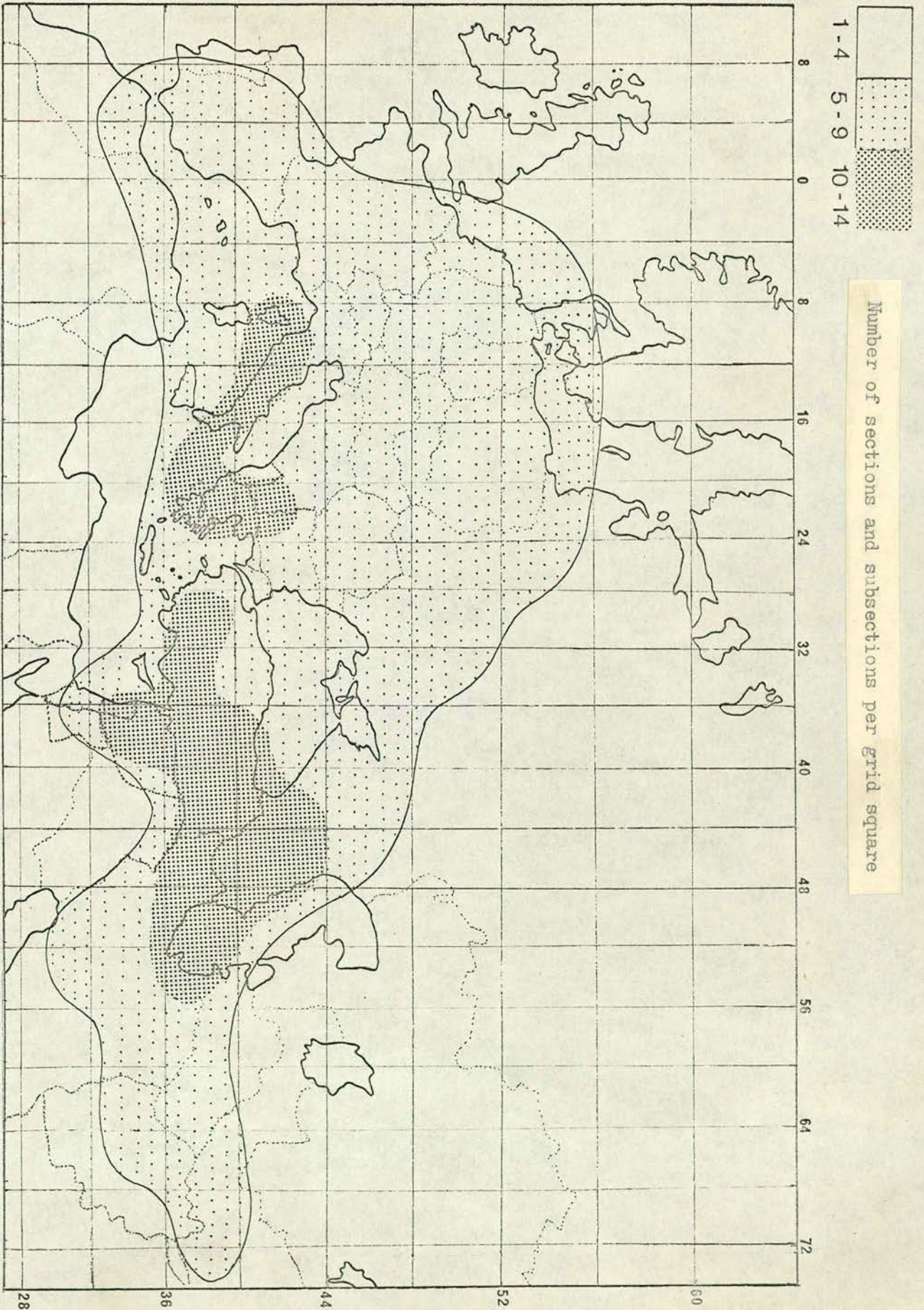
Disjunction at species level has been noticed in S. tournefortii, S. hydrophila and S. ocymastrum. The first one occurs in Crete and Cyrenaica, the second in N.W. Africa and Lebanon, and the third in N. Africa, Spain, Corsica, Italy, Greece and Crete.

These species and sectional disjunctions between E. and W. Mediterranean may be thought of in terms of contraction of a once more continuous area, mainly brought about by the accentuation of aridity in the eastern Mediterranean (Davis & Hedge, (1971). For the section Ambleia, it has been suggested that certain northern groups have made themselves at home in Southern Africa but not concentrated in the winter-rainfall area. The degree of disjunction

suggests that this particular group is the remnant of an extensive semi-arid flora (Burt, 1971).

An isoflor map representing the sectional and subsectional concentration in different parts of their range of distribution have been plotted on a grid map, taking 4° degrees latitude and longitude as a grid square. Each species has been considered as a unit, and their distribution based on the herbarium material supplemented by literature records. The map (Map 7) shows the density of sections and subsections per grid square and the boundaries have been modified to take account of topography etc. As the number of sections and subsections in an area is indicative of morphological diversity, from the isoflor map it can be easily seen that there are two major centres, one in S.W. Asia and the other in S.E. Europe. In S.W. Asia the area covered is Turkey, Transcaucasia, N.W. Iran, N. Iraq, N. Syria and Lebanon; it includes two major phytogeographical regions, Irano-Turanian and E. Mediterranean, the density of sections and subsections being 10-14. In S.E. Europe, the main area is the Southern part of the Balkan peninsula and Italian peninsula, which phytogeographically embraces the E. Mediterranean and to a lesser extent the Euro-Siberian region (sensu Zohary, 1966); the density is 10-11. The maximum concentration of species is in S.W. Asia (94 out of 150 species, i.e. about $\frac{2}{3}$ the total number of species considered in this account). The number gradually decreases towards the east, from W. Iran, through Afghanistan to the Far East; southwards from Syria, and S. Iraq to Arabia; and westwards to Western Europe.

Endemism: For the sake of calculating the percentage of endemism, the whole area is divided into several units; Iraq, Turkey and Iran are cited separately and their political frontiers taken as their boundaries. Other countries have been grouped together in (as far as possible) a floristically meaningful way.



Map 7

Isoflor map of the sections and subsections of *Stachys J.*

The 11 areas recognised are, of course, not equivalent in size, topography and climate. Table 6 shows the number of sections as they are represented in each such area and the percentage of endemics. It also gives (lowest horizontal column of the Table) the overall percentage of species of each section, restricted to a single smaller area, as well as the percentage of endemism in the whole genus (61% on the basis of the 11 areas used in the table). Endemism has been calculated at species level.

A high percentage of species endemism is found in the Balkan peninsula (60%) including Bulgaria, Yugoslavia and Albania, in comparison to Turkey (39%) and Iran (29%). The lower percentage of endemism in Turkey is partly due to the fact that political boundaries have been used in calculating endemism. The northern boundary of the Balkans is less significant in the distribution of Stachys than the eastern boundaries of Turkey, which are floristically unnatural, many E. Anatolian species extending into Transcaucasia, N.W. Iran and N. Iraq.

If we compare the number of species and sections as they occur in Turkey (70 species in 14 sections) with those in the Balkan peninsula (45 in 9 sections), it becomes evident that more basic diversification and speciation has occurred in Turkey than in S.E. Europe. This is partly due to the Irano-Turanian region (an ancient evolutionary centre) being well represented in Turkey but absent from Europe.

The maximum morphological diversity and species concentration in S.E. Europe and S.W. Asia are partly explained by the rugged topography, which provides favourable niches for relict endemics, a considerable degree of geographical isolation, the aridity which stimulates further differentiation (Stebbins, 1950), and (in S.W. Asia) the juxtaposition of 4 phytogeographical regions (instead of 2 in Europe).

Sect. Neurocalyx	Sect. Corsica	Sect. Satureioides	Sect. Campanistrum	Sect. Betonica	Sect. Macro-stachya	$\frac{\text{Total No. Endemics}}{\text{Total No. Species}}$	% of Endemism
-	-	-	$\frac{0}{3}$	$\frac{0}{3}$	-	$\frac{0}{16}$	0%
-	$\frac{1}{1}$	-	$\frac{0}{4}$	$\frac{0}{3}$	-	$\frac{2}{22}$	9%
-	-	-	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{1}$	$\frac{27}{45}$	60%
-	-	-	$\frac{0}{1}$	$\frac{0}{2}$	$\frac{1}{3}$	$\frac{4}{21}$	19%
-	-	-	-	$\frac{0}{2}$	$\frac{0}{2}$	$\frac{3}{28}$	11%
-	-	$\frac{1}{4}$	$\frac{0}{3}$	$\frac{0}{2}$	$\frac{0}{1}$	$\frac{26}{70}$	37%
-	-	$\frac{0}{1}$	$\frac{0}{1}$	$\frac{0}{1}$	$\frac{0}{2}$	$\frac{11}{38}$	29%
-	-	$\frac{0}{3}$	-	-	-	$\frac{3}{20}$	15%
$\frac{1}{1}$	-	$\frac{0}{2}$	$\frac{0}{3}$	-	-	$\frac{5}{26}$	19%
-	-	-	$\frac{1}{5}$	$\frac{0}{1}$	-	$\frac{9}{19}$	47%
-	-	-	-	-	-	$\frac{1}{2}$	50%
$\frac{1}{1}$	$\frac{1}{1}$	$\frac{1}{4}$	$\frac{2}{8}$	$\frac{1}{5}$	$\frac{2}{4}$	$\frac{91}{150}$	61%
100%	100%	25%	40%	25%	50%		

Table 6.

Number of *Stachys* species and per cent

Area	Sect. Erio- stomum	Sect. Mucronata	Sect. Infra- rosularis	Sect. Stachys	Sect. Setifolia	Sect. Candida	Sect. Swain- soniana	Sect. 01
Iberian Peninsula & Balearics	$\frac{0}{3}$	—	—	$\frac{0}{3}$	—	—	—	
Alps, S. France, Italy, Corsica, Sar- dinia & Sicily	$\frac{0}{6}$	—	—	$\frac{0}{2}$	—	—	—	
Balkan peninsula, Aegean Islands incl.	$\frac{0}{9}$	$\frac{1}{1}$	—	$\frac{0}{2}$	—	$\frac{4}{4}$	$\frac{10}{10}$	
W., C. & E. Europe (incl. U.S.S.R.)	$\frac{2}{7}$	—	—	$\frac{0}{2}$	$\frac{0}{1}$	—	—	
Caucasia & Crimea	$\frac{0}{8}$	—	—	$\frac{0}{2}$	$\frac{0}{1}$	—	—	
Turkey	$\frac{6}{18}$	—	$\frac{5}{6}$	$\frac{0}{2}$	$\frac{0}{2}$	—	—	
Iran	$\frac{0}{6}$	—	—	$\frac{0}{1}$	$\frac{0}{1}$	—	—	
Iraq	$\frac{0}{3}$	—	—	—	$\frac{1}{3}$	—	—	
Syria, Lebanon, Palestine & Sinai	$\frac{1}{7}$	—	$\frac{0}{1}$	$\frac{0}{1}$	—	—	—	
Morocco, Algeria & Tunisia	$\frac{1}{2}$	—	—	$\frac{2}{4}$	—	$\frac{1}{1}$	—	
Libya, Egypt & Sudan	$\frac{0}{1}$	—	—	—	—	—	—	
Totals	$\frac{13}{28}$	$\frac{1}{1}$	$\frac{5}{6}$	$\frac{2}{6}$	$\frac{1}{3}$	$\frac{5}{5}$	$\frac{10}{10}$	
% of species in restricted areas	48%	100%	83%	33%	33%	100%	100%	

Note: Numerator = endemic species

ies and percentage of endemics

Sect. Swainsoniana	Sect. Olisia	Sect. Fragili-caulis	Sect. Roseo-stachys	Sect. Thammostachys	Sect. Aucheriana	Sect. Zietenia	Sect. Ambleia	Sect. Sideritopsis
-	$\frac{0}{4}$	-	-	-	-	-	-	-
-	$\frac{0}{5}$	-	-	-	$\frac{1}{1}$	-	-	-
$\frac{10}{10}$	$\frac{6}{12}$	-	-	-	-	-	-	-
-	$\frac{0}{3}$	-	-	-	-	-	$\frac{1}{2}$	-
-	$\frac{1}{6}$	$\frac{0}{1}$	-	$\frac{2}{4}$	-	$\frac{0}{1}$	$\frac{0}{1}$	-
-	$\frac{5}{13}$	$\frac{8}{12}$	-	$\frac{1}{3}$	-	$\frac{0}{1}$	$\frac{0}{1}$	$\frac{0}{2}$
-	$\frac{0}{3}$	$\frac{2}{8}$	-	$\frac{0}{1}$	$\frac{5}{5}$	$\frac{0}{1}$	$\frac{4}{7}$	-
-	$\frac{0}{2}$	$\frac{2}{6}$	-	-	-	$\frac{0}{1}$	$\frac{0}{2}$	-
-	$\frac{0}{5}$	-	-	-	-	-	$\frac{2}{3}$	$\frac{1}{3}$
-	$\frac{3}{5}$	-	$\frac{1}{1}$	-	-	-	-	-
-	-	-	-	-	-	-	$\frac{1}{1}$	-
$\frac{10}{10}$	$\frac{15}{24}$	$\frac{12}{17}$	$\frac{1}{1}$	$\frac{3}{5}$	$\frac{6}{6}$	$\frac{0}{1}$	$\frac{8}{11}$	$\frac{1}{3}$
100%	63%	71%	100%	60%	100%	-	73%	33%

ndemic species;

Denominator = total number of species in each section.

IV. GENERIC AFFINITIES

Bentham in his monographic work (1834) placed Stachys in the tribe Stachydeae in which he also included Lamium, Marrubium, Sideritis and other genera. He delimited the tribe on the characters, "stamens ascending, lower longer; calyx 5-10-nerved, nutlets dry." Unfortunately he did not provide the classification with a satisfactory key. Briquet in Engler & Prantl's Pflanzenfamilien (1896) made a very satisfactory treatment of the tribal and subtribal limits of the Labiatae. He included Stachys in the subtribe Laminae of the tribe Stachydeae and recognised 26 genera within it, of which Stachys is the largest. In doing so he separated the tribe Marrubieae (including Marrubium and Sideritis) mainly on the key characters: corolla tube usually included in calyx and genitalia included in corolla tube. This constitutes a major change from Bentham's treatment. His tribal and subtribal delimitations, supported by practical dichotomous keys, are satisfactory and thus acceptable in this present revision.

Since Briquet's classification a few more genera, viz. Stachyopsis, Taitonia, Pseuderemostachys, Metastachys, Neustruevia and Phlomidoschema have been added to the subtribe Laminae by different taxonomists. Some of these relevant genera will be discussed later in the chapter.

The generic limits of the subtribe are more or less well marked in Briquet's classification. He distinguished Stachys from other genera by a combination of the following characters, a) styler branches almost alike, b) anther \pm divaricate, rarely parallel, c) lower corolla lip without apophyses, d) nutlets usually with blunt rounded apex and e) calyx teeth not widened at base and/or not growing together. These key characters can still be used to separate Stachys from the genera Eremostachys, Phlomis, Galeopsis, Lamium, Leonurus, Molucella, Wiedmannia and these new genera under Laminae mentioned

above. But the situation is somewhat different with Ballota. This genus is the closest relative of Stachys and is traditionally delimited from the latter mainly on calyx characters such as: a) calyx teeth 5-10- ∞ widening at the base or sometimes growing together, b) calyx tube dilated into the limb above, the discoid calyx limb being an adaptation for the wind dispersal of the calyx with the nutlets inside (observed by Davis in B. acetabulosa), and c) shape of calyx \pm regular, tubular-campanulate to infundibuliform. These characters hold true throughout most of the genus, except in some species of the Sect Ballota (B. nigra ssp. kurdica, ssp. sericea, ssp. nigra and ssp. foetida) and in two monotypic sections, Stachydiformis and Royleoides (Patzak 1957, '58). The last three species ^{of Sect. Ballota} have 5-toothed calyces with the tube obscurely dilated; particularly in the two monotypic sections, the calyx is characteristically bilabiate (fide illustrations in Patzak, 1958). I have had the opportunity in examining the species of Sect. Ballota, but material of the two monotypic sections has not been available for study.

Comparable forms in at least some calyx characters are found in Stachys Sect Fragilicaulis (mainly in S. pinardii, S. longiflora, S. euadenia, S. brantii and S. fragillima). In these species the calyx tubes are more or less regular, infundibuliform, and there is a tendency of the tube to widen above in S. pinardii (Dudley, D.35700) and the type specimen of S. brantii. So apparently the calyx characters break down to some extent. Besides these features, the cymosely branched peduncles of verticillasters which are of frequent occurrence in Ballota have also been found in the species S. laetivirens and S. ballotiformis of Stachys Sect. Fragilicaulis. Stachys Sect. Eriostomum in its herbaceous perennial habit (predominantly mesophytic) many-flowered verticillasters, conspicuous herbaceous bracts, and large and broad ovate-cordate leaves, is quite close to Ballota Sect. Ballota. Assessment of all

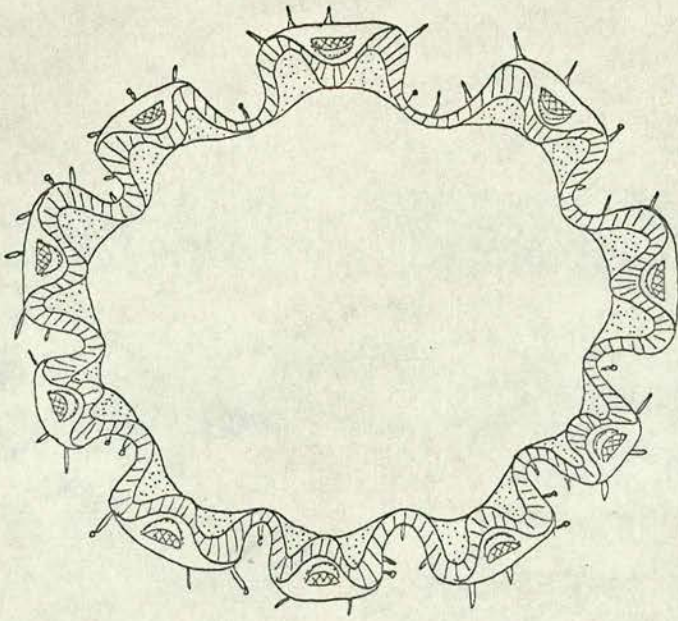
these characters shows that the nearest relative of Stachys is genus Ballota. From the available material and species descriptions I tried to discover some other traits to delimit Ballota from Stachys, and found that the deeply sulcate calyx tube of Ballota is a constant feature for delimiting the latter genus from Stachys. In a few species of Stachys, like S. sericantha and S. libanotica of Sect. Eriostomum, the calyx nerves are very prominent, but transverse sections, when compared with the species of Ballota, show a reasonable difference in shape, and distribution of strengthening tissue in the calyx tube (Fig. 28). The distinctly nerved calyx tube of Stachys can never be referred to as deeply sulcate, as found in Ballota species. Although the genus Stachys, the largest in the subtribe Lamiinae, shows a wider range of variation in many characters than the smaller allied genus Ballota, it is worth recognising them as separate genera despite some amount of intermediacy in a few distinguishing characters. The taxonomic relationship of these two large genera is supported by their general pattern of distribution; both of them have their main centres of morphological diversity in the Mediterranean and adjacent regions. They are probably linked together through a generalised stock and later diverged and speciated - the bridging taxa becoming few and isolated in some restricted areas and later becoming extinct. The isolated position of two monotypic sections of Ballota, Sect. Stachydiformis (Ethiopia) and Sect. Royleoides (S. Arabia), having calyx characters more or less similar to Stachys confirm this.

Stachys Sect. Sideritopsis shows some outward resemblances to the annual section Hesiodia of Sideritis in general habit, indumentum and inflorescence structures. In fact, Stachys pseudosideritis was originally placed under Sideritis as S. balansae by Boissier (1879). But on closer examination, particularly of the androecium and stigma characters, reveals that S. pseudo-sideritis definitely belongs to Stachys, and not to Sideritis, the main

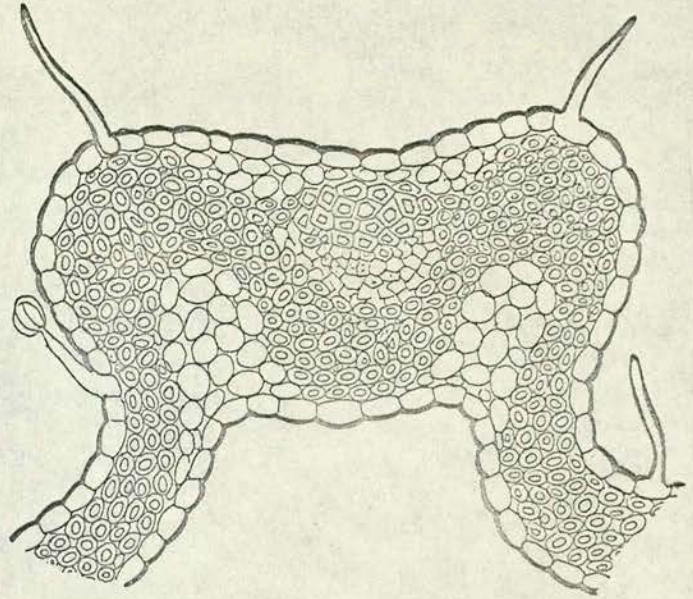
Fig. 28. CALYX TUBE ANATOMY OF BALLOTA & STACHYS

- A - Ballota nigra ssp. nigra (Diagrammatic);
- B - Ballota nigra ssp. nigra (Part of T. section);
- C - Stachys sericantha (Diagrammatic);
- D - S. sericantha (Part of T. section)

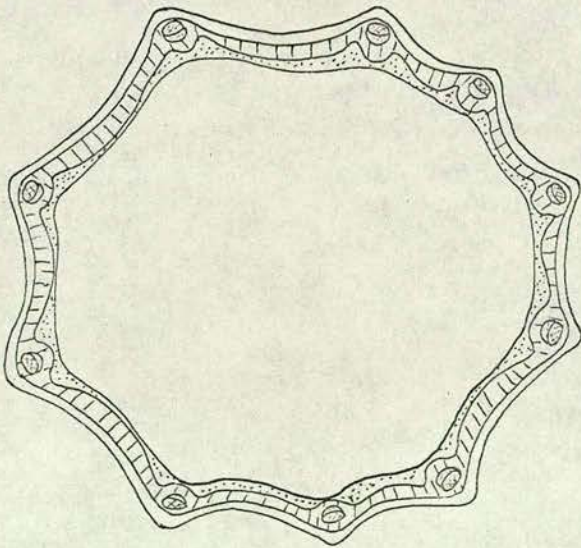
(vascular bundle - cross-hatched,
sclerenchymatous tissue - hatched, palisade - dotted.)



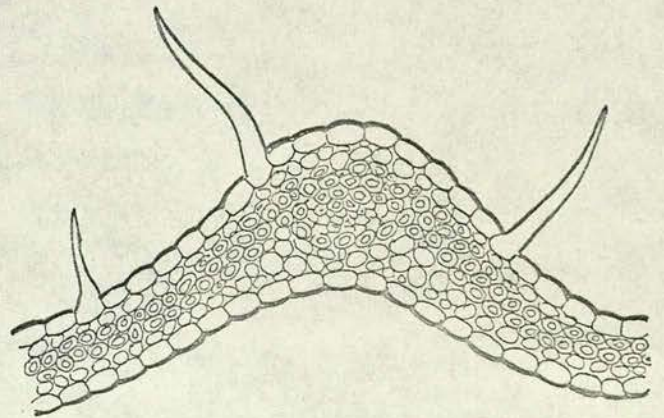
A



B



C



D

FIG. 28 CALYX-TUBE ANATOMY OF BALLOTA & STACHYS

diagnostic characters of Sideritis being a) stamens included in corolla tube and b) two stigmatic lobes distinctly unequal in length and different in shape (not both terete and subequal as in Stachys). As mentioned before, Briquet was right in his judgement in placing Sideritis in a separate tribe Marrubieae, and the outward similarity could be due to convergent evolution. It is worth mentioning in this context that Stachys dictyoneura Rech. fil. from Syria and Lebanon (Rechinger, 1952) rests on a misidentification of a Sideritis species (probably Sideritis glandulifera Post). I came to the above conclusion after examining the type.

The main key character by which the tribe Stachydeae is separated from the tribe Nepeteae is: the anterior pair of stamens longer than the posterior (inner) pair. But this character breaks down in some species of Stachys, particularly some American species as S. nepetifolia, S. bogotensis and S. keerlii, where the outer pair of stamens is a little shorter than the inner pair. On the other hand, the two well known species of Stachys, S. sylvatica and S. palustris, have their inner pair reaching the same level as the outer pair. So the main diagnostic feature of the two tribes break down, particularly in the genus Nepeta which is a very variable one. But so far as its delimitation from the genus Stachys is concerned, usually the bluish colour of the corolla and structure of the nutlets (having a distinct areole at the base) are quite useful. Above all, considering the large size of these two genera and their overall character correlation, they are maintained as distinct.

Now I shall try to survey the various genera proposed recently, relevant to the circumscription of Stachys a) Stachyopsis Popov (1928) has been proposed for the species Phlomis oblongata, P. lamifolia and P. marrubifolia. In the diagnosis, it is stated to differ from Stachys in having truncate

nutlets and villous anther filaments. Rechinger (1954) described a species, Stachys maleolens from Khas District of Iran, which has been transferred to Stachyopsis by Hedge (1968)¹⁹⁷². This transference seems justified on the above mentioned diagnostic characters supplemented by two other characters, i) upper corolla lip densely and softly villous and ii) longer than lower lip.

b) Phlomidoschema Vved (1941) was used as a new generic name for the taxa Stachys parviflora Benth. Vvedensky (1941) emphasised the fact that this species differs from the rest of Stachys in having included stamens, but differs from Sideritis in stigma characters. Besides these, the presence of stellate hairs on the nutlets and the superior position of the anterior (outer) pair of stamens in this monotypic genus are two new attributes seen by me that have never been met with any species of Stachys. Considering these features, it is desirable to keep the genus on its own. c) Taitonia Yamamoto (1938) and (d) Metastachys Knorr (1954) are two other related genera from Formosa and C. Asia respectively. These two are monotypic genera based on T. callicarpoides and M. sagittata, of which the latter is based on Ballota sagittata. Both these genera have been considered related to Stachys but differ in having unequal stigma lobes, one of the main key characters separating Stachys from related genera (Briquet 1896). Due to the unavailability of the relevant species, the generic limits of Taitonia and Metastachys could be assessed only by considering the descriptions and illustrations (cf. Yamamoto, 1938); on this basis they are provisionally accepted as distinct genera.

V. EVOLUTIONARY TRENDS IN STACHYS L.

Diversification of the genus, as it is present, leaves no doubt of a prolonged evolutionary history. After careful investigation of morphological diversity, some primitive (less specialised) features have been selected out and evolutionary speculations have been made on their basis.

Habit: As has been mentioned earlier in Chapter II, p.15 the genus has basically 3 types of habit, i.e. herbaceous perennial, suffruticose to suffrutescent perennial, and annual. The apparently primitive herbaceous perennial habit is characteristic of Subgenus Stachys Sect. Eriostomum, Sect. Setifolia, Sect. Stachys and Subgenus Betonica, which occupy more or less mesic habitats.

In Sect. Stachys Subsect. Sylvaticae the herbaceous habit with long perennating rhizome in a mesic habitat is more advanced than other herbaceous perennial sections with short rhizomes as it is evident from its very wide distribution (even in the New World) and high polyploid constitution (cf. Ch.III D), which suggests that the group has actually spread out after the Ice Age from S. Europe followed by successful stabilisation by hybridisation and one of the effective means by which they spread out successfully was their extensive method of vegetative spread.

From herbaceous perennial type of habit condition two completely different types of life-forms have been selected out in response to particular habitat conditions. One is the saxatile, suffrutescent-perennials woody at the base. This habit is advantageous for successful establishment and persistence in rocky xeric environments. The life-span of these perennials is quite long and as they often grow in "biologically closed" communities as found in cliffs and in crevices, their longevity increases the chance that some of their seeds will eventually find out similar habitats. This type of habitat is thus

particularly favourable for long-lived and woody perennials. Sections Infra-
rosularis, Swainsoniana, Candida, Roseostachys etc. are included in this type. Completely woody and suffruticose habit with spreading branches, often ending in spinescent branches or calyx teeth, is also found in this type, e.g. in Sections Aucheriana, Mucronata, Thamnostachys and Olisia Subsect Spinosa. Their woody, spinescent nature helps them to persist in extreme xeric environment coupled with excessive grazing pressure. The other extensive habit is the annual type which has some advantages over perennials under certain circumstances.

They can avoid excessive summer drought in the form of seeds, and can grow to flowering within a very short period. Because of their shorter life cycles they can occupy unstable and disturbed habitats for their successive spread. The rate of evolution is also more rapid than the perennials due to shorter life-span; in autogamous species, e.g. S. arvensis, S. pseudosideritis, S. brachyclada etc. immediate fitness in their genetic constitution favours colonisation of relatively large and uniform habitats.

Indumentum: Simple, eglandular and glandular hair types have been considered primitive from which more elaborate and complex stellate and dendroid hairs evolved. No doubt the latter are more specialised in that they are complex and elaborate structures that effectively cover the plant body, checking desiccation in prolonged drought. Their occurrence is restricted to the sections Amblesia, Zietenia and Macrostachya.

Leaves: Long-petioled, broadly laminar and deeply crenate-margined leaves with pinnate-brochidodromous venation are considered more primitive than narrower, subsessile to sessile, subentire to entire margined leaves with parallel brochidodromous venation (cf. Ch. II, p. 21).

Verticillasters: Multiflowered verticillasters, as have been found to occur in Subgenus Stachys Sect. Eriostomum and Subgenus Betonica, are considered the basic type from which a constant process of sterilisation brings about reduction in the number of flowers per verticillaster. This is achieved within the same or different sections of the genus (cf. Ch. II, p.36), e.g. in Sect. Eriostomum Ser. B, Sect. Fragilicaulis Ser. A, Sect. Olisia Subsect. Spinosae, Subsect. Rosulatae and in Sections Thamnostachys, Mucronata etc.

Bracts: Reduction in the size and number of bracts per verticillaster is an important evolutionary trend met with in the genus. Larger size and greater number, considered as primitive is always associated with herbaceous texture. Bracts of these types are more or less constantly associated with the Sections Eriostomum, Fragilicaulis Ser. B, Setifolia, Swainsoniana etc. of Subgenus Stachys and Sections Betonica and Macrostachya of Subgenus Betonica. From this condition, reduction in size and number, associated with inconspicuous and setaceous texture, has been noticed in Sections Olisia (Subsections Annuae, Rectae, Rosulatae), Stachys, Fragilicaulis Subsect. Fragiles and Ser. A, Thamnostachys, Zietenia etc. Extreme reduction is achieved in Sections Satureioides and Neurocalyx, where the bracts are entirely suppressed. Advancement is usually based on a reduction series in this character.

Flower: From the standpoint of advancement, three different features are noticeable in flower characters, viz. a) reduction in the length of pedicel, b) calyx distinctly bilabiate associated with herbaceous calyx teeth, c) increase in the length of corolla tube.

a) Pedicel: As has been mentioned earlier in chapter II, p.36 most of the members of Subgenus Stachys, e.g. Sect. Eriostomum, Mucronata, Sideritopsis, Corsica etc. have very conspicuous pedicels, attaining a length of even 10-14 mm. This feature is considered as primitive from which reduction in length is

achieved in Sections Satureioides, Neurocalyx, Olisia Subsect. Distantes and the pedicels never exceed more than 1.5 mm. In Subgenus Betonica reduction is greatest and the flowers are completely sessile. Intermediate conditions are scattered throughout the rest of the sections of Subgenus Stachys.

b) Calyx: The genus as a whole is characterised by a sub-bilabiate calyx with more or less unequal calyx teeth. Most species of Subgenus Betonica and Sect. Satureioides, Sect. Fragilicaulis of Subgenus Stachys have a more or less regular calyx with more or less equal teeth. An advanced condition is noticeable in Sections Sideritopsis, Neurocalyx, Swainsoniana Subsect. Decumbentes and few scattered species like S. alpina, S. persica etc. where the calyx is conspicuously bilabiate with distinctly unequal teeth. From an evolutionary standpoint, a strongly bilabiate calyx is specialised over sub-bilabiate and regular ones. The herbaceous texture of the calyx tip is considered another primitive condition from which spinescent to stiffly spiny calyx teeth have been evolved for effective protection and dispersal. The first type is found in Sections Fragilicaulis, Roseostachys, Candida and some Amblesia, while in Sections Mucronata, Sideritopsis, Olisia etc. they are conspicuously spiny to spinescent.

c) Corolla tube: The primitive short-tube condition of corolla tube is found in Sect. Eriostomum, Sect. Roseostachys etc. A long exerted corolla tube is considered advanced, as it has a particular selective advantage over the shorter one, having presumably been selected in relation to specialised long-tongued insect pollinators. This type is met with in the Subgenus Betonica and in some scattered species of Subgenus Stachys, e.g. S. longiflora, S. euadenia, S. fragillima, S. pinardii etc. Some annual species like S. arvensis, S. brachyclada and S. pseudosideritis though, have a very short corolla (cf. p. 45) almost included in the calyx; these are not considered primitive as they are

apparently self-pollinating (autogamous) - undoubtedly a secondary specialisation.

The primitive and derived states discussed above are represented in Table 7. Following Table 7, and adopting the method proposed by Sporne (1956), the degree of relative advancement in each section of the genus has been calculated and expressed as a percentage advancement index (Table 8). The left hand side of each vertical column of the table⁸ indicates primitiveness, while the right hand side is the state considered derived from it. For each primitive versus advanced character, scores of 0 and 2 are respectively recorded. When a section contains both advanced and primitive states of the particular character, the scoring is considered on the basis of the frequency of the character states. To make this clear, examples can be put forward. In Sect. Fragilicaulis a herbaceous calyx tip (a primitive character) occurs in all of the species excepting S. viscosa, and is therefore scored as 0. On the other hand, when a section contains more or less equal number of species bearing advanced and primitive states in respect to a particular character, e.g. Sect. Infrarosularis having more or less equal number of species with conspicuous herbaceous and inconspicuous setaceous bracts, it is scored as 1. For character states of the verticillaster column, '2' is scored for the sections having only 1-2-(-4)-flowered verticillasters and '0' for ∞ -flowered (more than 12) verticillasters; the intermediates, i.e. 6-10-flowered are scored as '1'. Using these procedures the percentage of advancement has been calculated for each section (last vertical column of Table 8) and a target diagram (Fig. 29) drawn. In the diagram the concentric circles correspond to successive grades of advancement, the sections being arranged according to their percentage advancement indices. The range of advancement is from 17% (Sect. Eriostomum) to 72% (Sect. Satureioides). Having arranged the sections concentrically in order of advancement, they are then arranged near to one another, on the basis of phenetic resemblance, in

so far as their position on the advancement radius allows. The scattering of the sections over the area roughly indicates the affinity of one group to the other. The more closely related sections are placed next to each other while distantly related ones are placed apart. Thus the Sections Roseostachys, Setifolia and Stachys come next after the groups Eriostomum, Mucronata, and Infrarosularis, followed by Sections Candida and Swainsoniana in a clockwise direction. Subgenus Betonica comes closer to Section Eriostomum of Subgenus Stachys, but widely apart from the rest of its sections. Phenetic relationships between the sections are emphasised by joining them with lines. Solid, broken and dotted lines joining the sections represent strong, close and weak affinities respectively. Presentation of advancement indices in a target diagram is meaningful in the sense that it aims at presenting a natural classification on a horizontal plane, and takes account of evolutionary advancement. It is a rough compromise between a phenetic classification and an evolutionary arrangement, and in no way can be considered as phylogenetic or cladistic.

Conclusion: Overall assessment of primitive versus advanced characters shows that the advancement of various organs does not take place simultaneously, and the rates of advancement may be slower or faster in different organs and in different groups. Features which we assume to be primitive may even have evolved in the reverse order, or in two directions from a median position; no time scale can be implied; primitive characters can be ancient or relatively recent in origin, dependant on the group concerned. Takhtajan (1959) termed this phenomenon as 'heterobathmy'.

With all these shortcomings, a convincing evolutionary conclusion is impossible to draw; and any attempt to do so is highly speculative. Comprehensive investigations from different fields of approach can help to recognise primitive and advanced groups, but the selection of suitable characters

Table 7. Primitive versus advanced characters in Stachys L.

Primitive	Advanced
1. Habit herbaceous, perennial	1. Habit annual/suffruticose to suffrutescent perennial
2. Indumentum of simple hairs	2. Indumentum of stellate or dendroid hairs
3. Leaf venation pinnate-brochidodromous and margin deeply crenate	3. Leaf venation parallel brochidodromous and margin subentire
4. Verticillaster many-flowered	4. Verticillaster 1-2-flowered
5. Bracts conspicuous, herbaceous and numerous per verticillaster	5. Bracts inconspicuous, setaceous and few per verticillaster
6. Calyx lip herbaceous	6. Calyx lip spiny to spinescent
7. Flowers pedicellate	7. Flowers sessile
8. Corolla tube short	8. Corolla tube long
9. Calyx more or less regular	9. Calyx strongly bilabiate

mainly depends upon experienced taxonomists' careful decisions. An apparently primitive character may remain unchanged or may be secondarily acquired in evolutionary history depending on the selective action of a stable or changing environment.

Table 8.

% Advancement Indices of the Sections

Sections	Habit		Indumentum		Leaf Venation		Verticillaster		Conspicuous
	Herbaceous perennial	0 or 2 Suff. shrub	Non-stellate	Stellate or Dendroid	Pinnate brochidromous	Parallel brochidromous	(2)-4-6-flowered		
Eriostomum	0		0		0		0		0
Mucronata		2	0		0			2	0
Infra-rosularis		2	0		0			1	
Roseostachys		2	0		0			1	0
Setifolia	0		0		0			1	0
Stachys	0		0		0			1	
Candida		2	0		0			1	
Swainsoniana		2	0		0			1	0
Fragilicaulis		2	0		0			1	0
Olisia		2	0		0			1	
Campanistrum		2	0		0			1	
Corsica		1	0		0			2	
Sideritopsis		2	0		0			1	
Neurocalyx		2	0			1		1	
Satureioides		2	0			2		1	
Thamnostachys		2	0			2		2	
Aucheriana		2	0			2		2	
Zietenia		2		2		2		1	
Ambleia		2		2		2		1	
Betonica	0		0		0		0		0
Macrostachya	0			2	0		0		0

the Sections of Stachys L.

Bract		Calyx tip		Pedicel		Corolla tube		Calyx		% Advance-ment Index
Con- spicuous	Absent or incon- spicuous	Her- baceous	Spin- escent	Present long or short	Absent or very short	Short	Long	Re- gular	Bi- labiate	
0			2	0		0			1	17%
0			2	0		0		0		33%
	1	0		0			2		1	39%
0		0			1	0			1	28%
0			2		2	0			1	33%
	2		2		2		2		1	56%
	2	0			1		1		1	44%
0		0			1		1		2	39%
0		0			1		2		1	39%
	2		2		1		2		1	61%
	2		2		1	0			1	50%
	2		1	0			2		1	50%
	1		2		0	0			2	44%
	2		2		2	0			2	67%
	2		2		2		2	0		72%
	2	0		0			2	0		56%
	2		2	0			2	0		67%
	2	0			1	0		0		56%
	2	0		0			2		1	67%
0			2		2		2		0	33%
0			2		2		2		0	44%

Fig. 29. Target Diagram

The concentric circles correspond to successive grades of advancement, the black areas represent sections. Solid, broken and dotted lines joining the sections represent more to less close affinities. The radial extent of each section represents the percentage of advancement and the size indicates the size of the constituent taxa.

- (A - Eriostomum; B - Mucronata; C - Infrarosularis;
D - Roseostachys; E - Setifolia; F - Stachys; G - Candida;
H - Swainsoniana; I - Fragilicaulis; J - Olisia;
K - Campanistrum; L - Corsica; M - Sideritopsis; N - Neurocalyx;
O - Satureioides; P - Thamnostachys; Q - Aucheriana;
R - Zietenia; S - Ambleia; X - Betonica; Y - Macrostachya)

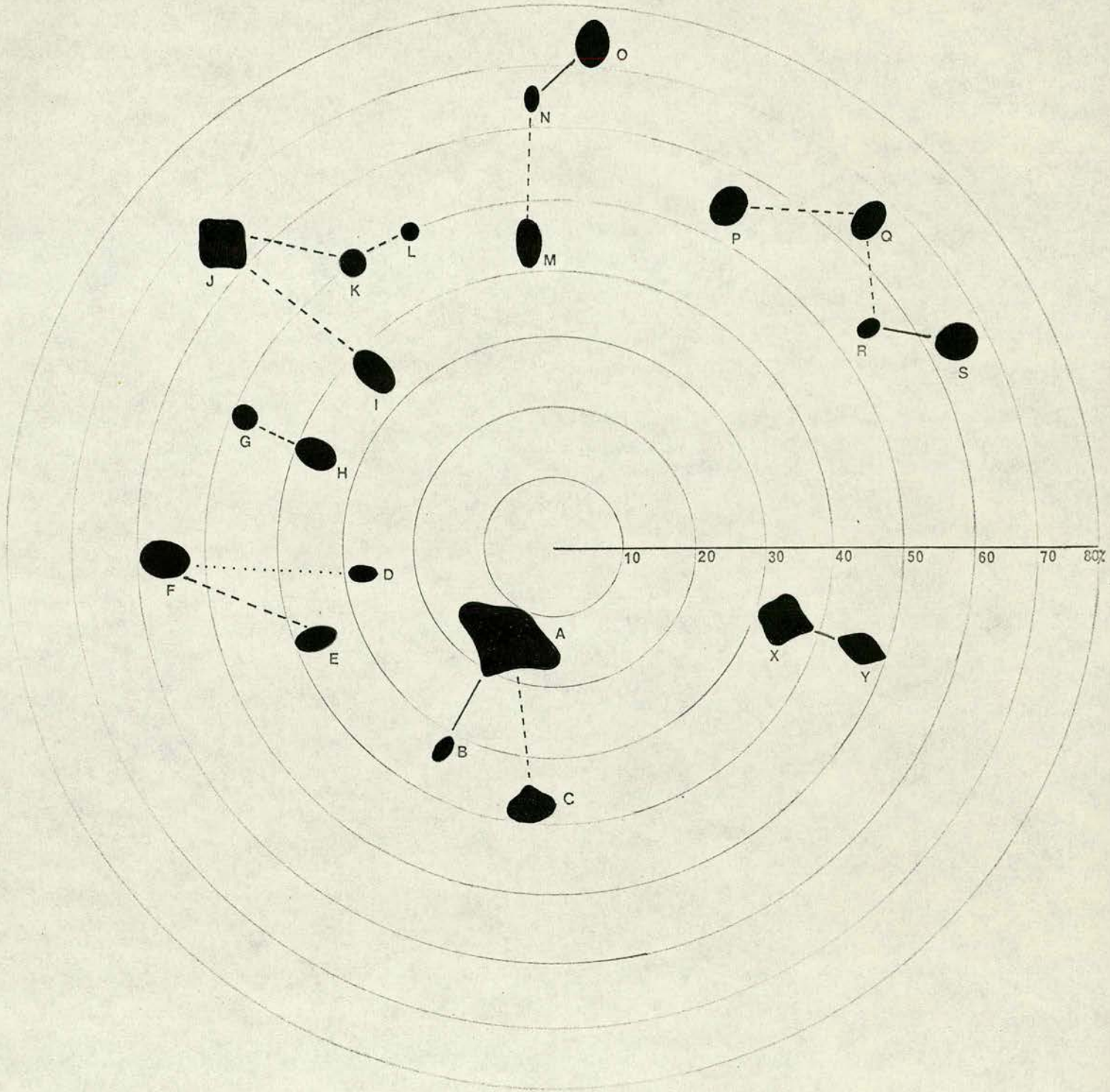


Fig. 29 Target diagram showing relationship and relative advancement of the sections of Stachys

PART B.

TAXONOMIC TREATMENT OF TURKISH SPECIES

VI. SYSTEMATIC ACCOUNT OF THE TURKISH SPECIESA. INTRODUCTION:

This revision of Turkish species owes much to the invaluable work of Boissier (Fl. Or. 4, 1879). He recognised 42 species of Stachys L. and 4 of Betonica L. (now treated as a subgenus of Stachys) as occurring in Turkey. Of these S. heldreichii Boiss. and S. cassia Boiss. have been reduced to subspecies of S. germanica L. and S. cretica L. respectively; S. nepetifolia Desf. was mistakenly reported from Cappadocia. Besides that, Betonica brantii (Benth.) Boiss. was wrongly placed in the Betonica group; it is now moved to Sect. Fragilicaulis of Stachys.

Since Boissier's time new species have been continuously added to the Turkish list by different taxonomists as exploration has proceeded and new collections made. Contributors in this field include Handel-Mazzetti (1913), Bornmüller (1919), Rechinger (1937, 1940, 1949), Davis (1951) and Kapeller (1961); Huber-Morath's collections contained a number of new species independently recognised by him and the author, and described here for the first time.

The revision covers the region accepted by the Flora of Turkey (Davis, 1965). For convenience in treating endemism, Mt. Cassius (on the Turkish/Syrian border) is included within the boundary. The revised list comprises 70 species distributed in 14 sections. Seven species are new to science, and various new subspecies and varieties recognised.

The usage of specific and infraspecific ranks:

The treatment does not differ from most contemporary W. European revisions of sexual groups based mainly on herbarium studies. The species are mainly morphological/geographical, as biosystematic and cytogenetic data are entirely lacking so far as Turkish material of Stachys is concerned.

Two populations have been referred to different species if they show more or less sharp discontinuities in at least two characters, although in some rare cases the criterion is less rigid. For example, if two populations grow sympatrically with few intermediates (cf. S. germanica ssp. bithynica and S. balansae) but their extreme forms are strikingly different, their specific status is maintained. Information from ecology and distribution has also provided useful supporting evidence for assessing status.

For the subspecific category, the proposals of du Rietz (1930), supported by Hedberg (1958) has been followed as far as possible. Geographically and/or ecologically isolated groups of populations showing some morphological discontinuity in at least one diagnostic or a few differential characters have been given subspecific rank. Some morphological intermediates between subspecies have been taken for granted where two such populations meet.

Varietal rank has been assigned usually to some locally differentiated populations that are morphologically and geographically or ecologically distinct in minor diagnostic or differential characters.

In some exceptional cases varietal rank is used for very striking variants within the species range whose nature remains more or less obscure due to insufficient material. Thus either a species or a subspecies may contain one or more varieties.

The species concept adopted here does not coincide with the Komarovian species concept. The latter is a unitary one in the sense that it does not recognise subspecific or (at least in the original form) varietal ranks. In the present work, when species were revised throughout their distribution range, it has not been possible to maintain some of accepted Russian binomials as they show a considerable amount of character overlap. To

achieve as much uniformity of treatment as possible in my revision, some of them have had to be reduced to synonymy or given infraspecific rank.

Key:

A key to 5 convenient informal groups has been made, based on the characters of leaves, bracts and corolla. The species have then been keyed out under each group. Emphasis has been mainly given to ease of use combined with certainty of identification; some variable species have been keyed out several times. For those few species which could not be examined, an assessment has been made from available descriptions, geographical records and illustrations.

Descriptions:

The description of little known species has been broadened on the basis of the variability shown by all available material. A few widely known species are not described and some have been provided with short descriptions. Information about flowering time, habitat and altitude has been cited, based on Turkish material. Whenever type material of synonyms has been examined, an exclamation mark is given after the reference to the synonym.

Citation of specimens:

The grid system adapted in the Flora of Turkey (Davis, 1965) has been followed for citation of specimens. For species occurring in less than 8 grids only, 1 specimen per province per grid has usually been cited. For widely distributed species, 1 specimen per grid is cited. An exclamation mark has been given after specimens examined by the author. External distributions have been summarised from herbarium specimens, and (with caution) literature records. Distribution maps for each species have been provided, including additional herbarium material and literature records when the

latter are considered reliable.

Typification:

Usually the type locality, the collector's name and the number of his specimen have been cited. The places where holotypes and/or isotypes are conserved are cited in parenthesis when they are known authentically; when examined personally, an exclamation mark has been given for the typification of some Linnean species, the procedures advocated by W.T. Stearn (Introduction to the facsimile edition of Linnaeus's *Species Plantarum*, 1957) are followed when it was possible to trace the Linnean type, the specimen was usually examined personally either in the Linnean Herbarium or in the Herb. Cliff. (B.M.); when the Linnean species could not be readily typified, the species' area of origin is cited as given by Linnaeus.

B. KEY TO TURKISH SPECIES

1. Bracts conspicuous, at least the outer ones ^{half} as long as or longer than calyx tube (excluding the pedicel), ovate-lanceolate to linear-lanceolate, herbaceous
2. Upper corolla lip covered with long and densely sericeous hairs usually exceeding the lip; calyx mouth with dense hairy ring Group A
2. Upper corolla lip usually glabrescent or thinly covered with short adpressed hairs not exceeding the lip; calyx mouth glabrous or thinly hairy between the calyx teeth
3. Plants with basal rosettes of leaves; cauline leaves not more than 4-paired Group B
3. Plants without basal rosettes of leaves; cauline leaves more than 5-paired Group C
1. Bracts absent or inconspicuous, when present less than half the length of calyx tube, linear, usually setaceous, sometimes bearing few hairs
4. Lower cauline leaves oblanceolate to lanceolate, rarely linear with attenuate base Group D
4. Lower cauline leaves ovate to orbicular, rarely oblong-lanceolate with cordate to truncate or rounded base Group E

GROUP A

1. Lower cauline leaves oblong-lanceolate to oblanceolate, narrowed towards base; base usually attenuate to rounded, rarely subcordate

2. Calyx tube \pm regular with distinctly visible nervature; stem patently pilose with dense glandular hairs; corolla creamish white 10. tmolea
2. Calyx tube oblique to suboblique with nervature hidden by dense indumentum; stem usually adpressed and densely tomentose with or without few glandular hairs; corolla pink or purple
3. Calyx teeth lanceolate-subulate, as long as or slightly less than calyx tube; basal leaves rounded to subcordate at base 11. cretica
3. Calyx teeth triangular to ovate-triangular, $\frac{1}{3}$ - $\frac{1}{2}$ the length of calyx tube; basal leaves attenuate to cuneate or sometimes rounded at base
4. Calyx teeth recurved at maturity; floral leaves ovate-lanceolate to ovate
5. Indumentum grey-tomentose to sparsely tomentose on stems and leaves; calyx teeth $\frac{1}{2}$ as long as tube 12. thirkei
5. Indumentum lanate-tomentose on stems and leaves; calyx teeth $\frac{1}{3}$ as long as tube 13. byzantina
4. Calyx teeth erect at maturity; floral leaves oblong to oblong-lanceolate
6. Verticillasters usually remote; indumentum not lanate
7. Calyx teeth $\frac{1}{2}$ as long as tube or slightly less; upper floral leaves longer than verticillasters 11. cretica
7. Calyx^{teeth} $\frac{1}{3}$ the length of tube; upper floral leaves as long as or slightly shorter than verticillasters 13. byzantina
6. Verticillasters usually congested above; indumentum densely lanate 13. byzantina

1. Lower cauline leaves ovate or oblong to oblong-lanceolate
 ± broader towards base, base usually cordate to subcordate,
 rarely truncate to rounded
8. Verticillasters 4-6(8)-flowered; calyx ± widely campanulate
9. Calyx regular and densely tomentose; bracts not
 spinescent 15. longispicata
9. Calyx sub-bilabiate, subglabrous; bracts spinescent
10. Leaves softly villous with rugose lower surface; calyx
 14-16 mm, villous towards base 8. libanotica var. minor
10. Leaves ± glabrous with smooth lower surface; calyx
 8-10 mm, subglabrous 9. sericantha
8. Verticillasters more than 10-flowered; calyx tubular to
 subcampanulate
11. Indumentum on stem short and adpressed, greyish tomentose;
 calyx teeth usually eglandular, rarely glandular
12. Inflorescence densely paniculate; verticillasters 16-20-
 flowered; calyx tube densely lanate 16. viticina
12. Inflorescence not paniculate; verticillasters 10-12(-14)-
 flowered; calyx tube densely tomentose
13. Calyx ± regular; teeth erect and eglandular
14. Cauline leaves 9-10 x 3.5-5 cm, margin crenate-
 serrate and base cordate 14. spectabilis
14. Cauline leaves 1.5-3.5 x 0.8-1.5 cm, margin obscurely
 crenate, base rounded to truncate
15. Verticillasters distant throughout; flowering stems
 usually unbranched 17. huetii

15. Verticillasters \pm congested upwards, 1-2 remote below;
flowering stems much branched 18. bayburtensis
13. Calyx sub-bilabiate, teeth recurved and glandular 6. pinetorum
11. Indumentum on stem long, patently pilose to lanate, sparse
or dense; calyx teeth usually glandular
16. Calyx usually regular; teeth \pm equal, as long as tube ... 7. obliqua
16. Calyx usually oblique, teeth unequal, shorter than tube
17. Base of lower cauline leaves rounded, rarely cuneate,
margin faintly crenulate
18. Indumentum densely villous; verticillasters \pm approximate
above; floral leaves ovate 5. huber-morathii
18. Indumentum sparsely tomentose; verticillasters remote;
floral leaves oblong-lanceolate 4. rizehensis
17. Base of lower cauline leaves distinctly cordate, margin
crenate to crenate-serrate
19. Stem eglandular haired 1. germanica
19. Stem with glandular and eglandular hairs
20. Fruiting calyx with distinct nerves; teeth ovate-
triangular and widely recurved at maturity 2. alpina
20. Fruiting calyx not distinctly nerved, teeth triangular-
lanceolate, erect to subpatent at maturity
21. Median cauline leaves broadly ovate to ovate-oblong,
margin crenate; stem densely lanate 1. germanica
21. Median cauline leaves oblong-lanceolate to oblong-
elliptic, margin crenate-serrate; stem usually
 \pm sparsely pilose 3. balansae

GROUP B

1. Verticillasters 1-2-flowered; margin of basal and cauline leaves entire to faintly serrate 54. diversifolia
1. Verticillasters (4-)-10-15-flowered; margin of basal and cauline leaves crenate to crenulate
2. Leaves distinctly crenate; corolla tube exannulate
3. Corolla 30-35 mm long; leaves ovate-oblong to ovate-triangular, broader towards base 68. macrantha
3. Corolla 15-18 mm long; leaves oblong or oblong-lanceolate, sometimes ovate-oblong, not broader towards base as above
4. Indumentum with some stellate hairs; basal leaves narrowly oblong-lanceolate 70. macrostachya
4. Indumentum without stellate hairs; basal leaves broadly oblong rarely ovate-oblong 69. officinalis
2. Leaves obscurely crenulate; corolla tube annulate
5. Basal leaves elliptic, cuneate or attenuate at base; verticillasters congested into \pm globose head, 1-2 remote 24. citrina
leaves
5. Basal/oval to oblong, cordate to truncate at base; verticillasters usually remote, few \pm approximate forming an elongate spike
6. Calyx tubular, 10-13 mm; teeth oblong-lanceolate; bracts numerous, herbaceous, as long as calyx 19. rupestris
6. Calyx campanulate, 6-9 mm; teeth triangular-lanceolate to lanceolate-subulate; bracts few, setaceous, rarely some herbaceous, shorter than calyx tube

7. Flowering stems short (c. 7-8 cm); verticillasters 2-3;
calyx teeth $\frac{1}{5}$ - $\frac{1}{3}$ the length of tube
8. Calyx glabrescent, teeth with few eglandular hairs and
sessile glands 22. amanica
8. Calyx densely tomentose, teeth with glandular and
eglandular hairs 21. petrokosmos
7. Flowering stems long (c. 10-25 cm); verticillasters
several; calyx teeth $\pm \frac{1}{2}$ as long as tube
9. Stem patently pilose; calyx teeth with copious glandular
hairs 20. cataonica
9. Stem adpressed-tomentose; calyx teeth glabrescent or
with few sessile glands 23. pumila

GROUP C

1. Stem patently pilose to hispid rarely subpatently pilose with
retrorse hairs
2. Plant annual; calyx bilabiate; calyx teeth oblong-acuminate
3. Lower cauline leaves obovate with attenuate base; corolla
(including lips) \pm included in calyx (tube and teeth)
10-12 mm 58. pseudosideritis
3. Lower cauline leaves ovate with cordate base; corolla
exserted from calyx, 14-15 mm 59. obscura
2. Plant perennial; calyx sub-bilabiate to \pm regular; teeth
triangular-lanceolate to triangular
4. Lower cauline leaves oblong-lanceolate, median and floral
leaves spinescent

5. Stem and leaves pilose; verticillasters remote, few \pm
approximate above 25. setifera
5. Stem and leaves glabrescent with few sessile glands;
verticillasters all \pm approximate 26. menthoides
4. Lower cauline leaves orbicular, ovate to ovate-lanceolate,
median and floral leaves not spinescent
6. Stem densely and patently pilose (c. 1.2-2 mm) with large
eglandular and shorter glandular hairs; leaf surface densely
subsericeous-tomentose
7. Cauline leaves $\frac{3.4-5 \times 2-3}{/}$ cm; verticillasters congested into a
dense \pm globose head 34. brantii
7. Cauline leaves $\frac{0.5-3 \times 0.4-2.8}{/}$ cm; verticillasters distinct,
cm apart 33. glechomifolia
6. Stem sparsely and retrorsely pilose (less than 1 mm)
with eglandular hairs and subsessile glands; leaf surface
glabrescent to sparsely pubescent 35. megalodonta
1. Stem adpressed floccose-tomentose to arachnoid
9. Stem and leaves adpressed-arachnoid, canescent, \pm glabrescent
when old 47. aleurites
9. Stems and leaves woolly-tomentose and felted; not
glabrescent when old
10. Calyx teeth erect and tip softly spinescent; bracts ovate-
rhomboid, erect to subpatent 48. bombycina
10. Calyx teeth widely recurved and tip spinescent;
bracts lanceolate-subulate, widely recurved
49. distans var. cilicica

GROUP D

1. Plant with basal rosettes of sterile shoots; calyx teeth 1.5-4 times longer than calyx tube; indumentum with some unequal stellate hairs 41. lavandulifolia
1. Plant without basal rosettes of sterile shoots; calyx teeth as long as or shorter than calyx tube; indumentum simple or rarely dendroid
 2. Stems and leaves densely felted with dendroid hairs 67. inflata
 2. Stems and leaves with sparse and simple hairs
 3. Plant annual
 4. Calyx tube \pm regular, tubular, urceolate in fruit; mouth densely hairy; corolla mauve to purple
 5. Calyx teeth erect in flower, \pm half as long as tube 62. burgadorffioides
 5. Calyx teeth recurved in flower, as long as or slightly less than tube
 6. Verticillasters \pm approximate, few remote; uppermost floral leaves ovate-rhomboid, as long as or shorter than verticillasters 63. melamyooides
 6. Verticillasters usually remote, few \pm approximate above; uppermost floral leaves oblong-lanceolate, longer than verticillasters
 7. Stem slender, pruinose-puberulent above, \pm glabrescent below; calyx tube \pm faintly nerved 60. satureioides
 7. Stem stout, sometimes dwarf, white-tomentose, with longer hairs (0.5-1.5 mm), not glabrescent, calyx tube distinctly nerved 61. ramosissima

4. Calyx tube oblique, \pm campanulate, gibbous in fruit, mouth sparsely hairy; corolla pale yellow 51. annua
3. Plant perennial
8. Stem pruinose puberulent to glabrescent; verticillasters 2-flowered; calyx tubular, inflated in fruit
9. Stem glabrescent; lower cauline leaves laciniate pinnati-partite, margin entire 44. angustifolia
9. Stem puberulent; lower cauline leaves simple and oblanceolate, margin crenate-dentate
10. Pedicels of flower 3-5 mm; calyx teeth herbaceous and not rigid, recurved in fruit 64. fruticulosa
10. Pedicels 1-2 mm; calyx teeth rigid and erect in fruit
11. Calyx teeth unequal; stem indumentum with few glandular hairs 65. sosnowskyii
11. Calyx teeth \pm equal; stem without glandular hairs 66. araxina
8. Stem adpressed-pubescent. Verticillasters 4-6-flowered; calyx usually not inflated in fruit
12. Stamens exerted more than half way along upper corolla lip; corolla yellow
13. Calyx teeth lanceolate-subulate, as long as calyx tube or more, width of teeth never more than 1 mm; verticillasters congested spicate, few remote below 43. atherocalyx
13. Calyx teeth triangular-lanceolate, \pm half as long as tube, width of teeth more than 1 mm; verticillasters remote throughout, few \pm approximate above 42. recta

12. Stamens little exerted from the corolla tube; corolla mauve
or creamy-white, rarely yellow
14. Calyx teeth triangular-oblong; tip blunt and with very
short micro 37. kurdica
14. Calyx teeth triangular-lanceolate, tip acute and spinescent
15. Pedicel of fruiting calyx c. 6 mm, calyx teeth as long as
tube; flowers loose in verticillaster 45. sparsipilosa
15. Pedicel of fruiting calyx 2-3 mm, calyx teeth $\frac{1}{2}$ as
long as tube; flowers congested in
verticillasters 46. iberica

GROUP E

1. Median cauline leaves abruptly distinct from lower cauline and basal
leaves; stems glabrescent to puberulent with subsessile to sessile
glands
2. Verticillasters 2-flowered; basal rosettes of leaves on
flowering shoots 52. inanis
2. Verticillasters 4-6-flowered; basal rosettes of leaves on
sterile shoots 53. munzurdagensis
1. Median cauline leaves gradually distinct from lower cauline and
basal leaves; stems patently pilose to adpressed pubescent
with glandular hairs
3. Basal rosettes of leaves present on sterile shoots; stems
retroscely pubescent
4. Corolla tube \pm twice exerted from calyx tube; calyx teeth
as long as or slightly shorter than calyx tube; verticillasters
usually remote, few \pm approximate above 54. annua

4. Corolla tube \pm included in calyx tube; calyx teeth $\frac{1}{3}$ - $\frac{1}{2}$ as long as tube; verticillasters densely spicate, 1-2 remote below
 50. maritima
3. No basal rosettes of leaves present on sterile shoots; stems usually patentely pilose, sometimes antrorsely pubescent
5. Plants procumbent or sometimes erect annuals
6. Stems patentely pilose to hispid, sometimes aculeate at angles; calyx teeth subglabrous to sparsely hairy
7. Corolla c. 7-8 mm, subincluded; calyx teeth oblong-acuminate with patent hairs 57. arvensis
7. Corolla more than 12 mm, subexserted; calyx teeth ovate or lanceolate without patent hairs
8. Stem glabrescent below and aculeate-haired at angles; calyx teeth ovate-triangular; corolla yellow 55. spinulosa
8. Stem hairy throughout, not aculeate-haired at angles; calyx teeth lanceolate; corolla purplish 56. arabica
6. Stems adpressed pubescent with patent-glandular hairs; calyx teeth densely pubescent 51. annua
5. Plants erect to pendant perennials
9. Herbaceous perennials with long rhizomes, stamens as long as upper corolla lip
10. Lower cauline leaves ovate c. 1.4 times as long as broad, petiole c. 4-10 cm; stems patentely pilose above
 27. sylvatica
10. Lower cauline leaves oblong-lanceolate, 3-4 times as long as broad, petiole 0.25-1.5 cm, stems retrorsely pubescent 28. palustris

9. Suffrutescent perennials without rhizomes; stamens extending about half way along upper corolla lip or less than that
11. Lower cauline leaves 3-6 x 2-4.8 cm; stems patently pilose
12. Verticillasters 2-flowered; corolla tube 4 times longer than calyx tube 29. longiflora
12. Verticillasters \pm 6-flowered; corolla tube c. twice as long as the calyx tube
13. Leaves subsessile to sessile, orbicular with rounded apex, margin wavy to broadly crenate 30. euadenia
13. Leaves long to shortly petioled c. 1.5-4 cm, lamina ovate, apex not rounded, margin densely crenate to dentate
14. Verticillasters densely spicate, c. 1-2 cm distant; upper and lower corolla lip 8 & 4 mm respectively 31. pinardii
14. Verticillasters lax spicate, 2-4 cm distant; upper and lower corolla lip 5 & 3 mm respectively 32. yenyurukensis
11. Lower cauline leaves 1-2.8 x 0.8-2 cm; stems retrorsely pilose to \pm adpressed pubescent
15. Verticillasters usually \pm congested, 1-2 remote below; stems and calyx teeth eglandular 36. ballotiformis
15. Verticillasters usually remote, few \pm approximate above; stems and calyx teeth with glandular hair and/or with subsessile glands
16. Calyx oblique, gibbous at base; calyx teeth densely pubescent 51. annua

16. Calyx \pm regular, not gibbous at base; calyx teeth sparsely pubescent
17. Calyx teeth herbaceous, broadly oblong to triangular with blunt apex; fruiting calyx c. 7-8 mm 37. kurdica
17. Calyx teeth rigid, narrowly triangular-lanceolate with acute apex; fruiting calyx c. 10-12 mm
18. Calyx teeth erect, spinescent; stems with eglandular hairs and sessile glands 38. viscosa
18. Calyx teeth subpatent, softly spinescent or herbaceous; stems without sessile glands
19. Flowering stems paniculately branched above; verticillasters 12-16-flowered 39. laetivirens
19. Flowering stems simple or with few branches above; verticillasters 6-10-flowered 40. subnuda

C. ACCOUNT OF THE SPECIESSect. ERIOSTOMUM (p.108)1. S. germanica L., Sp. Pl. 581 (1753)Syn. S. lanata Crantz., Strip. Austr. ed 2 fasc. 4: 267 (1769)S. tomentosa Gatr., Descr. Pl. Montaub. 107 (1789)S. polystachya Ten., Prodr. Fl. Nap. 2: 23 (1814)S. nova Sadler ex Reichb., Fl. Germ. Exc. 319 (1830)S. pannonica Lang ex Ten., Syll. Fl. Neap. 291 (1831)S. bithynica Boiss., Diagn. Ser. 1(5): 28 (1844)!S. pisidica Boiss. & Heldr. in Boiss., Diagn. Ser 1(12): 75 (1853)!S. penicillata Heldr. & Sart. in Boiss. Diagn. Ser 2(4): 37 (1859)!S. heldreichii Boiss., Fl. Or. 4: 721 (1879)!S. sublanata Fleisch. ex Nym., Consp. 577 (1881)!S. tymphaea Hausskn., Mitt. Thür. Bot. Ver. Ser 1(5): 70 (1886)S. reinertii Heldr. ex Halácsy, Cons. Fl. Gr. II: 521 (1903)S. cordata Klok. in Fl. RSS Ucr. 9: 647 (1940)S. heterodonta Zefirov. in Not. Syst. (Leningrad) 14: 341 (1951)!

(Map 8).

Perennial mesophytic herb, usually with basal sterile rosettes. Flowering stems erect, 25-150 cm, terminal to the subterranean rhizomatous portion, simple or rarely branched above. Indumentum densely lanate-villose with long eglandular hairs, sometimes mixed with short or long glandular hairs or sessile glands. Cauline leaves ovate to ovate-lanceolate, 5-12 x 2-5.5 cm, obscurely crenate to crenate-dentate, apex acute or sometimes obtuse, cordate at base, upper surface densely sericeous-tomentose, lower surface rugose, densely adpressed floccose-white-tomentose, petiole 3-8 cm, gradually passing above into ovate-lanceolate, subsessile to sessile floral leaves as long as or

longer than verticillasters. Verticillasters remote or few approximate above, 10-15-(20)-flowered. Bracts lanceolate to linear, 6-10 mm, herbaceous, tip not spinescent. Pedicels 1-4 mm. Calyx sub-bilabiate, subcampanulate, 8-12 mm, densely tomentose; teeth subequal, lanceolate to ovate-lanceolate $\frac{1}{3}$ to $\frac{1}{2}$ as long as tube, densely eglandular, sometimes mixed with glandular hairs, micro 0.7-1.5 mm. Corolla 14-16 mm, rose-pink, tube subincluded. Nutlets obovoid, faintly trigonous, 2.5 x 2 mm, slightly winged near base.

Key to subspecies:

1. Flowering stem and calyx with eglandular hairs; calyx teeth triangular-lanceolate, erect in fruit subsp. heldreichii
1. Flowering stem and calyx with glandular hairs; calyx teeth ovate-triangular, slightly recurved in fruit subsp. bithynica

Subsp. heldreichii (Boiss.) Hayek, Prodr. Fl. Balc. 2: 285 (1931)

Syn. S. heldreichii Boiss. Fl. Or. 4: 721 (1879)

Fl. July

Habitat: Roadside, fallow fields.

Lectotype: [Greece] Hab. in herbidis humidis et paludosis Baeotiae ad Lebadeam, Heldreich (G; E!)

S.W. Anatolia, rare.

C2 Muğla: Köyceğiz, 25.7.47, D.13564!

External distribution: S. part of the Balkan peninsula. E. Mediterranean element.

Among the original syntypes of S. heldreichii, Boissier cited 3 gatherings from N.W. Turkey. These have not been seen, but may well be referable to S. germanica subsp. bithynica.

subsp. bithynica (Boiss.) Bhattacharjee, stat. nov.

Syn. S. bithynica Boiss., Diagn. ser. 1(5): 28 (1844)!

S. germanica L. var. bithynica (Boiss.) Boiss., Fl. Or. 4: 720
(1879) !

S. pisidica Boiss. & Heldr. in Boiss. Diagn. ser. 1(12) 75 (1853)!

Fl. June-September.

Habitat: Limestone gullies, moist or dry rocky slopes.

Syntypes [Turkey A2(A) Bursa] in lapidosis alpinae Olympi Bithynia supra
Kirkbounar, Boissier (holo. G!); montis Kitirlidagh, Pichler

N.W. & N. Turkey; rare in S.W. Anatolia

A1(E) Kirklareli, near Demirköy, A. Baytop 13918!

A2(A) Bursa: Ulu Dağ, 2200 m, D.14834!

A3 Bolu: Ala Dağ on Kartal Kaya tepe, 2100-2200 m, D.37246B

A4 Kastamonu: N. side of Ilgaz Dağ, 2200 m, D.38446

A5 Kastamonu: Tossia (Tosya) Sintenis 1892:4569!

A5/6 Samsun: above Lâdik on Ak Dağ 16-1900 m, Bornm. 665 (as S. balansae
var. drosocalyx Freyn!)

C3 Isparta: Davros Dağ, Heldreich, sub S. pisidica Boiss. (holo. G!);
Dedegöl Dağ, 1600 m, Sorger 65-43-106!

External distribution: Greece, Crimea. Euro-Siberian element.

S. germanica L. is a widespread and widely variable species growing throughout Europe and S.W. Asia. It forms a more or less coherent group together with the closely allied S. alpina and S. balansae; sometimes considerable difficulty arises in separating these species due to the large amount of character overlap. The main character by which S. germanica L. is separated from S. tymphaea Hausskn. (cf. Fl. Europea, 1972) is the

glandulosity of the indumentum, the former being eglandular throughout and the latter with glandular calyx teeth. Again, S. bithynica, at first treated as a distinct species (Boiss., Diagn. Ser. 1844) and later as a variety (Boiss., Fl. Or. 1879) of S. germanica L., has glandular hairs on the stems and calyx-teeth, though on the stem they are not readily apparent, being concealed under longer eglandular hairs. So it is quite obvious that the presence or absence of glandular hairs is not sufficient to separate S. germanica L., S. tymphaea Hausskn. and S. bithynica Boiss., as other characters like leaf-shape, length and shape of calyx teeth and mucro, density of indumentum and verticillasters show different degrees of overlap throughout the whole range of distribution. For a consistent and more practical treatment, it is better^{to} assign them subspecific rank. Eglandular forms of S. germanica are mainly restricted to the western part of its range (Europe eastwards to the Balkan peninsula), and fall into 3 subspecies var. lusitanica, heldreichii and germanica as recognised in Fl. Europaea 3: (1972); the form with glandular calyces, reported from C. & S. Italy and W. part of the Balkan peninsula and maintained as a distinct species, S. tymphaea, should be considered as a subspecies of S. germanica [ssp. tymphaea (Hausskn.) Bhattacharjee comb. et stat. nov., syn. S. tymphaea Hausskn., Mitt. Thür. Bot. Ver. Ser 1(5): 70 (1886)] and the glandular form S. bithynica mainly restricted to the eastern part, particularly N.W. Turkey, should be assigned to S. germanica ssp. bithynica.

Subspecies bithynica in Anatolia, particularly distinct in N.W. Anatolia, shows an affinity with the eastern species S. balansae, from which it is mainly distinguished by its broadly ovate-oblong cauline leaves and dense and adpressed-floccose indumentum on the lower leaf surface. But as these two taxa approach each other geographically in N. Anatolia (Kastamonu and Amasya)

these distinguishing characters break down to a considerable extent, (Sintenis 426813 and Darrah 64 from Ilgaz Dağ, and Borrmüller 2873 from Amasya). The possible hybrid origin of these specimens is suggested by their high percentage of sterile pollen and no apparent seed output.

Subsp. heldreichii has been seen only once from Mugla (D. 13564), where its occurrence may be due to chance introduction from the mainland of S. Greece.

2. S. alpina L. ssp. macrophylla (Albow) Bhattacharjee comb. et stat. nov.

Syn. S. macrophylla Albow, Prodr. Fl. Colch. I: 202 (1895)

S. masanderana Borrm. & Gauba, in Feddes Rep. 49: 269 (1940) (Map 8).

Perennial mesophytic herb, usually with basal sterile rosettes. Flowering stem erect, c. 40-100 cm, simple or sparsely branched, patently pilose with long eglandular and short glandular hairs. Cauline leaves ovate to ovate-orbiculate, 10-15.5 x 7-12.5 cm, margin distinctly crenate-dentate, apex obtuse, cordate at base, glabrescent to softly pilose on both surfaces, petiole 4-12 cm. Floral leaves ovate, abruptly smaller than cauline leaves 1-4 x 0.5-3 cm, subsessile to sessile as long as or shorter than verticillasters. Verticillasters 12-16-flowered, remote, 1-6 cm distant, upper 2-3 approximate. Bracts lanceolate to linear, 4-8 mm, herbaceous, not spinescent. Pedicels 1.5-3 mm. Calyx sub-bilabiate, subcampanulate, 8-11 mm, sparsely hairy and strongly nerved in fruit; teeth triangular lanceolate to ovate triangular, $\frac{1}{2}$ as long as tube, strongly nerved; recurved in fruit, margin glandular, mucro 0.7-1 mm. Corolla 10-12 mm, rose-pink, tube subincluded. Nutlets obovoid 2 x 1.7 mm, bluntly trigonous and slightly winged at base. Fl. June-September.

Habitat: Rocky slopes and pastures, 150-914 m.

Type [Caucasus] Abchasia: in jugo Grykhtzy prope fl. Gumista, alt. 150 m.

(N. A 1893, nos. 59, 62, 1894), in jugo Astyush-Akhyawya alt. circ 914 m. (N.A 1889).

N. Anatolia

A5 Sinop: Çangal Dağ above Ayancik, 900 m, D.38177

External distribution: Caucasus, N. Iran. Euro-Siberian (Hyrcano-Euxine) element.

This subspecies is the only representative of S. alpina in Turkey and has only been collected once. From the typical subspecies it differs in having floral leaves abruptly shorter than the cauline leaves and as long as verticillasters or even shorter, and by its smaller bracts and flowers. The variation present in S. alpina, however, does not justify treating subsp. macrophylla as a distinct species.

3. S. balansae Boiss. & Kotschy in Boiss., Fl. Or. 4: 723 (1879)

Syn. S. terekensis Knorr. in Not. Syst. (Leningrad) 15: 342 (1953)

(Map 8).

Perennial mesophytic herb with basal sterile rosettes. Flowering stems 35-100 cm, simple, rarely branched, erect, patentily pilose with eglandular and glandular hairs. Basal leaves oblong to ovate-oblong, 3-10.5 x 1.5-3.5 cm, usually sparsely (rarely densely) adpressed sericeous-pilose on upper surface and softly villous to glabrescent below, margin distinctly crenate serrate, apex obtuse to acute, cordate to subcordate at base, petiole 3-10 cm. Cauline leaves oblong to oblong-lanceolate, 3-10 x 1-3 cm, apex acute rarely obtuse, shortly petioled to sessile 0.5-5.5 cm, gradually passing upwards into similar but smaller, sessile floral leaves, usually as long as verticillasters. Verticillasters remote throughout or a few confluent above, 1-6 cm distant, 10-16-flowered. Bracts lanceolate to linear, 6-12 mm, herbaceous, softly pilose, non-spinescent. Pedicels 1.5-10 mm. Calyx

sub-bilabiate, subcampanulate, 9-12 mm, sparsely sericeous; teeth subequal, ovate to ovate-lanceolate or lanceolate, $\frac{1}{3}$ - $\frac{1}{2}$ as long as tube, erect to slightly recurved in fruit, margin with glandular and eglandular hairs, mucro 1-2 mm. Corolla 15-18 mm, rose-pink, tube subincluded. Nutlets obovoid, 2 x 1.8 mm, slightly winged at base.

Key to subspecies:

1. Leaves sericeous-pilose on upper surface; median cauline leaves narrowly oblong-lanceolate, length/breadth ratio 2.5-4 subsp. balansae
1. Leaves glabrescent at upper surface; median cauline leaves oval to broadly elliptic, length/breadth ratio 1.6-1.7 subsp. carduchorum

subsp. balansae

Fl. June-September

Habitat: Rocky slopes and pastures, stream sides and lush meadows. 1700-2800 m.

Type: Turkey B8 Mus in schistosis alpium prope Musch inter Astragalos, 2286 m, 6.ix.1859, Kotschy 441 (holo. G!, iso. K!).

Mainly N.E. & E. Anatolia, extending to Anti-Taurus.

A7 Giresun: Balban-dağları (Kiline Tepe) above Tamdere, 2700 m, D.20579!

Gümüşane: above Artabir (Ertbil), Sintenis 1894:7001

Erzurum: Kop Dağ, Aşkale to Bayburt, 1950-2000 m, Huber-Morath 11395!

A8 Gümüşane: near Balbourt (Bayburt) 2.vii.1862, Bourgeau!

Rize d. İkizdere: Başkoy (Cimil) to Cermanin Yalyâ, 2300 m, D.21039!

A9 Çoruh (Artvin): Ardanuç, to Kordevan Dağ, 1700 m, D.30103!

Kars: 10 km from Sarıkamış to Karakurt, 2050 m, D.46552

- B5 Kayseri: Bakir Dağ at Akoluk yayla above Kisge, 2000 m, D.19437!
- B6 Sivas: 36 km N. Sivas, Kunduz Dağ, 1800 m, Sorger 69-52-
 Maraş: d. Çardak, Berit Dağ, 2800 m, D.20349!
- B7 Erzincan: Sipikor Dağ, Sintenis 1890:324!
 Tunceli: Pülümür to Mutu, 1780 m, Huber-Morath 15272!
- B8 Erzurum: 20 km from Hınıs to Pasinler, 1900 m, D.46343!
- B9 Ağrı: E. side of Tahir pass, 19 km from Eleskirt to Horasan, 2400 m,
D.47097!

External distribution: Crimea, Caucasia and W. Iran.

A species well developed in both Euro-Siberian (Euxine) and Irano-Turanian region.

subsp. carduchorum Bhattacharjee, subsp. nov.

A typo caulibus et foliis glabrescentibus, foliis caulinis medianis ovalibus vel late ellipticis recedit.

Fl. July-September

Habitat: Rocky slopes, limestone ravines, by stream sides. 2200-3124 m.

Type: Turkey C9 Hakkari Cilo Dağ, in gorge between Cilo Yayla and Diz deresi, 2438 m, 10.viii. 54, Davis & Polunin D.24265!

E. Anatolia

B9 Bitlis, d. Kotum: Karz Dağ above Kamer, 2200 m, D.24593!

Van, d. Şatak: Kavuşşahap Dağ, 3100 m, D.23214!, Artos Dağ above Gevaş,
 3000 m, McNeill 751!

Endemic. Irano-Turanian element.

Distinguished from the typical subspecies in having glabrescent stems and leaves and median cauline leaves \pm oval to broadly elliptic with a length/breadth ratio of 1.6-1.7.

S. balansae is closely allied to S. germanica ssp. bithynica and to S. alpina ssp. macrophylla; from the former it is distinguished by having oblong to oblong-lanceolate basal and cauline leaves, less dense stem indumentum, lower surface of leaf not being densely floccose-tomentose, and leaf margin crenate-serrate; and from S. alpina in not having broadly ovate leaves, and fruiting calyces not being distinctly nerved and teeth not patently recurved in fruit. Davis 22366 from Bitlis approaches S. germanica in having dense stem indumentum and lower leaf surface densely floccose-tomentose, but in general shape of the leaf and in geographical distribution it is closer to S. balansae.

4. S. rizehensis Bhattacharjee, sp. nov. (Map 8).

Affinis S. balansae sed caulibus inferne procumbentibus foliis ovato-ellipticis minoribus basi rotundatis obscure crenulatis recedit.

Perennial herb with subterranean caudiculi. ^{stems} Flowering/ascending erect, 30-40 x 0.15-0.25 cm, weakly branched near base, pubescent below, villous above, mixed with shorter glandular hairs. Cauline leaves ovate-elliptic to ovate, 1.5-3.5 x 0.6-2.5 cm, weakly crenate, apex obtuse, subcordate to rounded at base, + rugose on lower surface and sparsely sericeous on upper, with 0.8-2 cm adpressed-tomentose petioles. Floral leaves sessile to sessile, ovate-oblong to rhomboid-lanceolate, 1-3.5 x 0.3-1.8 cm, subentire to entire, apex blunt and acute, cuneate at base, as long as verticillasters above. Verticillasters remote, 1.2-4 cm distant, 8-10-flowered. Bracts lanceolate to linear-lanceolate, 0.5-1.2 cm, herbaceous, pilose, not spinescent. Pedicels 2-3 mm. Calyx subbilabiate, subcampanulate, 10-11 cm, sericeous-tomentose; teeth subequal, ovate-lanceolate with mucronate tip,



Pl. 13. *Stachys rizehensis* Bhattacharjee (Holotype)

lower and upper teeth 2-2.5 and 3-3.5 mm respectively, mucro 0.5-0.8 mm, margin glandular and eglandular. Corolla 15-18 mm, pinkish-purple, tube subexserted, annulate, upper corolla lip retuse to emarginate, 6-8 mm, lower lip 8-10 mm. Nutlets unknown. Fl. July-August.

Type [Turkey A8 Rize]: İkizdere: Baltas Tepe, 3200 m, dioritic screes, 30.viii.1952, Davis & Dodds, D.21114 (holo. E! iso K!).

Endemic. Euro-Siberian (Euxine) element.

This alpine scree species shows affinity with S. balansae Boiss., but differs from it in habit, leaf shape and ecology.

5. S. huber-morathii Bhattacharjee, sp. nov. (Map 9).

Affinis S. alpinae L. et S. balansae Boiss. sed ab ambabus foliis basalibus crassis \pm rugosis ovato-oblongis basi truncatis vel cuneatis, indumento ad nodos et ad basin calycis dense villosa inter alia differt.

Biennial or perennant with basal rosettes of leaves. Flowering stems erect, stout, 20-50 x 0.3-0.7 cm, simple or occasionally sparsely and shortly branched above; indumentum short and sparse, patently pilose with glandular and eglandular hairs at internodes but dense and villous, c. 6-8 mm at nodes. Basal leaves oblong to ovate-oblong 2-15 x 1-7 cm, rugose, margin crenate, apex \pm obtuse, truncate to cuneate at base, petiole 2-6 cm; indumentum sericeous-tomentose on upper surface, sparsely tomentose below. Cauline leaves few, 2-3-paired, ovate or rarely ovate-lanceolate, 3-7 x 2-4.5 cm, apex acute, subsessile to sessile. Floral leaves sessile, ovate, 1-4.5 x 0.7-3.5 cm, as long as verticillasters above. Verticillasters 8-15, remote below and 2-4.5 cm apart, \pm approximate above, 14-16-flowered. Bracts

Pl. 14. Stachys huber-morathii Bhattacharjee (Holotype)

lanceolate to linear-lanceolate, 8-14 mm, herbaceous, pilose, tip not spinescent. Pedicels 1.5-4 mm. Calyx sub-bilabiate, subcampanulate, 14-16 mm, villous towards base; teeth unequal, ovate to oblong-acuminate, recurved in fruit, upper and lower teeth 4-5 and 3-4 mm respectively, margin glandular-haired, mucro 0.8-1 mm. Corolla 17-19 mm, pink, tube subexserted, upper and lower corolla lip 5-6.5 and 8-9 mm respectively. Nutlets obovoid, 2.8-x 2.2 mm, slightly winged at base. Fl. May-July.

Habitat: Open steppe in Quercus scrub and gravelly fields, 900-1250 m.

Type: Turkey A5 Çorum d. Çorum: Kirkdilim Bögasi Quercetum 22 km N.

Von Çorum, 24.vi.1955, 1120-1955 m, Huber-Morath 14187 (holo. Hb. Huber-Morath, Basel!).

N. Anatolia

A5/6 Samsun: Lâdik İstasyon, Karadağ, 900 m, Tobey 1100! 1100A!

Endemic. This species occurs in an area where Euro-Siberian, Irano-Turanian and even Mediterranean elements intermingle.

The species differs from S. alpina in the fruiting calyx not being distinctly nerved, and from S. balansae by the different shape of the basal leaves. Its general facies is very distinctive.

6. S. pinetorum Boiss. & Bal. in Boiss., Diagn. Ser. 2(4): 36 (1859) (Map 9).

Perennial, mesophytic herb with basal rosettes of sterile shoots.

Flowering stems erect, simple or branched, 50-150 cm. Indumentum adpressed-tomentose with short eglandular hairs. Basal and cauline leaves ovate to ovate-oblong, 5-12 x 2-6 cm, margin crenate-dentate, cordate at base, petiole 2-10 cm; indumentum densely floccose and white-tomentose below, pubescent above. Floral leaves sessile, oblong-lanceolate, 1.5-3 x 0.5-2 cm, as long

as or longer than verticillasters. Verticillasters remote, 10-16-flowered. Bracts ovate-acuminate to lanceolate, 4-8 mm, herbaceous, not spinescent tipped. Pedicels 2-4 mm. Calyx sub-bilabiate, subcampanulate, 9-12 mm, sparsely pilose with glandular hairs, nerves \pm prominent; teeth unequal, ovate-lanceolate, \pm half as long as tube, recurved in fruit, mucro 0.8-1 mm. Corolla 14-18 mm, pink, tube subincluded. Nutlets ovoid, 2.2 x 2 mm. Habitat: Streams and river sides; steep gullies. 335-1800 m.

Type: Turkey C5 Icel Hab. in sylvis Pini lariciensis ad septentrionem Pyramidum Cilicidarum (Gölek Boğazi) sitis, viii.1855, Balansa 535 (holo. G, iso. E!).

S. Anatolia

C5 Adana: Karınca Da, N. of Pozanti, 335 m, Aberdeen Univ. Amanus Exped.

No. F2434!

C6 Hatay: Mt. Amanus, 1372 m, Haradjian 452!

Adana d. Bahçe: Dülûlî Dag between Başkonuş Yaylâ and Hussein Oluk

Çesme, 1800 m, D.16378! Hasanbeyli 914 m, Darrah 704!

External distribution: N. Syria (Latakia). E. Mediterranean element.

This species shows relationship with S. spectabilis but is distinguished from it in having crenate-margined leaves, sparsely hairy and glandular haired calyx, with oblique mouth, and teeth recurved in fruit. Specimen F2434 from Adana differs from the rest in having eglandular calyces; Darrah 704 shows gynodioecism with male sterility, with reduction in length of corolla tube (c. 12 mm).

7. S. obliqua Waldst. & Kit. Pl. Rar. Hung. 2: 142 (1805).

Syn. S. orientalis sensu Vahl, Symb. Bot. 2: 64 (1791) non L. (1753).

S. montbrettii Benth. in Ann. Sci. Nat. 2(6): 48 (1836)

S. pauciflora Vis. in Illus. 1: 10 (1840)

S. heraclea var. lutea Benth. in DC., Prodr. 12: 463 (1848) (Map 9).

Perennial with basal rosettes of sterile shoots. Flowering stems erect, 20-75 cm, usually simple. Indumentum patently lanate-hirsute with glandular and eglandular hairs. Basal leaves oblong-lanceolate, 2.5-10 x 1-3.5 cm, crenate, apex acute, rounded to subcordate at base, rugose, petiole 2-8 cm. Floral leaves ovate, 1-9 x 0.8-1.5 cm, subentire to entire, apex acute, sessile, slightly longer than verticillasters. Verticillasters remote, 1-7.5 cm apart, few ± approximate above, 6-10-(12)-flowered. Bracts linear to lanceolate, 5-10 mm, herbaceous, pilose. Calyx sub-bilabiate, subcampanulate, 10-12 mm; teeth subequal, lanceolate, as long as or slightly less than calyx tube, micro 0.5-1.2 mm. Corolla c. 15 mm, pale yellow, upper corolla lip c. 6 mm, lower lip c. 8 mm. Nutlets obovoid, 2.5 x 2 mm smooth. Fl. May-July.

Habitat: On rocky substratum in Quercus macchie. 125-1190 m.

Type: [Yugoslavia] In pratis aridis Capidosis Croatiae ad Koreniczam.

A1(E) Kirklareli: 9 km E. Babaeski, 125 m, Sorger 62-96-1!

B1 Balikesir, Mt. Ida (Kaz Dağ) prov. Karcikos, Sintenis 1883:487!

Çanakcale: 11 km S. Ayvacik, 300 m, Sorger 68-6-4!

C2 Burdur: Tefenni to Dermil, 1190 m, Hub.-Mor. 8468!

External distribution: Greece, Bulgaria, Albania and Yugoslavia.

E. Mediterranean element?

Related to the Greek S. acutifolia Bory & Chaub from which it is distinguished by its yellow corolla and longer calyx teeth.

8. S. libanotica Benth. var. minor Boiss., Fl. Or. 4: 718 (1879)

Syn: S. ciliaris Boiss., Diagn. Ser. 1(12): 78 (1853) (Map 9).

Perennial woodland herb. Flowering stems erect, simple c. 1 metre. Indumentum patently hispid pilose. Basal and cauline leaves oblong 7-8 x 2.5-3.5 cm, margin crenulate, apex obtuse, rounded at base, petiole 2-6 cm. Floral leaves ovate-attenuate, subsessile to sessile, longer than verticillasters. Verticillasters remote, 1-10 cm apart, 6-8-flowered. Bracts oblong-lanceolate to linear lanceolate, 7-8 mm, herbaceous, apex spinescent. Pedicels 2-3.5 mm. Calyx sub-bilabiate, subcampanulate, 9-10 mm, strongly nerved in fruit; teeth ovate half as long as tube, mucro 1-1.2 mm. Corolla 15-18 mm, rose, tube subexserted.

Type: [Turkey C5 Hatay] in regionis sylvatica inferior monti Cassii Syriae borealis, Boissier.

Endemic. E, Mediterranean element.

This variety has not been seen by me but from the characters described by Boissier (1853) it is evident that it differs from the typical variety of S. libanotica (from N. Syria, Lebanon and Palestine) in its shorter calyx tube and shorter mucro of calyx teeth. In these characters it approaches S. sericantha and is geographically intermediate between the latter (S.W. Anatolia prov. Antalya) and var. libanotica.

9. S. sericantha Davis in Kew Bull. 1951: 111 (1951) (Map 9).

Perennial herb with woody stock. Flowering stems 35-70 cm. Indumentum sparsely and patently pilose, glandular and eglandular. Cauline leaves oblong-lanceolate 4-5 x 1.4-1.7 cm, serrate-crenate, truncate at base, petiole 3-5 cm. Floral leaves softly petioled to sessile, narrowly ovate with mucronate tip, 3-4 times longer than verticillasters. Verticillasters remote, 2-6-flowered. Bracts lanceolate to linear 8-9 mm, herbaceous, tip spinescent. Pedicels 1.5-2 mm, calyx sub-bilabiate, campanulate, 9-10 mm, prominently nerved; teeth subequal, as long as or slightly shorter than tube, recurved in fruit. Corolla 13-16 mm, purple-pink, tube subexserted. Nutlets obovoid 2 x 1.5 mm. Fl. June-July.

Habitat: Rocky limestone slopes, in Pinus brutia woods, 20-1300 m.

Type: Turkey C3 Antalya d. Kemer (Lycia), between Ovacik on Teke Dağ and ^{Cumasi} Soğut/Yayla near Çalbalı Dağ, 1100-1300 m, 13.vii.1949, Davis 15227 (holo. K! iso E! BM!).

S.W. Anatolia

C3 Antalya: Kara Dağ, 90 m, P.B. Smith 541 at the base of Musa Dağ at Çirali, Huber-Morath 10138!, 13 km W. of town c. 20 m, Sorger 65-33-40! Tahtali Da, between Kesme Boğ and Kuzdere Y., D.15156!

Endemic. E. Mediterranean element.

Apparently most nearly related to S. libanotica Boiss., but distinguished from it in having a smaller calyx and corolla, slender flowering stems, and sparsely pilose indumentum.

The hybrid S. x burrii Davis (D.15174b!) between S. cretica ssp. mersinea and S. sericantha was found growing among the parents shows intermediacy in the calyx and indumentum characters. The pollen grains are abortive and nutlets are not formed.

10. S. tmolea Boiss., Diagn. Ser. 1(5): 29 (1844) (Map 9).

Perennial with basal rosettes of sterile shoots. Flowering stems c. 1 m, simple or with few branches. Indumentum densely adpressed-tomentose, lanate-villose above. Basal leaves oblong-spathulate, 2-14 x 0.5-4.5 cm, weakly crenate to subentire, apex obtuse or sometimes acute, attenuate to rounded at base, petiole 4-10 cm. Cauline leaves 2-3-paired, oblong, 6-10 x 1.5-2.5 cm, petiole 3-7 cm, sericeous-tomentose. Floral leaves subsessile to sessile, oblong-lanceolate to ovate-lanceolate, 1.3-7 x 0.5-2 cm, larger than verticillasters. Verticillasters few-3-5, remote, 2-14 cm apart, 15-20-flowered. Bracts lanceolate to linear-lanceolate, 2-18 mm, herbaceous with soft spinescent tip. Pedicels 1.5-4 mm. Calyx sub-bilabiate, tubular to subcampanulate, 12-16 mm, hirsute; teeth subequal, triangular erect, \pm half as long as tube, mucro 0.5-1.5 mm, margin glandular and eglandular. Corolla 16-19 mm, pale lemon yellow, tube subexserted; upper corolla lip retuse. Nutlets obovoid, 2.2 x 1.8 mm, trigonal. Fl. June-August. Habitat: Limestone gorges and screes, eroded stony banks and forest undergrowth. 200-1270 m.

Type: Turkey B2 Izmir in regione alpina Tmoli (Boz Dağ) circa Bozdagh, vi.1842, Boissier (holo. G!)

W., N.W. and adjacent C. Anatolia

A2(A) Bursa: below Mt. Olympus (Ulu Dağ), above Bursa, 200 m, Bornmüller 1899: 5448!

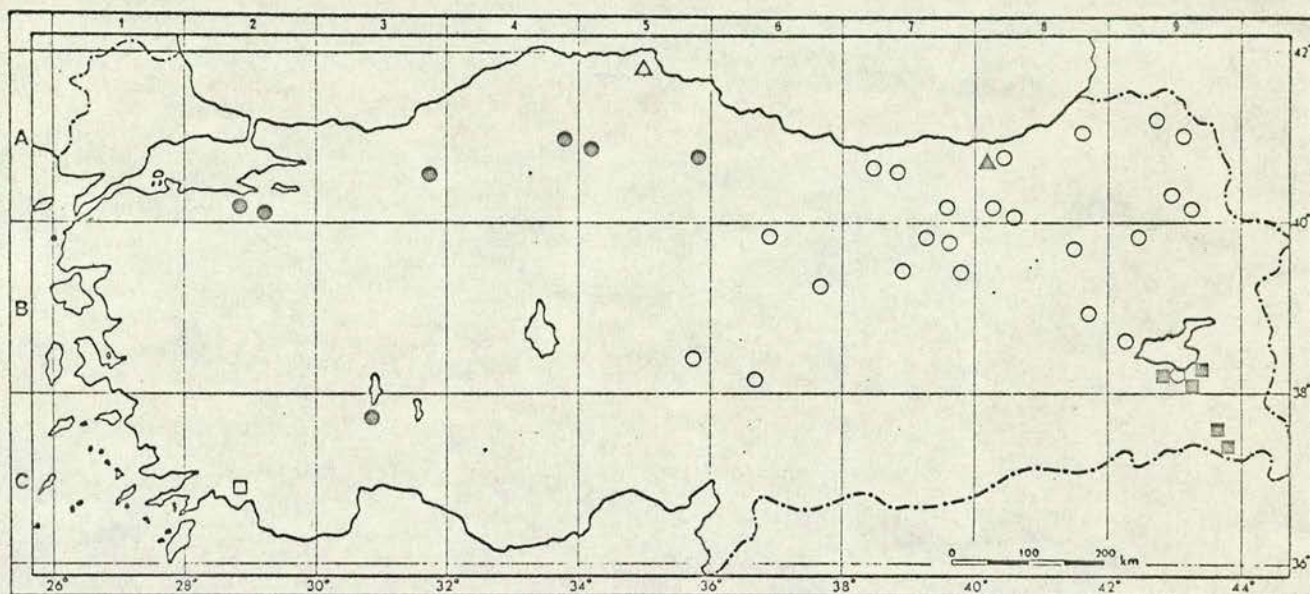
B1 Balıkesir: Mt. Ida (Kaz Dağ), Karcikos, Sintenis 1883: 570!

Çanakkale: Bayramiç işletmesi, 1100-1200 m, 178.1951, Ismail Abbas!

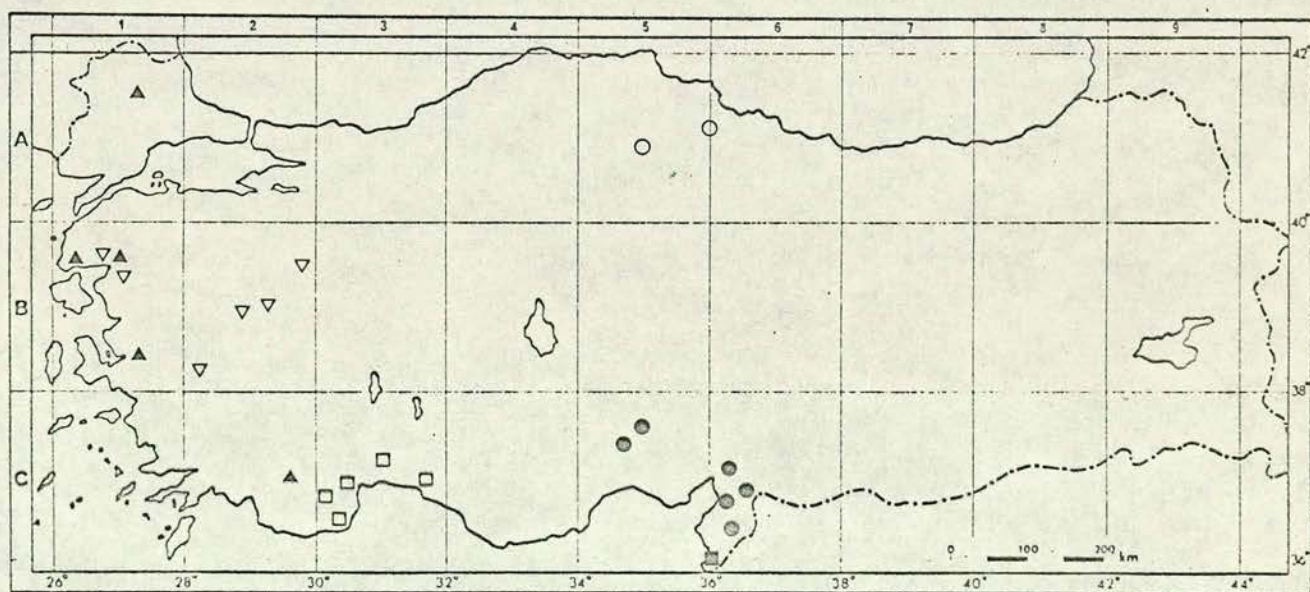
B2 Kütahya: Murat Dağ (above Gediz) below Hamam, 1200 m, D.36858!

Manisa d. Demirci to Simav, 1380 m, Huber-Morath 12734!

Izmir: Bozdağ, S.W. of the village, 1100-1500 m, Sorger 68-16-96



Map 8. ● S. germanica ssp. bithynica; □ ssp. heldreichii;
 ▲ S. alpina ssp. macrophylla; ○ S. balansae ssp. balansae;
 ■ S. balansae ssp. carduchorum; ▲ S. rizehensis



Map 9. ○ S. huber-morathii; ● S. pinetorum;
 ▲ S. obliqua; ■ S. libanotica var. minor;
 □ S. sericantha; ▼ S. tmolea

Endemic. E. Mediterranean element.

The species has an affinity with S. cretica L. but differs from it in having few (2-5) verticillasters, usually being 10-14 cm distant, and in the calyx tube and mouth not being oblique. Bornmüller 5448 from Bursa is different from other material of S. tmolea in having more glandular-haired indumentum on stems and calyces and in its larger calyx teeth.

11. S. cretica L., Sp. Pl. 581 (1753); Rech. fil. in Ann. Nat. Hofmus. Wien 48: 167 (1937) and Bot. Jahrb. 71: 534 (1940).

Syn. S. salvifolia Ten. Fl. Nap. 2: 23 (1820)

S. italica Benth., Lab. Gen. et Sp. 563 (1834) non Mill.

S. cassia Boiss. Diagn. Ser. 1(12): 76 (1853)!

S. germanica ssp. italica var. italica Briq., Lab. Alp. Marit. 224 (1893)

S. germanica ssp. italica var. boissieri Briq., Lab. Alp. Marit. 222 (1893) p.p.

S. velata Klok. in Fl. RRS Ucr. 9: 646 (1960) (Map 10 & 11).

Perennial with basal sterile rosettes. Flowering stems c. 25-100 cm, erect, branched or unbranched. Indumentum usually densely or sparsely adpressed greyish-tomentose, rarely patently pilose; glandular hairs less frequent than eglandular hairs. Basal leaves oblong-spathulate, 4-10 x 1-3.5 cm, obscurely crenulate to faintly crenate, apex obtuse sometimes acute, attenuate rarely rounded to subcordate at base, narrowed towards the base from the middle of the leaf, petiole 2-8 cm. Cauline and floral leaves similar to basal but gradually becoming smaller above, shortly petiolate to subsessile or sessile. Floral leaves oblong-lanceolate to lanceolate,

1-6 x 0.5-1.2 cm, as long as or longer than verticillasters. Verticillasters usually remote throughout rarely approximate above, 10-16-flowered. Bracts ovate-lanceolate to lanceolate, 5-16 mm, herbaceous, not spinescent. Pedicels 1-2.5 mm. Calyx sub-bilabiate, subcampanulate to tubular 12-16 mm, densely tomentose, teeth subequal, ovate to lanceolate, as long as to $\frac{1}{3}$ the length of the tube; micro 1-3 mm. Corolla 18-20 mm, rose-pink, tube subexserted. Nutlets obovoid, 2 x 1.5 mm, smooth.

Key to subspecies (excluding intermediate plants):

1. Verticillasters approximate for the most part; at least some of the basal leaves truncate to subcordate at base
 2. Calyx teeth as long as or slightly less than calyx tube, micro 2-3 mm; lower cauline leaves 2-3 times longer than broad subsp. cassia
 2. Calyx teeth half as long as the tube, micro 1-1.5 mm; lower cauline leaves 3.5-5 times longer than broad subsp. bulgarica
1. Verticillasters remote throughout, rarely 2-3 approximate above; basal leaves usually cuneate to attenuate, rarely few rounded at the base
 3. Calyx teeth ovate; median cauline leaves broadly oblong-lanceolate
 4. Stem sparsely villous-tomentose and not adpressed, calyx teeth with glandular hairs subsp. smyrnaea
 4. Stem adpressed white-tomentose; calyx teeth usually eglandular subsp. trapezuntica
 3. Calyx teeth triangular-lanceolate to shortly triangular; median cauline leaves narrowly lanceolate, sometimes broader

5. Inflorescence usually paniculately branched; flowering stem broad
(0.5-0.8 cm) and elongate (80-100 m)
6. Calyx teeth usually erect or slightly recurved in fruit;
mucro c. 2 mm; indumentum densely adpressed on calyx
tube in fruit subsp. mersinaea
6. Calyx teeth widely recurved in fruit; mucro 1 mm;
indumentum sparsely villous-tomentose sometimes
glabrescent in fruit subsp. garana
5. Inflorescence usually erect and unbranched; flowering stem
slender (0.3-0.6 cm) and short (50-80 cm)
7. Verticillasters 4-10-(42) cm distant throughout; stem and
leaf indumentum loosely adpressed villous, evanescent
above subsp. vacillans
7. Verticillasters 2-4-(-6) cm distant throughout; stem and
leaf indumentum short and adpressed tomentose
8. Calyx tube hidden under dense indumentum; glandular hairs
absent from calyx teeth subsp. anatolica
8. Calyx tube not hidden under dense indumentum; glandular
hairs or substipitate glands present on calyx teeth
..... subsp. lesbiaca

Subsp. cassia (Boiss.) Rech. fil. in Bot. Jahrb. 71: 534 (1940)

Syn. S. cassia Boiss., Diagn. Ser. 1(12): 76 (1853)!

Fl. April-August

Habitat: Rocky limestone slopes; in Quercus maquis, 200-1050 m.

Type: Turkey/N. Syria: in regione sylvatica inferiori montis Cassii

Syriae borealis, Boissier!

S. Anatolia (Amanus)

C6 Adana: above Yeniköy at Haruniye, 630-700 m, Huber-Morath 12561!

Adana: d. Osmaniye, Amanus Dağları, 600 m, Alkan 1!

C6 Hatay: d. Antakya: Iskenderun to Antakya, W. of Amik Göl, 150 m, D.27129!

External distribution: C. Greece. E. Mediterranean element.

This subspecies is characterised by its congested verticillasters, and calyx teeth as long as the tube with longer c. 2-2.5 mm mucro. D.27129 from Hatay diverges from the rest in having \pm remote verticillasters, but the calyx teeth and mucro length agree with the other specimens. The disjunction in distribution is a striking feature in this subspecies as it grows only in C. Greece, and S. Anatolia (Amanus) region.

Subsp. garana (Boiss.) Rech. fil. in Ann. Nat. Hofmus. Wien 48: 176 (1937)

Syn. S. garana Boiss., Diagn. Ser. 1(12): 76 (1853)!

S. cretica var. garana Boiss. Fl. Or. 4: 719 (1879)

S. germanica ssp. italica var. garana Briq., Lab. Alp. Marit.:
223 (1893)

S. cretica Hand.-Mazz. in Ann. Nat. Hofmus. Wien 27: 414 (1913)

Fl. June-July.

Habitat: Rocky igneous slopes; undergrowth of Quercus forests 1067-1900 m.

Type: \sqrt{N} . Iraq in lapidosis montis Gara Kurdistaniae Kotschy 413!

S. & E. Anatolia

A8 Erzurum, d. Aşkale, Erzurum to Erzincan, 1900 m, Huber-Morath 15287!

B7 Tunceli: above Pertek, 1600 m, D.31051!

B8 Bingöl: In Mt. Bingöl between Mush and Erzurum, 1524 m, Kotschy Supp. 670

C5 Iğel: In Mt. Tauro, Kotschy 445

C8 Mardin: Bakakri, Sintenis 1888: 1253!

External distribution: N. Iraq. Irano-Turanian element.

Distinguished by its tall and stout c. 100 cm stems, broader leaves, villous calyx indumentum, \pm approximate verticillasters, and recurved fruiting calyx teeth with prominent nervature. D.31051 from Tunceli is somewhat exceptional from the rest in having narrower leaves.

Subsp. lesbiaca Rech. fil. in Ann. Nat. Hofmus. Wien 48: 175 (1937)

Syn. S. cretica Candargy in Bull. Soc. Bot. Fr. 45: 190 (1898)

S. acutifolia Rech. fil. in Ann. Nat. Hofmus. Wien 43: 327 (1929) non
Chaub & Bory (1832).

Fl. May-June.

Habitat: In rocky ruins on mountain slopes.

Described from islands of Lesbos and Lemnos.

W. Anatolia and Islands

A1(A) Çanakkale: d. Yenice-Çan, 10 km from Çan, 220 m, Huber-Morath 17247!

Dardanelles: On mountain at Kursunlu, Sintenis 1883: 647!

B1 Balıkesir: Assos, Sintenis 1883: 647!

Islands

Mytilini (Lesbos): Antissa, Trachyt, Rech. 5871, between Kapi and Gelia,

Trachyt, Rech. 5753, at Megali Limni, Serpentin, Rech. 5699.

Endemic. E. Mediterranean element.

Subsp. trapezuntica Rech. fil. in Ann. Nat. Hofmus. Wien 48: 172 (1937)

Syn. S. italica Hand.-Mazz. in Ann. Nat. Hofmus. Wien 23: 185 (1913) non Mill.

Fl. June-July.

Described from Trabzon

N.E. Anatolia

A7 Trabzon: between Dschevislik and Hamsiköy, Sint. 1890: 3432!

near Trabzon, Bourgeau 695, B

near Dshinik, Hand.-Mazz. 324.

Endemic. E. Mediterranean element?

The area near Trabzon is one of the most eastern Mediterranean enclaves on the Black Sea coast.

Subsp. bulgarica Rech. fil. in Ann. Nat. Hofmus. Wien 48: 171 (1937)

Syn. S. italica et S. cassia auct. Bulg.

Fl. May-August

Habitat: Rocky slopes.

Lectotype [Bulgaria] Sadovo, June 1907, Stribnyj!

N.W. Turkey

A1/2(A) Çannakkale: Dardanelles, Renköi (Erenköy), May 1856, Kirk!

A2(A) Istanbul: Baghlarbachi, 10.viii.1893, Aznavour 1767!

External distribution: Bulgaria, Greece, E. Mediterranean element?

Kirk's specimen from Renköi (the Dardanelles) differs from the rest in having large mucronate calyx teeth and distant verticillasters.

Subsp. vacillans Rech. fil. in Bot. Jahrb. 71: 536 (1940)

Syn. S. cretica Boiss., Fl. Or. 4: 719 (1879) p.p. quoad plantam syriacam.

Fl. May-June.

Habitat: Limestone soils and fallow fields, 305-1341 m.

Type: [Syria] A Damasco versus Palmyra: frequens in lapidosis ad Marra pagum, 1219 m, 26.v.1855, Kotschy 476 (holo. MW).

S. and adjacent E. Anatolia

C3 Antalya: d. Kemer, Teke Dağ near Ovacik, 1100-1200 m, D.15174a!

C5 Icel: near Güzlü Dere, 20.v.1855, Balansa 510!

C5 Hatay: Djebel Seman, 15-20.v.1908, Haradjian 2079!

C6 Gaziantep: around Aintab (Gaziantep) 549 m, Hausknecht.

External distribution. Lebanon, Syria, Palestine. E. Mediterranean element.

Subsp. smyrnaea Rech. fil. in Ann. Nat. Hofmus Wien 48: 174(1937)

Syn. S. cretica Boiss. Fl. Or. 4: 719 (1879) p.p.

S. germanica ssp. italica var. boissieri Briq., Lab. Alp. Mar.

2: 223 (1893) p.p.

Fl. May-August.

Habitat: Limestone hillsides in Pinus brutia forest etc. 5-1380 m.

Described from N.W., W. and S. Anatolia and E. Aegean islands.

NW, W. and S. Anatolia and Islands

A1(E) Kirklareli: 9 km E. Babaeski, 125 m, Sorger 62-96-2!

A1(A) Canakkale: d. Canakkale, 5 m, Huber-Morath 17618!

B1 Izmir: 11 km S. Aliaga, 200 m, Sorger 66-5-9!

B2 Manisa: Inegöl to Buldan, 400 m, Huber-Morath 5256!

C1 Muğla: Yatagan to Milas, 660 m, Huber-Morath 12735!

B1 Balıkesir: Mt. Ida: Szu Szu Dağ (Ka. Dağ) Sintenis 1883: 1180!

C1/2 Aydın: Aydın to Pasayaylas, T. Baytop 2414!

C2 Muğla: Muğla to Kala, 1120 m, Huber-Morath 16743!

C3 Isparta: d. Sutçuler, above Sarp Dağ, 1300 m, D.15832!

Antalya: Akseki, 1380 m, Huber-Morath 17248!

Islands

Samos: in Vathy, Davis 1695!

Chios: in Pinus forest, 150 m, Huber-Morath 5255!

Rhodos: Salakos, Bourgeau 258B

Icaria, Rech. 4328

Kos, Rech. 8037

Ambelos, Rech. 2176

Endemic. E. Mediterranean element.

This subspecies is readily distinguishable from the others by its lax and sparsely villous-tomentose indumentum with glandular and eglandular hairs, broader leaves and ovate and glandular calyx teeth.

Subsp. mersinaea (Boiss.) Rech. fil. in Ann. Nat. Hofmus. Wien 48: 176 (1937)

Syn. S. mersinaea Boiss., Diagn. Ser. 2(4): 37 (1859)

S. cretica var. paniculata Boiss. Fl. Or. 4: 719 (1879)

S. germanica ssp. italica var. mersinaea Briq., Lab. Alp. Marit.
223 (1893)

Fl. June-September.

Habitat: Rocky limestone slopes and meadows. 5-1600 m.

Type: Turkey C5 Içel Hab. ad pagum Bouloukli prope Mersina Ciliciae
littoralis in arvis incultis, Balansa 583

S. and E. Anatolia

B5 Niğde: between Taspınar and foot of Hasan Dağ. 1000-1100 m, D. 18879!

B6 Maras, d. Göksun: Hobek Dağ, 1600 m, D. 20228!

B7 Elazığ: Kharput (Harput), above Pekenik, Sintenis 1889: 771!

C2 Burdur: Tefenni to Burdur, 1100 m, Huber-Morath 5257!

C3 Isparta: Antalya (Adalia) to Isparta, Heldreich 1128!

Antalya d. Manavgat: 3 km NW of Side, 5 m, Huber-Morath 17719!

- C4 Konya: 14 km S. of Konya, 1100 m, Huber-Morath 8390!
- C5 Içel: near Mersin, 10.vi.1855, Balansa 511!
Güzül dere, 1000 m, Siehe 1895/96: 119!
Cilician Taurus, Balls 1232!
- C6 Hatay: Arsuz to Iskenderun, Huber-Morath 12564!
- C7 Malatya: Entre Arga to Malatya, G. & B. Post 63!

Endemic. E. Mediterranean element.

Gynodioecism has been observed in Heldreich 1128 and Balls 1232 from Isparta and Içel without any striking change in corolla length. Sorger 71-24-4 from Içel shows intermediacy in the character of calyx indumentum between subspp. smyrnaea and mersinea.

Subsp. anatolica Rech. fil. in Ann. Nat. Hofmus. Wien 48: 175 (1937)

Syn. S. cretica Boiss., Fl. Or. 4: 719 (1879) p.p.

S. germanica ssp. italica var. boissieri Briq., Lab. Alp. Mar.
2: 222 (1893) p.p.

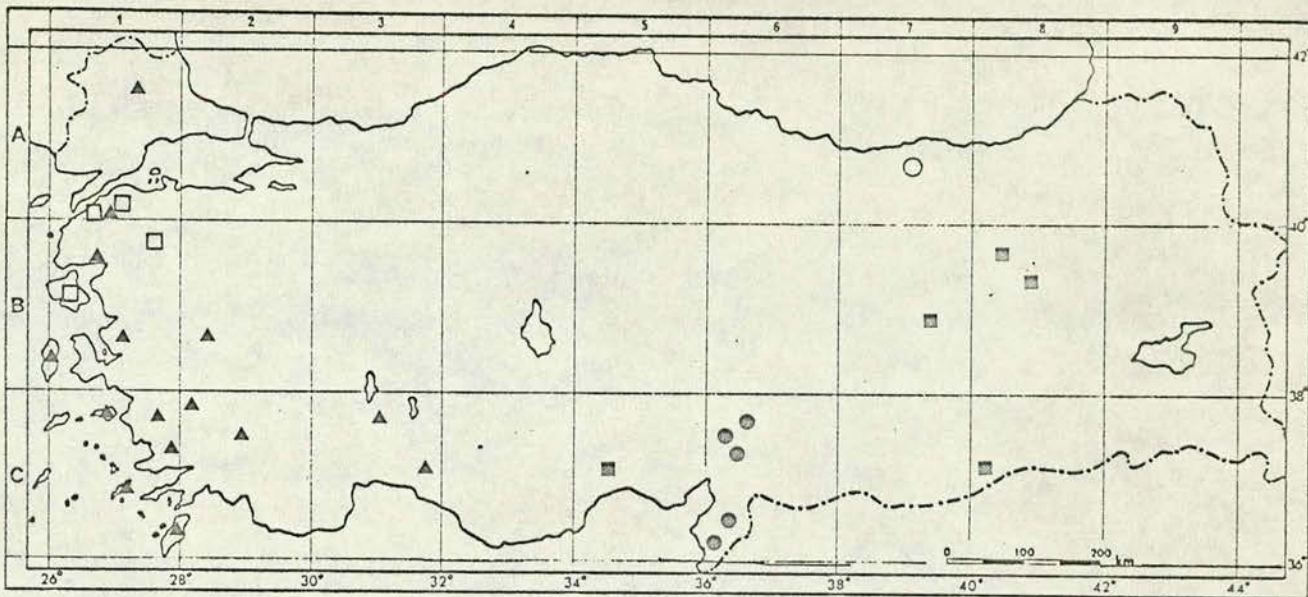
Fl. May-September

Habitat: Limestone slopes and steppes and flat meadows. 100-2900 m.

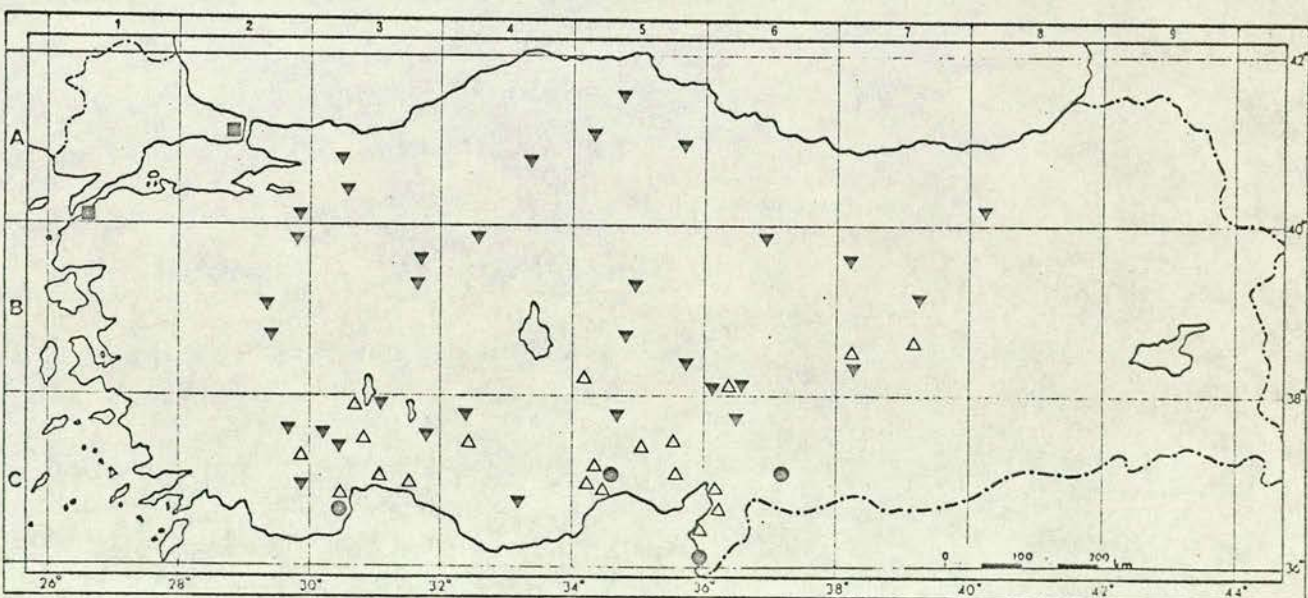
Described from N. C. and S. Anatolia

N., C and S. Anatolia

- A2 Bilecik: Pazaryeri, 750 m, D.36493
- A3 Adapazari: near Geyve, 100 m, D.36296
- A4 Cankiri: in valley of Cakmakli-dere, 800 m, Bornm. 1929: 14544!
- A5 Kastamonu: Tossia (Tosya), Sintenis 1892: 4286!
Amasya, Weidemann 374B
- A8 Gümüşane: Baiburt, Bourgeau 697!



Map 10. ● S. cretica ssp. cassia; ■ ssp. garana;
 ▲ ssp. smyrnaea; ○ ssp. trapezuntica
 □ ssp. lesbiaca



Map 11. △ S. cretica ssp. mersinaea; ▼ ssp. anatolica;
 ■ ssp. bulgarica; ● ssp. vacillans

- B2 Usak: 4 miles S. of Usak, 800 m, Coode 2389!
 Kütahya, d. Gediz: Şaphane, 1000 m, D.18479!
- B3 Eskişehir: 18 miles from Polatlı to Sivrihisar, 800 m, Coode 2291!
- B4 Ankara: Ankara, Bornmüller 1892/93: 3091!
- B5 Nevşehir: Ürgüp, 1250 m, Sorger 70-37-23!
- B6 Maraş: Maraş to Göksun, 1300 m, Stainton 5563!
- B7 Tunceli: N. of Pertek, Pertek to Tunceli, 1490 m, Huber-Morath 11398!
- C2 Antalya: Elmalu (Elmalı), Bourgeau 208!
- C3 Isparta : Eğirdir (Igridir), Heldreich!
- C4 Konya: 13 km W. of Konya, 1170 m, Huber-Morath 8393!
- C5 Niğde: Maden, W. of Maden, Darrah 302!

Endemic. Irano-Turanian element?

S. cretica is a widely variable species in such characters as density of indumentum, calyx teeth shape, tube/teeth ratio, length of sepal micro, and length/breadth ratio of leaves. Reehinger (1937, 1940) revised the species throughout its range and divided it into 11 subspecies, 9 of which grow in Anatolia. Although he described the subspecies, he did not attempt to key them out. Certain amount of morphological overlap occur between them in regions of contact.

12. S. thirkei C. Koch in *Linnaea* 24: 685 (1848)

Syn. S. janiana Ces., Pass. & Gib., *Comp. Fl. It.* 318 (1867)

S. thirkei C. Koch var. condensata Boiss., *Fl. Or.* 4: 720 (1879)

S. germanica subsp. italica var. italica Briq., *Lab. Alp. Marit.*

224: (1893)

S. italica var. janiana Arcangeli, *Comp. Fl. Ital.* 437 (1894) (Map 12).

Fl. May-September.

Habitat: In eroded sloping banks, fallow fields, on hill. 40-350 (-1700) m.

Type Turkey A2(A) Bursa Bei Brussa, C. Koch

N.E. Turkey

A1(E) Edirne: Edirne to Havsa, 100 m, McNeill 205!

Kirklareli: Payreli to Islambeyli, 350 m, A. Baytop 13829!

Tekirdağ, 3 miles W. of Tekirdağ, 100 m, Coode 2831!

Istranca Dağ, Kayacik 31!

A2(E) Istanbul: San Stephano to Safrakeuy, 18.vi.1905, Aznavour!

A2(A) Kocaeli: d. Karamürsel, Karamürsel to Yalova, 50 m, Huber-Morath 17245!

Istanbul: Polonezköy to Yeniçiftlik, 24.vi.1940, B. Post!

Brussa (Bursa): lower side of Mt. Olympus, 200 m, Bornm. 5451!

Adapazari: Dogançay, 100 m, D.36325!

A3 Bolu: Abant G., 1700 m, Sorger 69-5-17!

Zonguldak: Yenice to Balıksık, 100-200 m, D.37917!

B1 Balıkesir: Szu Szu Dağ (Kaz Dağ), Sintenis 1883: 1180!

External distribution: Bulgaria, Greece, Italy and Yugoslavia. Apparently occurring in both Euro-Siberian and Mediterranean regions in Turkey.

This species is related to S. cretica and S. byzantina being distinguished from the former in having distinctly curved and densely glandular calyx teeth, + congested inflorescence and broadly ovate floral leaves; from the latter it differs in the nature of its shortly adpressed-tomentose indumentum, rugose upper surface of leaves, and longer triangular lanceolate calyx teeth.

13. S. byzantina C. Koch in *Linnaea* 21: 685 (1848)

Syn. S. lanata Jacq. *Ic. Pl. rar.* 1: 11 (1781) non Grantz (1769)

S. olympica sensu Briq., *Lab. Alp. Marit.* 215 (1893) vix Poiret (1817)

S. taurica Zefirov in *Not. Syst. (Leningrad)* 14: 348 (1951) (Map 12).

Perennial with sterile basal rosettes. Flowering stems c. 1 m, usually simple, rarely sparsely branched, densely lanate-villous to floccose-tomentose, rarely sparsely arachnoid-tomentose. Basal leaves oblong-spathulate to broadly lanceolate, 3-8 x 0.5-3.5 cm, densely sericeous-tomentose to arachnoid, subcrenulate to entire, apex \pm obtuse, attenuate at base rarely rounded but always narrower towards base, with 2-6 cm petiole. Cauline leaves similar to basal, leaves gradually becoming shortly petioled to sessile above. Floral leaves sessile, lanceolate, 1-5 x 0.3-1 cm, as long as the verticillasters above. Verticillasters few remote below, \pm approximate above, 15-20-flowered, rarely all remote. Bracts ovate-lanceolate to linear-lanceolate, 1.5-7 mm, tip not spinescent. Pedicels 0.5-1.2 mm. Calyx sub-bilabiate, subcampanulate, 8-10 mm; teeth ovate-triangular $\frac{1}{4}$ to $\frac{1}{3}$ as long as the tube, tip very shortly mucronate, micro 0.2-0.5 mm, \pm erect to slightly recurved in fruit, eglandular sometimes with few glandular hairs. Corolla 12-14 mm, rose-pink, tube \pm included. Nutlets obovoid 2.5 x 2 mm. Fl. June-September.

Habitat: In mountainous areas, Juniperus communities, edge of fields, 1100-2000 m.

Type: $\overline{\text{Turkey A2(E) Istanbul}}$ In B5ytkderoh am Bosphor auf Mergelboden, 30-60 m, C. Koch

N. Turkey; rare in C. Anatolia

A4. Kastamonu: Ilgaz to Kastamonu, 1350 m, Huber-Morath 15288! Ilgaz Dağ,

S. side of pass, 2000 m, Darrah 110! N. side of Ilgaz Dağ, 1500 m, D.25057!

Zonguldak: Keltepe, above Karabük, 1800 m, D.38827!

Keltepe above Sorgun Yayla, 1700 m, D.37852!

A5 Kastamonu: Tossia (Tosya) Sintenis 1892: 4571! 4449!

Samsun: Ladik nr. Ak Dağ, 1800 m, Bornm. 1890: 2664!

B3 Konya: Sultan Dağ above Akscheher (Aksehir), 2000 m, Bornm. 1899: 5453!

External distribution: N. Iran, Caucasia. Euro-Siberian element.

Closely related to S. thirkei C. Koch from which it differs in having densely lanate-tomentose indumentum, shorter and ovate-triangular calyx teeth, $\frac{1}{4}$ - $\frac{1}{3}$ as long as calyx tube, and oblong-lanceolate floral leaves. Sintenis 4449 and 4571, D.38827 and D.25057, Darrah 110 are somewhat exceptional in having an arachnoid-tomentose plant body instead of the usual dense lanate-villous indumentum. Besides that, D.37852, D.25057, Sintenis 4571 and some others from Zonguldak and Kastamonu have remote verticillasters and less dense indumentum. Gynodioecism has been observed in these specimens with reduction of corolla length (4.5-6 mm) and long exerted styles (cf. Fig. 18) in the female. Normal hermaphrodite plants have been found from the same localities. D.38839 from Zonguldak differs from the rest in having \pm cordate leaf base and rugose leaf surface; no pollen or seeds were found; the plant may be a hybrid involving S. byzantina.

14. S. spectabilis Choisy ex DC. in Mem. Soc. Phys. Genev. 1: 457 (1823)

Syn. S. hypoleuca C. Koch in Linnaea 21: 688 (1848)

S. elata C. Koch in Linnaea loc. cit. (1848)

S. germanica L. var. spectabilis (DC.) Briq. in Engler & Prantl, Naturl. Pflanzenfam 4(3a): 263 (1896)

S. spectabiliformis Kapeller in Not. Syst. Geogr. Inst. Bot.

Tphilisi, fasc. 16: 14 (1951) (Map 12).

Mesophytic perennial. Flowering stems erect, 50-120 cm, simple or with few branches, short and adpressed greyish tomentose, eglandular, glabrescent below. Cauline leaves ovate to ovate-lanceolate, 2.5-14 x 0.8-6 cm, serrate-dentate, apex acute, cordate at base, petiole 1-5 cm; indumentum short and adpressed white-tomentose on lower surface, glabrescent above. Floral leaves subsessile to sessile, ovate-lanceolate to ovate, 1-6 x 0.8-1.5 cm, weakly serrate to subentire, longer than verticillasters. Verticillasters few, remote, 1.5-4 cm apart, the rest \pm approximate above, 12-16-flowered. Bracts lanceolate to linear-lanceolate, 5.5-8.5 mm, herbaceous, tip spinescent. Pedicels 1-2 mm. Calyx sub-bilabiate, subcampamulate, 8-10 mm, white-tomentose; teeth subequal, ovate-lanceolate to lanceolate, \pm half as long as tube, usually eglandular, occasionally with few glandular hairs, mucro 0.5-0.8 mm. Corolla 13-14 mm, pink, tube subexserted. Nutlets lenticular, 2 x 1.4 mm, trigonous. Fl. June-August.

Habitat: Stream sides and river banks, wet rocky slope. 1500-2200 m.

Described from cultivated material.

E. and S. (Amanus) Anatolia

A8 Gümüşane: N. of Bayburt, 1500 m, D.31987!

Erzurum, 7 km SW of Tortum, 1800 m, Huber-Morath 15281!

A9 Kars: Yalnıscam, 1800 m, D.32551!

B7 Tunceli: foot of Munzur dağ above Ovaçik, 1500 m, D.31386!

Erzincan: Sipikor prov. Bendolam, Sintenis 1890: 3234!

B8 Erzurum: Erzurum, Aucher 1705!

B9 Agri: 15 km from Eleskirt to Horasan, 2200 m, D.47197!

Bitlis: d. Kotum; Karz Dağ, 2000 m, D.24576!

C5 Hatay: above Arsus (Arsuz), 5.vii.1862 Kotschy 14.8!

C9 Hakkari: Koçanis, 2286 m, D.24343!

C10 Hakkari: Sat Dağı, near Vareğöz, 1750-1900 m, D.45733!

External distribution: N. Iraq, Iran and Caucasia. Irano-Turanian element.

Related to S. longispicata but differing in having many-flowered verticillasters, sub-bilabiate and less hairy calyx tube. It also has some affinity with S. pinetorum but can be distinguished by its usually eglandular and \pm erect calyx teeth, and usually indistinctly nerved calyx tube.

15. S. longispicata Boiss. & Kotschy in Boiss., Fl. Or. 4: 725 (1879) (Map 13).

Perennial mesophytic herb. Flowering stems 40-1 m, branched above, short and dense, eglandular greyish tomentose, stem \pm glabrescent below. Cauline leaves oblong to oblong-lanceolate, 3-8 x 1-2 cm, margin crenate-dentate, apex acute, cordate to truncate at base, petiole 1-5 cm. Floral leaves subsessile to sessile, ovate to ovate-lanceolate, 0.4-3.5 x 0.2-1.2 cm. Leaf indumentum adpressed-sericeous, tomentose. Verticillasters remote, 1-4.5 cm, distant, 6-8-flowered. Bracts lanceolate to linear-lanceolate, 1-5 mm. Pedicels 1.5-2 mm. Calyx \pm regular, campanulate, 6-9 mm, indumentum sericeous-tomentose; teeth equal, as long as or longer than the tube micro 1-1.5 mm. Corolla 8-9 mm, rose-pink, tube subincluded. Nutlets obovoid, 1.9 x 1 mm. Fl. July-September.

Habitat: Moist places. 850-1270 m.

Syntypes: Turkey B6 Maras Hab. in dumosis secus fluvium Aksu prope Marasch (Maras) Cataoniae, Hausknecht; B8 Bingöl Inter Noreb et Angag prov. Boglan Armeniae australis, 1219 m, Kotschy 429 (G!), Lebanon in Coelesyria inter Zachle et Balbeck, Ehrenberg.

S. and E. (southern) Anatolia

B6 Malatya: Albistan to Darende, B. Post 494!

Maras: Göksun, 4 km E. of Göksun, 1270 m, Huber-Morath 12569!

C6 Adana: d. Osmaniye, 1 km below Yarpuz, 850 m, Huber-Morath 16279!

C7 Urfa: Urfa, Titrish, Sintenis 1888: 1470!

C8 Mardin (?Diyarbakir): Mardin, Omer Agha, Sintenis 1888: 1377!

External distribution: N. Iraq, N. Syria, Lebanon. Irano-Turanian element.

The species shows affinity with S. spectabilis Choisy, from which it differs in its few-flowered verticillasters, densely sericeous-tomentose, and \pm regular and campanulate calyx.

16. S. viticina Boiss., Diagn. Ser. 1(12): 77 (1853) (Map 13).

Perennial mesophytic herb. Flowering stems 40-60(-100) cm, erect, simple and branched above. Indumentum adpressed greyish-tomentose with short eglandular hairs. Cauline leaves oblong to ovate-oblong, 2-4 x 0.5-1.5 cm, crenulate, apex acute or obtuse, truncate to rounded at base, petiole 1-2 cm. Floral leaves sessile, lanceolate, 1-2 x 0.4-0.8 cm, as long as or shorter than verticillasters. Verticillasters remote, 0.5-2 cm apart, 2-4 approximate above, 12-16-flowered. Bracts ovate to ovate-lanceolate, 4-6.5 mm, densely tomentose. Pedicels 1.5-2 mm. Calyx sub-bilabiate, subcampanulate 7-8.5 mm, floccose-tomentose; teeth ovate-acuminate, \pm half as long as calyx tube, micro short, 0.2-0.5 mm. Corolla 11-12 mm, rose-pink, tube subincluded. Nutlets obovoid, 1.8 x 1 mm. Fl. May-August.

Habitat: Moist and damp places, thickets, 1-20 m.

Syntypes: $\overline{\text{Turkey C5/6 Hatay}}$ Hab. in Syria boreali prope Seleucium,

Suadih, Antiochiam, Boissier & Aucher 528 et 1712

S. Anatolia (Amanus)

C5 Hatay: Mt. Cassius, in dit. Ain Aramié, Mouterde 65

External distribution: W. Syria, Lebanon and Palestine. E. Mediterranean element.

No specimen from Anatolia has been seen, but it has been reported from the Amanus by Boissier (1878), Post (1934) and Rechinger (1957). This species shows affinity with S. longispicata, but differs in having many-flowered verticillasters with floccose-tomentose calyx and bracts.

17. S. huetii Boiss., Fl. Or. 4: 722 (1879)

Syn. S. germanica L. var. huetii Briq., Lab. Alp. Mar. 2: 228 (1893) (Map 13).

Perennial. Flowering stems ascending, 20-60 cm, simple or sparsely branched. Indumentum short greyish-tomentose, eglandular. Cauline leaves few, 4-5 paired, oblong to ovate-oblong 1.5-4 x 0.8-1.5 cm, crenulate, apex obtuse, truncate to subcordate at base, rugose, petiole 0.4-1.5 cm. Floral leaves 1-2.5 x 0.5-1.5 cm, subsessile to sessile, as long as or slightly larger than verticillasters. Verticillasters remote, 1-6 cm distant, 6-10-flowered, rarely few approximate. Bracts linear-lanceolate to linear subulate 6-10 mm, herbaceous, shorter than calyx. Calyx sub-bilabiate, subcampanulate, 13-14 mm; teeth \pm equal, erect, \pm half as long as tube, margin eglandular, micro 1-1.5 mm. Corolla 14-15 mm, brownish yellow when dry, tube subincluded, upper corolla lip entire. Fl. May-July.

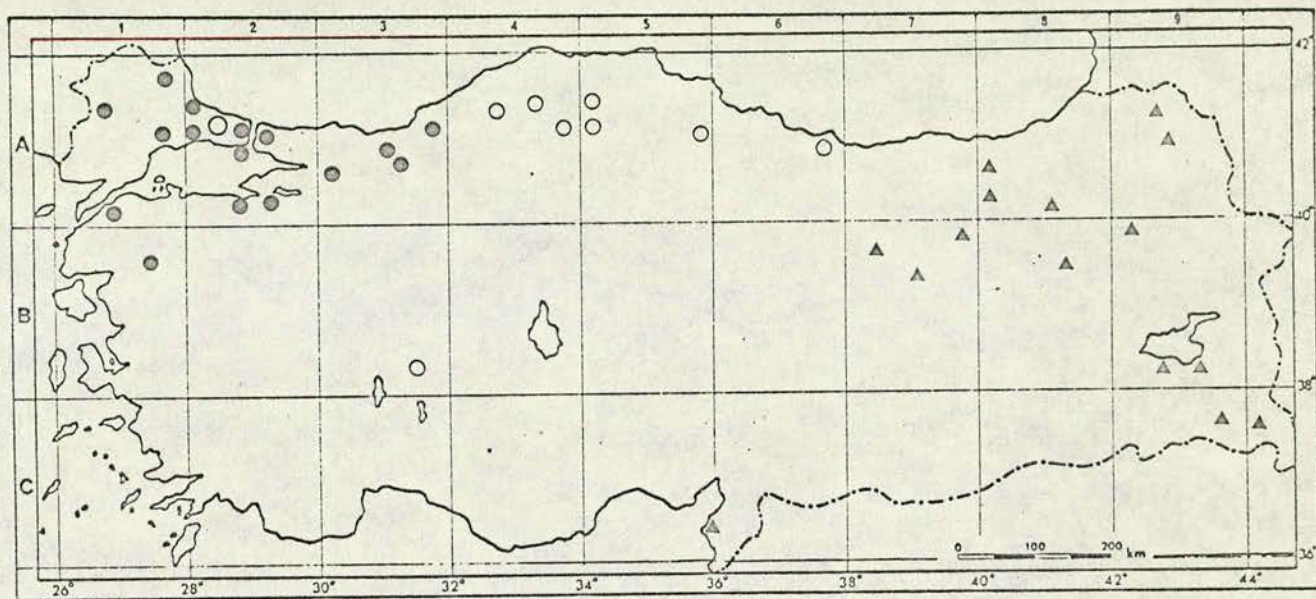
Habitat: Rocky substratum.

Type \surd Turkey Erzurum \surd Hab. ad radices montis Techdagh (Palandöhen Da.)

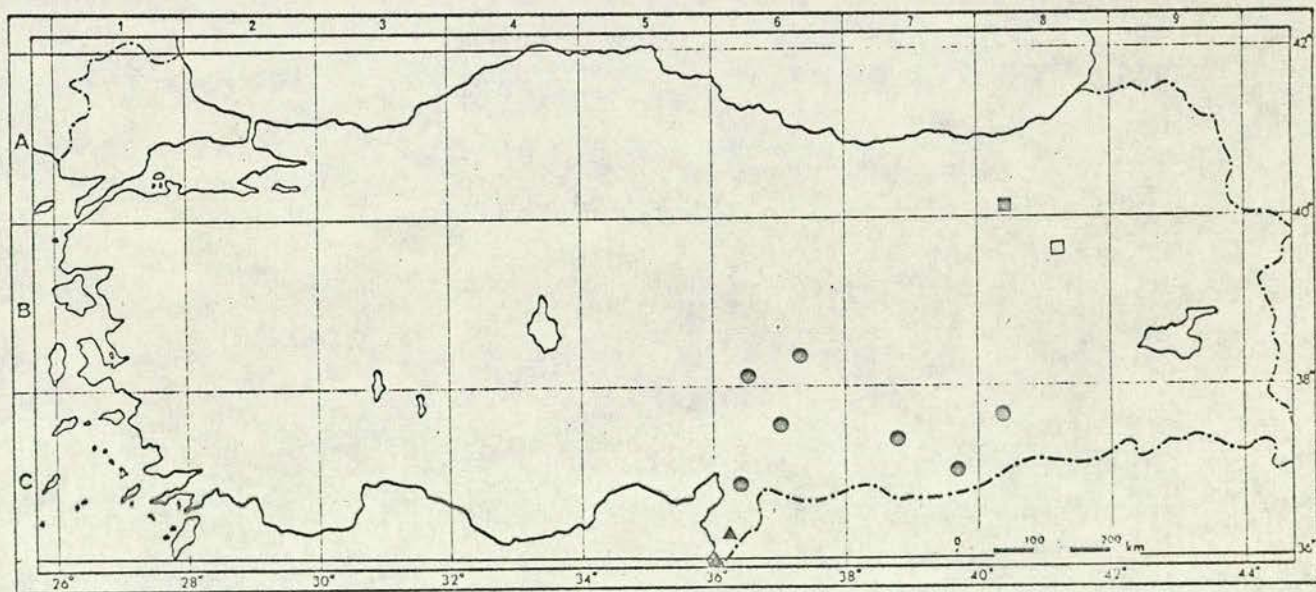
Armeniae Turcicae et circa Tortum, prope Erzurum, Huet (holo. G! Iso. K!)

Endemic. Irano-Turanian element.

No specimen has been found except the type gathering(s). The species shows some affinity with S. bayburtensis Bhattacharjee & Huber-Morath (q.v.)



Map 12. ● S. thirkei; ○ S. byzantina;
▲ S. spectabilis.



Map 13. ▲ S. viticina; ● S. longispicata;
□ S. huetii; ■ S. bayburtensis.

18. S. bayburtensis Bhattacharjee & Huber-Morath, sp. nov. (Map 13).

Species valde distincta, affinis S. huetii Boiss. sed caulibus multiramosis tenuioribus, foliis caulinis parvis basin cuneatis vel attenuatis, verticillastris magis approximatis, calycis dentibus brevioribus differt.

Perennial with branched \pm subterranean caudices. Flowering stems ascending, slender, 30-35 x 0.1-0.25 cm, manifestly branched, densely foliate.

Indumentum on stem short and sparsely tomentellous below, denser above with eglandular hairs and very few sessile glands. Lower cauline leaves oblong to ovate oblong, 1.6-2.5 x 0.3-1.2 cm, weakly crenulate, apex acute, cuneate to attenuate at base, petiole 1.2-2 mm; ~~indumentum;~~ indumentum sparsely adpressed pilose. Median cauline leaves similar but shorter, petiolate.

Floral leaves subsessile to sessile, oblong-lanceolate, 0.8-1.5 x 0.5-0.8 cm, weakly crenate to subentire, attenuate at base, slightly larger than verticillasters. Verticillasters 2-4 remote, 1-3.5 cm distant, 6-8-(-10)-flowered. Bracts linear to lanceolate, 4-8.5 mm, herbaceous, densely hairy, tip softly spinescent. Pedicels 1-2 mm. Calyx \pm regular, subcampanulate, 8.5-10.5 mm, densely adpressed tomentose towards base, sparse above; teeth \pm equal, erect, triangular-lanceolate, half as long as tube, spinescent at tip, micro 0.8-1.2 mm, margin eglandular haired. Corolla 10.5-14.5 mm, brownish when dry, tube exerted, annulate; upper corolla lip slightly retuse 3-4.5 mm and lower lip 6-7 mm, median lobe subentire to entire. Stamens exerted. Nutlets unknown. Fl. June-July.

Habitat: Rocky substrata.

Type: $\sqrt{\text{Turkey AS Gümüşane}}$ Bayburt: Kop Dağ, Bayburt-Aşkale, 2050-2100 m, 5.vii.1955, Huber-Morath 14186 (holo. Hb. Huber-Morath, Basel!)



Stachys bayburtensis Bhattacharjee &
Huber-Morath. Sp. nov.
Det. R. Bhattacharjee 15. 8. 73

HERBARIUM · A. HÜBER-MORATH

Flora Anatolica

Nr. 14186. *Stachys bayburtensis* Hub.-Mor. n. spec. ined.

Provinz AS Gümüşane District Bayburt

Kop Dag Bayburt - Aşkale.

2958 m ü. M.

5. Juli 1955.

leg. A. Huber-Morath

Pl. 15. *Stachys bayburtensis* Bhattacharjee & Huber-Morath (Holotype)

Endemic. Irano-Turanian element.

This new species is very distinct in itself but shows some resemblance to S. huetii Boiss. in the nature of undumentum, ascendant habit, and \pm regular and erect calyx teeth without glandular hairs. Indeed, the few-flowered verticillasters with smaller cauline leaves give a superficial resemblance to Sect. Fragilicaulis Subsect. Multibracteatae Ser. B, but overall resemblances clearly places this new species in Sect. Eriostomum subsect. Spectabiles. I could not possibly have said anything about its affinity unless I had seen the type material of S. huetii from Geneva Herbarium and from Kew. After examining them I have no hesitation in placing S. bayburtensis in its proper systematic position.

Sect. INFRAROSULARIS (p.

19. S. rupestris Montbr. & Auch. ex Benth. in Ann. Sci. Nat. Ser. 2, 6: 49
(1836) (Map 14).

Suffrutescent perennial with sterile basal rosettes. Flowering stems (9-)-14-30 cm, usually unbranched. Indumentum on stem sparsely and patently pilose or rarely densely tomentose with glandular and eglandular hairs. Basal leaves oblong-elliptic, 1.2-6 x 1-3.3 cm, margin obtusely-crenate, apex obtuse, base cordate to truncate, petiole 1.2-6 cm; surface of leaf sparsely pilose to densely velvety, rarely glabrescent. Cauline leaves 1-2-paired, shortly petioled to sessile, smaller than basal leaves. Floral leaves 0.8-3.5 x 0.2-2.2 cm, sessile, truncate to cuneate, larger than verticillasters. Verticillasters usually remote, 1-3 cm distant, 1-2 \pm approximate above, rarely congested-spicate, 6-14 mm apart, (4-)-6-10-flowered. Bracts herbaceous, lanceolate to linear, 2-9 mm, as long as or slightly shorter than calyx tube. Pedicels 1.5-3 mm. Calyx \pm sub-bilabiate, subcampanulate, 9.5-13 mm, softly pilose to tomentose with glandular hairs and/or sessile glands; teeth oblong-lanceolate or lanceolate-subulate with soft spinescent tip; upper and lower teeth 2-3.5 to 3-5.5 mm respectively. Corolla 14-18 mm, white or pink, rarely yellowish in sicco, tube subexserted or exserted. Nutlets oblong, 2.5-3 x 1.5-1.8 mm. Fl. April-July.

Habitat: Vertical limestone cliffs and crevices, sometimes under Pinus brutia forest, 200-1200 m.

Type [Turkey C5 Icel]: Hab. in rupibus Tauri Orientalis, Cilicia Aucher-Eloy 1701 (G!).

S. Anatolia (Taurus and Amanus)

~~B5~~ Mares/C5 Adana: Sis to Hadjin, B. Post 1906: 385!

C4 Icel: Kirobasi to Silifke, 900 m, Huber-Morath 10135!

C5 Icel: Mersin to Kuzusubelen, 280 m, Huber-Morath 10137!

C5 Adana: Nur Dağ above Kizildere, 200 m, D.26735! 5 km above Pozanti, 870 m,
Huber-Morath 12554!

Hatay: Djebel Semman, 2000 m, Haradjian 2150!

Icel: Gülek depe, 1200 m, Siehe 1895: 456! Silifke to Gölner, 470 m,
Huber-Morath 10136!

Endemic, E. Mediterranean element.

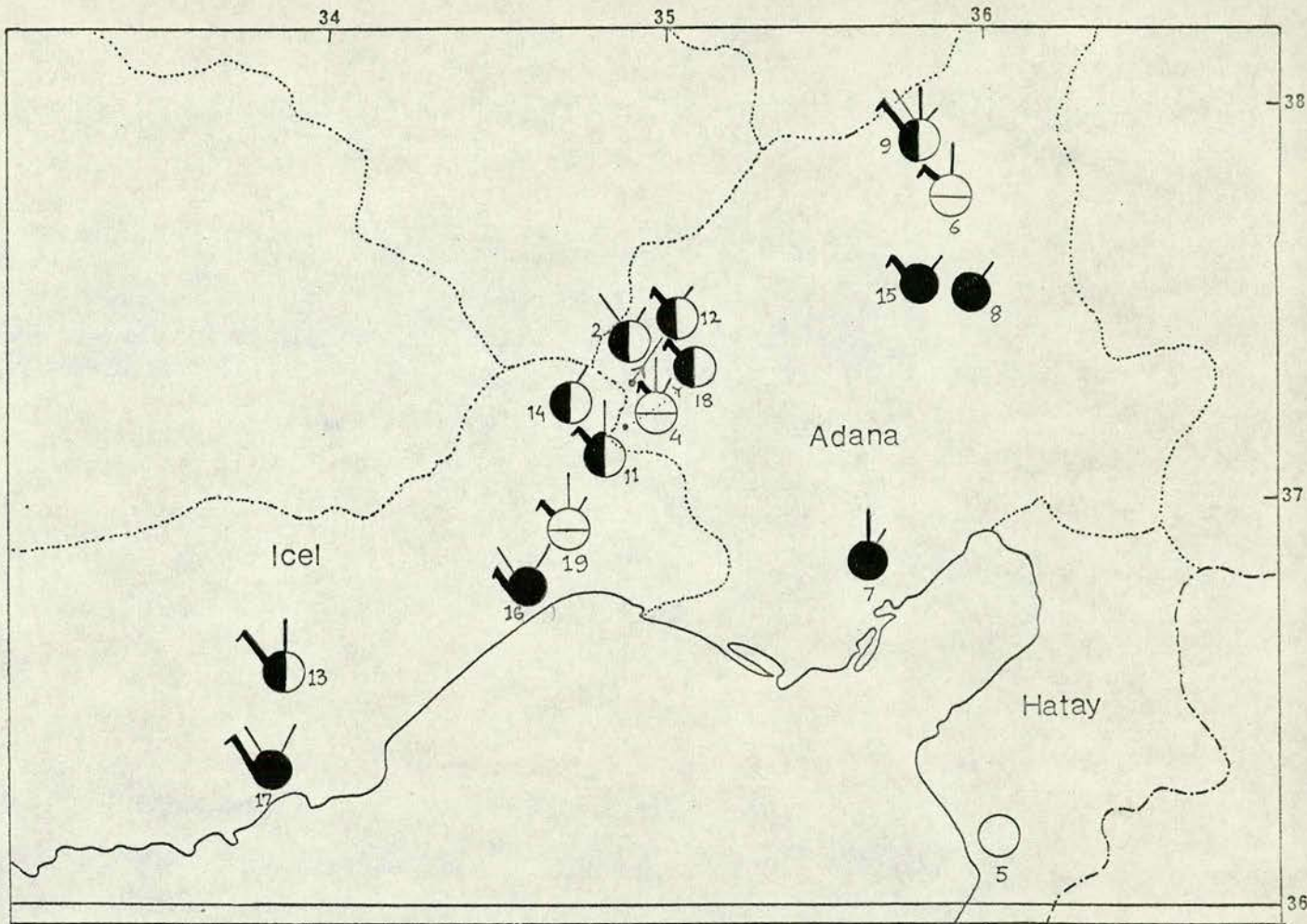
This species shows a wide range of variation throughout its distributional range. The characters like corolla colour, calyx teeth-tube ratio, density of verticillasters and indumentum type are so variable and show overlapping distributions that it would not be justifiable to recognise any infraspecific taxa within this species. Boissier (1879) noted the corolla colour as

'yellowish', in all but one of the available specimens the corolla colour is significantly white with pink markings or apparently pink throughout.

Haradjian 2150 from S. Hatay shows a yellowish corolla in the dried condition.

The distribution of this specimen is also at one extreme of the species range, whereas the rest of the specimens are mainly confined to the Taurus and Anti-Taurus. On the other hand, Huber-Morath 10136 and 10137 represent the western extremity of the species' range. The two specimens are exceptional in having a densely velvety indumentum. Huber-Morath labelled these plants as

"S. seleuciensis" (ined.). However, the character table (Table No. 9) and accompanying metroglyph map (Map 14) demonstrate that these two specimens (metroglyph 16 & 17) show morphological overlap with the variable S. rupestris Montbr. & Auch. More typical S. rupestris also grows nearby.



Map 14. Metroglyph Analysis of Distribution of *S. rupestris* Montb. & Auch.

Key to Metroglyph

- | | | |
|----------------------------|-------------------|-------------------------|
| 1. Corolla colour: | 3. Inflorescence: | 5. Calyx teeth shape: |
| pink ● | lax ○ | lanceolate subulate ○ |
| white with pink markings ● | dense ○ | triangular lanceolate ⤴ |
| colour not mentioned ⊖ | | oblong ⤵ |
| 2. Calyx teeth/tube ratio: | 4. Indumentum: | |
| < 3 ○ | glabrescent ○ | |
| > 3 or 3 ○ | subdense pilose ♂ | |
| | dense villous ♂ | |

Table 9. Character variation in *S. rupestris* Montb. & Auch.

No. of specimens	Dis-tribution	Stem indumentum	Inflo-rescence	Calyx teeth/tube ratio	Calyx shape	Corolla colour
1. Aucher-Eloy 1701	Cilicia	+	lax	+	+	white with pink dots
2. Aber.Univ. A132	Adana	++	dense	+	+	"
3. " " A15	Pozanti	+	"	+	+	pink
4. " " A4537	"	+	"	+	+	pink
5. Haradjian 2150	Adana	++	lax	++	++	white & pink dots
	Gülek					
	Djebel Semman	+	"	+	+	yellow ?
6. Post 385	Hadjin	+	"	++	++	unknown
7. D.26735	Adana	++	"	++	+	pink
8. D.26608	Adana:					
	Kozan	++	"	+	+	pink
9. D.19573	Adana:Feke	++	dense	++	+++	white & pink
10. Balansa 534	Içel	++	lax	++	++	" "
	Guzul-dere					
11. Hub.-Mor. 14184	Içel:	+	"	++	++	" "
	Taurus					
12. " " 12555	Adana:	++	"	+	++	" "
	Pozanti					
13. " " 10135	Içel	+	"	++	+++	white & pink
14. Siehe 456	Içel:					
	Gülek depe	++	"	+	+	" "
15. Hub.-Mor. 15280	Kozan	++	"	+	++	pink
16. " " 10137	Içel:	+++	dense	+	++	"
	Mersin					
17. " " 10136	Içel:	+++	"	+	+++	"
	Silifke					
18. Sorger 62.71.56	Adana	+	lax	+	++	white & pink
19. Hennipman 11411	Içel	++	"	++	++	unknown

Key: Stem indumentum glabrescent +, pilose ++, dense villose +++,

Calyx teeth/tube ratio: < 3 +, 3 or > 3 ++,

Calyx shape: lanceolate subulate +, triangular lanceolate ++,

oblong +++

20. S. cataonica Huber-Morath & Bhattacharjee, sp. nov. (Map 15).

Valde affinis S. pumilae Banks & Sol. sed pedunculo et calyce patenter piloso differt.

Suffrutescent perennial with sterile basal rosettes. Flowering stems 7-24 cm, usually unbranched and woody at base. Peduncle sparsely and patently pilose with glandular and eglandular hairs. Basal leaves oblong-elliptic to ovate-oblong, 2-5 x 1-3 cm, margin crenulate, apex obtuse, cordate to subcordate at base, petiole 1.5-3 cm. Cauline leaves 1-2-paired, shortly petioled to sessile, 0.2-1.5 cm similar but smaller than basal leaves 0.5-2.5 x 0.3-1.5 cm. Floral leaves sessile to sessile, similar to cauline leaves, 1-3 x 0.4-1.5 cm, as long as or slightly longer than verticillasters. Indumentum on leaf sparsely pilose to \pm glabrescent, petiole patently pilose. Verticillasters 2-5, usually remote, 1-7 cm distant, 8-12-flowered. Bracts oblong-lanceolate, 3-6.5 mm, herbaceous. Pedicels 0.8-2 mm. Calyx subbilabiate, subcampanulate, 7-9 mm, softly pilose; teeth triangular-lanceolate, 2-2.5 mm, patently pilose with glands and/or glandular hairs. Corolla 12-14 mm, yellowish, tube subexserted. Nutlets obovoid, 2 x 1.2 mm. Fl. June-July. Habitat: Crevices of vertical limestone rocks, 1350-1524 m.

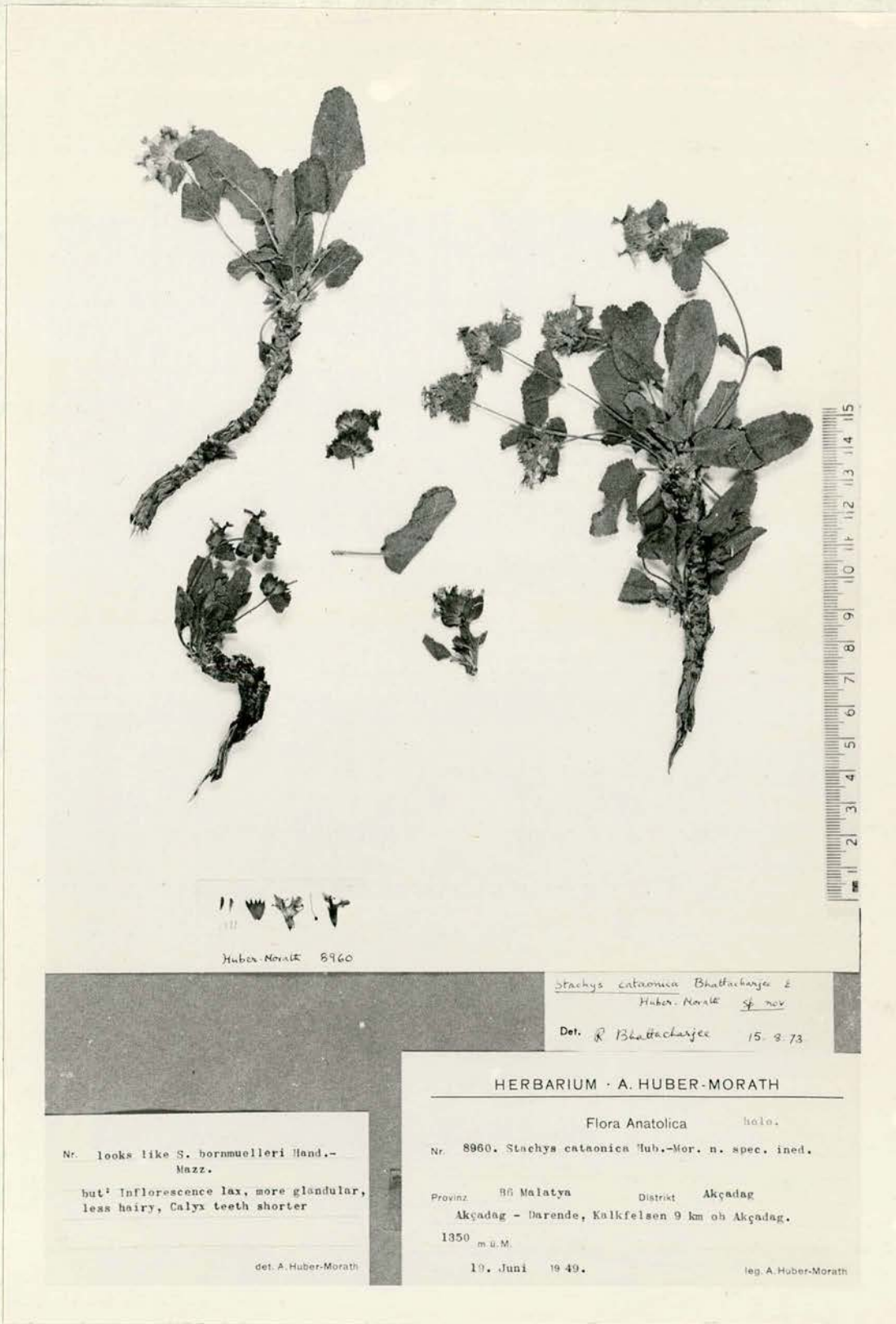
Type $\overline{\text{Turkey B6 Malatya}}$: Akçadag to Darende, Kalkfelsen 9 km ob Akçadag, 1350 m, 19.vi.1949, Huber-Morath 8960!

E. Anatolia

B6 Malatya: Darende to Akçadag, 1524 m, D. 21902! Kavak Avghatch (Akçadag) and Arga 16.7.1906, B. Post 891!

Endemic, Irano-Turanian element?

This new species is geographically separated from the rest of the species in Sect. Infrarogularis.

Pl. 16. *Stachys cataonica* Bhattacharjee & Huber-Morath (Holotype)

Although the closely related S. pumila (Taurus & Amanus) is a very variable species, it never has the indumentum characteristic of S. cataonica. From S. rupestris Mont. & Auch. ex Benth. the new species is distinguishable by its smaller calyx and bracts.

21. S. petrokosmos Rech. fil. in Sv. Bot. Tidskr. 43: 41 (1949).

(Map 15).

Suffrutescent perennial with sterile basal rosettes. Flowering stems (3-)-5-(8-) cm long, unbranched. Indumentum on stem patently pilose with short, glandular hairs. Basal leaves elliptic 2.5-4 x 1.8-2.2 cm, obscurely crenate, cordate at base, petiole 2-4 cm. Floral leaves subsessile to sessile, orbiculate to ovate, 0.7-1 x 0.4-0.8 cm, rounded to cuneated at base, as long as verticillasters. Verticillasters 2-3, remote, 4-6-flowered. Bracts linear-lanceolate, 3-4 mm, herbaceous to setaceous. Calyx sub-bilabiate, subcampanulate, 6-8.5 mm, densely pilose; teeth subequal, triangular-lanceolate, $\frac{1}{4}$ - $\frac{1}{3}$ as long as tube, densely glandular. Corolla 8-10 mm, yellowish in sicco, tube subexserted. Nutlets not found. Fl. June-July.

Habitat: Limestone cliffs, 1000-1300 m.

Type [Turkey C5 Hatay]: Mons Cassius, 1000-1300 m, June 1909, Haradjian 3086 (Hb. Del!).

Endemic, E. Mediterranean element.

No other specimen except the type has been found. The species shows affinity with S. rupestris Mont. & Auch. but is distinguished by having shorter flowering stems with 2-3 verticillasters, shorter calyx teeth and \pm included corolla tube.

22. S. amonica Davis in Kew Bull. 1951 (1): 108 (1951).

Syn: S. debilis Bornm. in Notizbl. Bot. Gart. Berlin 7: 35 (1917). non Humb. & Kunth (1817) nec Baker (1883). (Map 15).

Suffrutescent perennial with sterile basal rosettes. Flowering stems short, c. 5-10 cm. Indumentum short and sparsely adpressed-pilose, mixed with sessile glands and/or glandular hairs. Basal leaves oblong, 2-2.5 x 1-1.5 cm, margin obscure crenate, slightly subcordate at base, petiole 2-4 cm. Cauline and floral leaves sessile to subsessile, \pm similar to basal leaves, but gradually becoming shorter. Verticillasters 2-3, remote, 5-7-flowered. Bracts small, few, setaceous or herbaceous, linear to oblanceolate, 1.5-3 mm. Pedicels 1-2.5 mm. Calyx sub-bilabiate, campanulate, 5-6.5 mm, sparsely pilose to \pm glabrescent; teeth bluntly triangular to triangular-lanceolate, $\frac{1}{5}$ - $\frac{1}{4}$ as long as calyx tube. Corolla 11-12 mm, creamy-yellow, tube subexserted. Nutlets obovoid 0.7 x 0.5 mm. Fl. April-July.

Habitat: Cliffs and crevices of limestone and metamorphosed rocks, 330-2134 m.

Type [Turkey C6 Hatay]: Alexan-drette ("Harunje-Alexandrette") 200-400 m,

Meinsh 62

S. Anatolia (Amanus)

C6 Hatay: Kostelli Amanus Daglari, Alman 3581! Mons Amanus, region of Dildil, 1600-2200 m, Haradjian 2338!

Adana: dist. Bahçe, Dumanli Dağ near Haruniye, 900 m, D.26856!

Endemic. E. Mediterranean element.

This species is related to S. pumila Banks & Sol. and S. petrokosmos Rech. f., but differs from the former in having shorter flowering stems with 1-2-(3) verticillasters and sparsely pilose indumentum, and is distinguished from the latter in having adpressed-pilose \pm glabrescent stems and calyx tube and by the \pm

larger pedicel of the flower. D.26856 from Dumanli Dağ is somewhat exceptional from the rest having a \pm glabrescent plant body with few sessile glands and very sparse eglandular hairs; the calyx teeth are blunt and $\frac{1}{5}$ as long as tube and the bracts are longer.

23. S. pumila Banks & Sol. in Russell, Nat. Hist. Aleppo. ed. 2, 2: 255 (1794);

Ic. 10, op. cit. (1794)!

Syn: S. floribunda Mont. & Auch. in Ann. Sci. Nat. Ser. 2, 6: 49 (1836)!

S. pumila var. brachyodonta Boiss., Fl. Or. 4: 744 (1879)!

S. bornmulleri Hand.-Mazz. in Ann. Nat. Hofmus. Wien 27: 414 (1913)!

(Map 15).

Suffrutescent perennial with sterile basal rosettes. Flowering stems 25-35 cm, usually unbranched. Indumentum adpressed-tomentose, sericeous to greyish-white on leaf surface. Basal leaves oblong-elliptic, 0.5-5.5 x 0.3-3.5 cm, crenulate, apex obtuse, base cordate, petiole 0.8-4.8 cm. Cauline leaves orbicular to elliptic, 0.8-2.5 x 0.4-1.8 cm, subsessile to shortly petiolate, 0.2-2 cm. Floral leaves subsessile to sessile, \pm similar but smaller to cauline leaves, truncate to cuneate at base, as long as or slightly longer than verticillasters. Verticillasters remote or \pm approximate into a dense spike, the lower 1-2 remote, 0.5-3 cm distant, 6-10-flowered. Bracts oblong-lanceolate to linear, 3-6 mm, herbaceous to setaceous. Pedicels 0.6-2 mm. Calyx \pm regular, campanulate, 7.5-9 mm, adpressed-tomentose or glabrescent; teeth lanceolate-subulate, \pm half as long as the calyx tube, subrecurved. Corolla 12.5-14 mm, yellow, tube exerted. Nutlets oblong-ovoid, 1.5-2 x 0.8-1 mm. Fl. April-July. Habitat: Vertical limestone and conglomerate cliffs and crevices, 100-1650 m. Type: Hab. in Syria prope Aleppo, Russell (holo. BM!).

S. Anatolia (Amanus)

C6 Hatay: Antioch, Aucher 1701 (syntype of *S. floribunda*): d. Iskendurun:

7 miles N. of Iskendurun, 15 m, D.26944!

Adana: Osmaniye, N. Amanus, 1500-1650 m, Huber-Morath 15278!

Gaziantep: Tullup, 610 m, 27.vi.1865, Haussknecht (syntype of *S. bornmulleri*):

Maras: Maras to Göksun, near Söğükoluk Dağ, 600 m, D.27501!

Andirin, 8 km S. of Çatak, 800 m, Coode & Jones 1139!

Endemic (?) E. Mediterranean element.

The type of this species may well have been collected in Turkey between Iskendurun and Aleppo. Eig (1937) commented in his note that some of Russell's material had been gathered by other collectors besides the Russell brothers and included in their herbarium. Further collections outside Turkey may confirm its non-endemic nature in future. So far as the present investigation is concerned, all the certainly localised material has been collected within the political boundary of Turkey, including Mt. Cassius.

Montbret & Aucher (1836) previously separated the species *S. floribunda*, mainly on the shorter length of the calyx teeth. Later Boissier (1878) sunk it in *S. pumila* and called it var. *brachyodonta*. The distribution of these two varieties overlaps and no other characters are present to separate them. Later Handel-Mazzetti (1913) separated another species, *S. bornmulleri* Hand.-Mazz. from one of the syntypes of *S. pumila* var. *brachyodonta* (Haussknecht 27.vi.1865). He separated his species on shorter length of pedicels (0.5-0.8 mm), dense spicate inflorescence on elongated floral axis, and short setaceous bracts. This last mentioned character does not hold good in Haussknecht's specimen. At first his species as he described it from Gaziantep and Adiyaman seemed quite distinct, but additional material shows

considerable overlap in all the above mentioned characters.

Considering all this overlapping variability, separate treatment of either S. pumila var. brachyodonta or S. bornmulleri seems unjustified. This great amount of variability between the populations could be interpreted as due to rapid differentiation between small populations in restricted cliff communities.

Coode & Jones 1139 from Maras is somewhat exceptional, being glabrous throughout with very few sessile glands. This specimen grew in shady and moist rock, and its glabrescent nature may be ecotypic or environmentally induced. Additional may show that it deserved some formal infra-specific rank.

24. S. citrina Boiss. & Heldr. apud Benth. in DC., Prodr. 21: 490 (1848).

(Map 15).

Suffrutescent perennial with basal rosettes of sterile shoots. Flowering axis 30-35 cm, usually unbranched. Indumentum densely adpressed white-tomentose or rarely sparse, eglandular with few sessile glands. Basal leaves elliptical to oval or oblong 0.7-5 x 0.5-2 cm, margin faintly crenulate to subentire, apex obtuse, base attenuate to cuneate, petiole 1.5-3.5 cm. Cauline leaves shortly petiolate, similar to basal, 1.5-3 x 0.5-1.2 cm. Floral leaves sessile, oblong spatulate to oblong, sometimes ovate 1-2.5 x 0.5-1 cm, entire, obtuse, cuneate, shorter than verticillasters. Verticillasters \pm approximate into dense head, rarely 1-2 remote below, 6-8-flowered. Bracts linear-lanceolate 7-10 mm, as long as calyx tube. Calyx \pm regular, sub-campanulate, 11-15 mm; teeth subequal, erect $\pm \frac{1}{3}$ as long as tube, herbaceous to softly spinescent tipped. Corolla 20-25 mm, lemon-yellow, tube subexserted. Nutlets obovoid 1.5-2 x 1 mm. Fl. June-September.

Habitat: Screes and cliffs (mainly limestone), 1500-2600 m.

Key to subspecies:

1. Indumentum densely white-tomentose; calyx teeth short triangular,
 $\frac{1}{2}$ - $\frac{1}{3}$ as long as tube subsp. citrina
 1. Indumentum sparsely tomentose; calyx teeth triangular-
 lanceolate, $\pm \frac{1}{2}$ as long as tube subsp. chamaesideritis
- subsp. citrina

Type $\sqrt{\text{Turkey C4 Antalya}}$: In regione alpina inter Anemas Lycaoniae et
 Gheidagh $\sqrt{\text{Geyik Dag}}$ Isauriae, Heldreich (iso. E!)

S. Anatolia

C3 Isparta: Sütcöller (Isauria). Dedegöl da, 2200-2400 m, D.15962!

C4 Antalya: Ak Dag, S. of Geyik Dag, 2200-2300 m, D.14346!

C5 Niğde: Bulgar Maden, Siehe 1896: 522!

Endemic. E. Mediterranean element.

subsp. chamaesideritis (Boiss.) Bhattacharjee, stat. nov.

Syn: S. chamaesideritis Boiss. & Bal. in Boiss. Diagn. Ser. 2, 4: 41
 (1859)

S. citrina Boiss. var. chamaesideritis Boiss., Fl. Or. 4: 744 (1879)

Syntypes $\sqrt{\text{Turkey B5 Kayseri}}$: in regione alpina superiore montis Aslandach
 Cappadociae Balansa (G!); $\sqrt{\text{B6 Maraş}}$ monte Beryt dagh Cataoniae, 2438 m,
Haussknecht

S. and adjacent C. Anatolia

B6 Maraş: distr. Çardak, Berit Dag, 2300 m, D.20283!

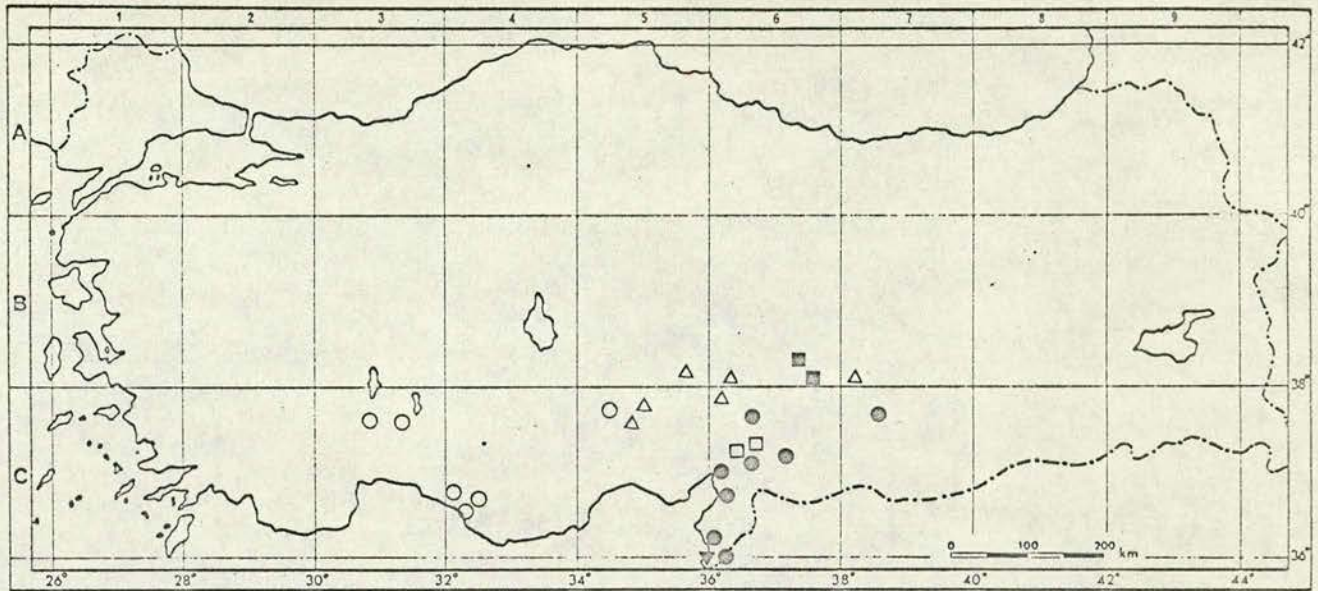
B7 Malatya: Koru ~~Yaylası~~ to Dedeyazi K., Pesmen 1058!

C5 Niğde: Maden river valley, Darrah 284! Ala Dağları on Dimirkasyk,

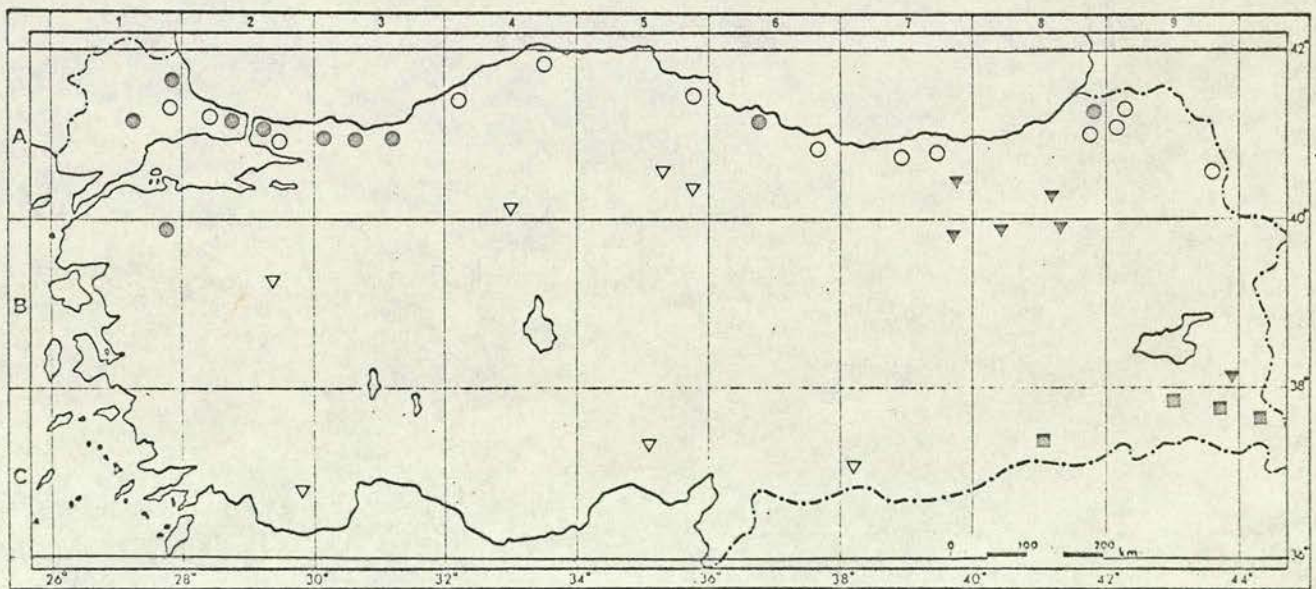
Findlay 209!

Endemic. E. Mediterranean element.

S. citrina Boiss. is distinct from other related species of the section Infrarosularis in having narrowly elliptic leaves with attenuate to cuneate base, verticillasters \pm approximate into a dense head, longer calyx and brighter lemon-yellow coloured corolla. Findlay 209 from Nigde is an exception from the rest of the subspecies chamaesideritis having broadly ovate to elliptic-orbicular leaf with cordate base. The pollen grains are all found sterile. This striking variation may probably be due to the process of hybridization.



Map 15. \blacksquare *S. cataonica*; \blacktriangledown *S. petrokosmos*;
 \square *S. amanica*; \bullet *S. pumila*;
 \circ *S. citrina* ssp. *citrina*; \triangle ssp. *chamaesideritis* .



Map 16. \bullet *S. palustris*; \circ *S. sylvatica*;
 \blacksquare *S. menthoides*; \blacktriangledown *S. setifera* ssp. *setifera*;
 \blacktriangledown ssp. *lycia* .

Sect. SETIFOLIA (p. 117)25. S. setifera C.A. Mey., Verz. Pfl. Cauc. 94 (1831)Syn. S. lycopsiformis C. Koch in Linnaea, 21: 692 (1848).S. bornmulleri Gandoger in Bull. Soc. Bot. Fr. 65: 68 (1918) non
Hand.-Mazz. (1910) (Map 16).

Herbaceous perennial with creeping rhizomes. Flowering stems 35-60 cm, usually simple, sometimes branched. Indumentum patently pilose to sub-patently or retrorsely adpressed-tomentose, sparse to dense, rarely glabrescent below. Lower cauline leaves ovate-lanceolate to oblong-lanceolate, 4-10 x 1-4.5 cm, serrate to serrate-dentate, sometimes subentire, truncate to rounded at base, apex acute, petiole 0.5-1 cm. Median cauline leaves similar to lower cauline ones but smaller, mucronate-tipped, subsessile to sessile. Floral leaves subsessile to sessile, ovate to ovate-lanceolate, 1-4.5 x 0.7-1.5 cm, subentire to serrate, cuneate at base, mucronate tipped. Verticillasters 4-6-flowered, remote, 1-3 cm distant, few, \pm approximate above. Bracts oblong-lanceolate to linear-lanceolate, 1.5-4 mm, herbaceous, mucronate at tip. Pedicels 0.2-0.8 mm. Calyx sub-bilabiate, subcampanulate, 7-9.5 mm; teeth subequal, oblong acuminate, half as long as tube, recurved in fruit; micro 1.2-1.5 mm. Corolla 10.5-12 mm, pink, tube subexserted, saccate towards base. Stamens little exserted from corolla tube. Nutlets bluntly trigonous 1.3-2 mm, smooth, apiculate with prominent ventral ridge. Fl. May-August.

Key to subspecies

1. Stem sparsely and retrorsely adpressed-pilose to pubescent; median cauline leaves usually narrowly oblong-lanceolate with weakly crenate-serrate to subentire margin subsp. setifera

1. Stem densely and patently pilose; median cauline leaves usually broadly ovate-oblong to ovate-elliptic with distinctly serrate margin subsp. lycia

Subsp. setifera

Syn. S. daenensis Gandoger in Bull. Soc. Bot. Fr. 65: 68 (1918)!

S. sintenisii Gandoger loc. cit. (1918)!

S. shirini Parsa in Kew Bull. 1948, 226 (1948)!

S. iranica Rech. fil. in Ost. Bot. Zeit. 99: 44 (1952)!

Habitat: By stream side and in damp places. 1900-2450 m.

Type: [Caucasia] In locis subhumidis montium Tulusch [Talysch] prope Swant (alt. 670 hexap) Meyer.

E. Anatolia

A7 Gümüsane, Ketschikale, Sintenis 1894: 6100 (type of S. sintenisii Gand.)!

A8 Erzurum: Erzurum to Tortum, 39 km N. of Erzurum, 1980 m, Huber-Morath 15284!

B7 Erzincan: Keşiş Dag above Cimin, 2450 m, D.31820!

B8 Erzurum d. Askale: Erzurum to Erzincan, 1900 m, Huber-Morath 15285!

B9/10 Van: Baskale, Layard s.n.

External distribution: Transcaucasia, Iran, Afghanistan, Irano-Turanian element.

Subsp. lycia (Gandoger) Bhattacharjee, subsp. et stat. nov.

Syn: S. lycia Gandoger in Bull. Soc. Bot. Fr. 65: 68 (1918)!

Habitat: By stream side, damp plains at base of mountains, 750-1400 m.

Type: [Turkey C2 Antalya] Elmalu (Elmali), secus rias et fossas, 17.vii.1860,

Bourgeau 220!

C., S. and E. (Mesopotamia) Anatolia.

A4 Ankara, d. Kalecik, Ankara to Kalecik, 1100 m, Huber-Morath 15283!

A5 Amasya: Pontus Galacticus, m.m. Sana-Dagh, 12-1400 m, Bornmüller 1890: 2831!

Tokat: Pontus australis, al. Sileh, Bornmüller, 1890: 2868!

B2 Kütahya: d. Gediz, Şaphane, 1000 m, D. 18481!

Endemic Irano-Turanian element.

This species shows a wide range of morphological variability in leaf shape, indumentum and habit. In overall resemblance it has close affinity with S. menthoides, from which it mainly differs in its more hairy indumentum and loose and remote verticillasters. Subspecies lycia was originally treated as a species by Gandoger (1918), together with some other species like S. sintenisii, S. daenensis and S. bornmülleri and described in a dichotomous Latin key. The types of all these species, except S. bornmülleri, have been examined by me and I have no doubt that they belong to the variable species S. setifera s.l. Considering some other W. and C. Anatolian material, S. lycia seems to deserve a formal subspecific rank, while the other species have been sunk under the typical subspecies.

26. S. menthoides Kotschy & Boiss. ex Boiss., Fl. Or. 4: 727 (1878). (Map 16).

Herbaceous perennial with creeping rhizomes. Flowering stems 20-65 cm, usually branched above. Stems and leaves glabrous with few sessile glands. Lower leaves ovate-lanceolate 4-9 x 1-4 cm, serrate, apex acuminate, truncate to cuneate at base, subsessile to shortly petioled, petiole 0.5-1 cm. Floral and median cauline leaves similar but with mucronate tip, subsessile to sessile. Verticillasters 4-6-flowered, \pm approximate at apex, few remote below. Bracts lanceolate to linear 1.5-4 mm, herbaceous, mucronate-tipped hirsute.

Pedicels 0.2-0.5 mm. Calyx sub-bilabiate, subcampanulate, 7-9 mm; teeth subequal, oblong-acuminate, mucronate, recurved; tube hairy. Corolla 10-12 mm, pink, tube subexserted, saccate. Nutlets bluntly trigonous, 1.3 x 2 mm, apiculate, ventral rib prominent. Fl. June-September.

Habitat: Stream sides or damp and moist places, 1550-2300 m.

Type: Turkey B8 Mus Hab. Armeniae Turcicae australis prope Gümüş ad pagum Gestemert, 1550 m, Kotschy suppl. 680!

E. (mainly S.E.) Anatolia.

B9 Van d. Satak: Kavussahap Dağ, 2134 m, D.23040!

C8 Mardin: Binibill, Sintenis 1888: 1204!

C9 Hakkari: Koçanis, 2286 m, D.24307a!

C10 Hakkari: Gevar ovasi 2-3 km from Yüksekova, 1950 m, D.45781!

Duncan & Tait 191!

Endemic. Irano-Turanian element.

Specimens D.45781 and Duncan & Tait 191 from Hakkari are somewhat different from the rest. Both of them have remote verticillasters and the latter has a more trailing habit.

Sect. STACHYS (p. 118)

27. S. sylvatica L., Sp. Pl. 580 (1753)

Syn: S. canariensis Jacq., Ic. Pl. Rar. 1: 11 t. 108 (1781)

S. cordata Gilib., Fl. Lituan. 1: 80 (1781)

S. glaucescens Mussin. ex Spreng., Syst. 2: 736 (1825)

S. foetida Gueldeust. ex Ledeb., Fl. Ross. 3: 413 (1846-51)

S. trapezuntea Boiss., Diagn. Ser. 2(4): 38 (1859) (Map 16).

Fl. June-September.

Habitat: Woodlander in damp soil, gravelly slopes and edge of forests, sea level to 2438 m.

Type: Described from Europe (Hb. Linn. 736.1!)

Mainly N. Turkey.

A1(B) Kirklareli: Istranca Dağ, Demirkoy to Iğneada, Kayacik 8!

A2(A) Istanbul: Adampol, 22.viii.1939 B. Post!

A4 Kastamonu: Kure Nahas at Erşchewit, Sintenis 1892: 5141!

A5 Amasya: Merzifon, 1900 m, Manissadjian!

A7 Trabzon: above Trabzon on Zigana Pass, Jenkins 2265!

Giresun: 10 km N. of Tandere, 1400 m, Huber-Morath 15290!

A8 Rize: Hemsin, Cat to Meydan Kobaca, 1100-1300 m, D.21214!

A9 Çoruh (Artvin): Yalnizcan Da 2438 m, Tong 442!

External distribution: Throughout Europe, Caucasia, Russia towards E. Asia and N. America. Euro-Siberian element.

This widely distributed species (in Turkey confined to the Euxine province) is very uniform in its morphological characters. S. trapezuntea Boiss. (described from Trabzon) has been kept distinct in Fl. URSS 21 (1954), but as the diagnostic characters of the above species, such as scabrid stem and

smaller bracts and calyx with smaller aristae, break down in N. Anatolia, it is treated here as a synonym of S. sylvatica, as indeed it was in Boissier's Fl. Or. 4 (1879). The nearest relative of the species is S. palustris L., from which it differs in the shape of leaf and indumentum.

28. S. palustris L., Sp. Pl. 580 (1753)

- Syn. S. angustifolia Gilib., Fl. Lituan. 1: 80 (1781) nom. invalidum
S. velutina Schwein. in Long Exped. Winneb. 2: 390 (1825)
S. affinis Bunge, Enum. Pl. Chin. Bor. 51 (1831)
S. baicalensis Fisch. ex Benth., Lab. Gen. et Sp. 543 (1834)
S. wolgensis Vilensky, Coll. Rec. St. Planning Comm. 1: 38 (1926)
S. maotica Postr. in Ukr. Bot. Zhurn. 7(2): 63 (1950) (Map 16).

Fl. June - October.

Habitat: Woodlander of damp places, at the edge of forest. Sea level to 1100 m.

Type: Described from Europe (Hb. Linn. 736.2!)

N. Turkey

A1(E) Edirne: between Ipsala and Greece frontier, A. Baytop 13599!

A2(E) Istanbul: Büyükdere, 16.ix.1894, Aznavour 1771!

A3 Sakarya: between Adapazare and Karasu, A. Baytop 18580! Arifiye, 30 m,
D.36277!

A6 Samsun: at Balik Göl near Bafra, 6.ix.1954, D.24978b

A8 Çoruh (Artvin): Savval Tepe above Murgul, 1100 m, D.32380!

This Eurasian-N. American species (in Turkey confined to the Euxine province) is related to S. sylvatica in the general habit, inflorescence, calyx and corolla structure. The Turkish specimens are \pm uniform in their characters. D.32380 and D.24978b from Artvin and Samsun are slightly different

from the rest in having shorter calyces (c. 5-6 mm). The hybrid between S. palustris and S. sylvatica is widespread throughout the range of distribution, but has not been reported from Turkey.

Sect. FRAGILICAULIS (p. 224)

29. S. longiflora Boiss. & Bal. in Boiss., *Diagn. Ser.* 2 (4): 39 (1859) (Map 17).

Suffrutescent pendant perennial. Flowering stems pendant, 44-50 cm, fragile at base. Indumentum subdensely and patently pilose with glandular and eglandular hairs. Cauline leaves ovate to ovate-orbicular, 3-6 x 2.5-5.5 cm, margin broadly dentate, apex acute, cordate at base, petiole 3-4.5 cm. Floral leaves similar but smaller, cuneate to truncate at base, subsessile to shortly petiolate, petiole 2-9 mm. Verticillasters remote, 0.7-1.2 cm distant, 2-flowered, ebracteate. Pedicels 1-3 mm. Calyx \pm regular, infundibuliform, 10-13 mm, teeth \pm equal, \pm half as long as tube, softly spinescent, macro 0.5-1 mm. Corolla 22-32 mm, purple, tube exerted, exannulate. Nutlets oblong-elongate, trigonous, 3 x 1.5 mm. Fl. October.

Habitat: Mouth of limestone caves.

Type [Turkey C5 Icel] Hab. in speluncis faucis Güzul Deré supra Sedichig in Cilicea littoralis prope Mersina, 2.10.1855, Balansa 598 (holo. G! Iso. E!)

Endemia: E. Mediterranean element.

This species shows affinity with S. yeni-yurukensis but differs from it in having 2-flowered verticillasters that are 0.7-1.2 cm distant, and longer (22-32 mm) purple corollas.

30. S. euadenia Davis in *Kew Bull.* 1951: 110 (1951) (Map 17).

Suffrutescent saxatile perennial, woody at base. Flowering stems pendant, 12-30 cm, fragile at base. Indumentum sparsely and patently pilose with

glandular and eglandular hairs. Cauline leaves ovate-orbicular, 2.9-4 x 2.6-3.8 cm, broadly dentate-crenate to undulate crenate, apex obtuse, cordate at base, petiole 0.5-5 mm. Floral leaves similar but smaller, subsessile to sessile, apex acute, cuneate at base, smaller than verticillasters above. Verticillasters remote, 4-6-flowered. Bracts usually absent, rarely present, few, herbaceous and linear, c. 3-5 mm. Pedicels 1-2 mm. Calyx \pm regular, infundibuliform, 6-7 mm; teeth \pm equal, $\frac{1}{2}$ to $\frac{1}{4}$ as long as calyx, herbaceous with softly spinescent tip. Corolla 12-17 mm, purplish, tube subexserted or exserted, exannulate. Nutlets elongate, trigonous, 3 x 1.25 mm, apiculate. Fl. June-August.

Habitat: Limestone cliffs and crevices. 1230-1700 m.

Type [Turkey C4 Konya]: d. Ermenek (Cilicia Trachea); Hamitseydi Boğaz between Sarivadi and Beşkuyu, 16.8.1949, 1500-1700 m, Davis 16228 (holo. K! Iso. Edin.! BM!).

S. Anatolia

C4 İçel d. Gölner: Gölner to Ermenek, 1230-1270 m, Huber-Morath 10140!

Endemic. E. Mediterranean element.

This species shows affinity with S. longiflora and S. pinardii but is readily distinguished from both of them in its shortly petioled to subsessile (0.5-5 mm) cauline leaves and broadly dentate-crenate to undulate leaf margin. Gynodioecism associated with reduction in length of corolla tube has been found in the isotype material D.16228.

34. S. pinardii Boiss., *Diagn. Ser.* 1(5): 29 (1844) (Map 17).

Suffrutescent perennial. Flowering stems 20-30 cm, pendant, fragile,

unbranched. Indumentum sparsely and patently pilose to hispid, glandular and eglandular. Cauline leaves ovate, 2.5-6 x 1.8-4.5 cm, narrowly crenate to crenate-dentate, apex obtuse, cordate at base, petiole 1-4 cm. Floral leaves shortly petiolate to subsessile or sessile, similar to cauline leaves but smaller, cuneate at base, smaller than verticillasters upwards.

Verticillasters few remote below, rest \pm approximate above, forming dense spike, 4-10-flowered, ebracteate. Pedicels 1-2 mm. Calyx \pm regular, infundibuliform, 8.5-11 mm; teeth triangular to ovate-triangular, $\pm \frac{1}{3}$ as long as tube, tip spinescent; mouth sparsely hairy. Corolla 13-18 mm, white, tube exserted, annulate, upper and lower lips 8 and 4 mm respectively. Nutlets obovoid, 2.5 x 1.5 mm, apex round. Fl. April-July.

Habitat: In limestone cliffs and crevices, 220-300 m.

Type [S.W. Turkey] Hab. in rupestribus Cariae littoralis Pinard (holo. G!) aut insulae Rhodi, April 1832, Pinard (fide Boiss.)

S. Anatolia

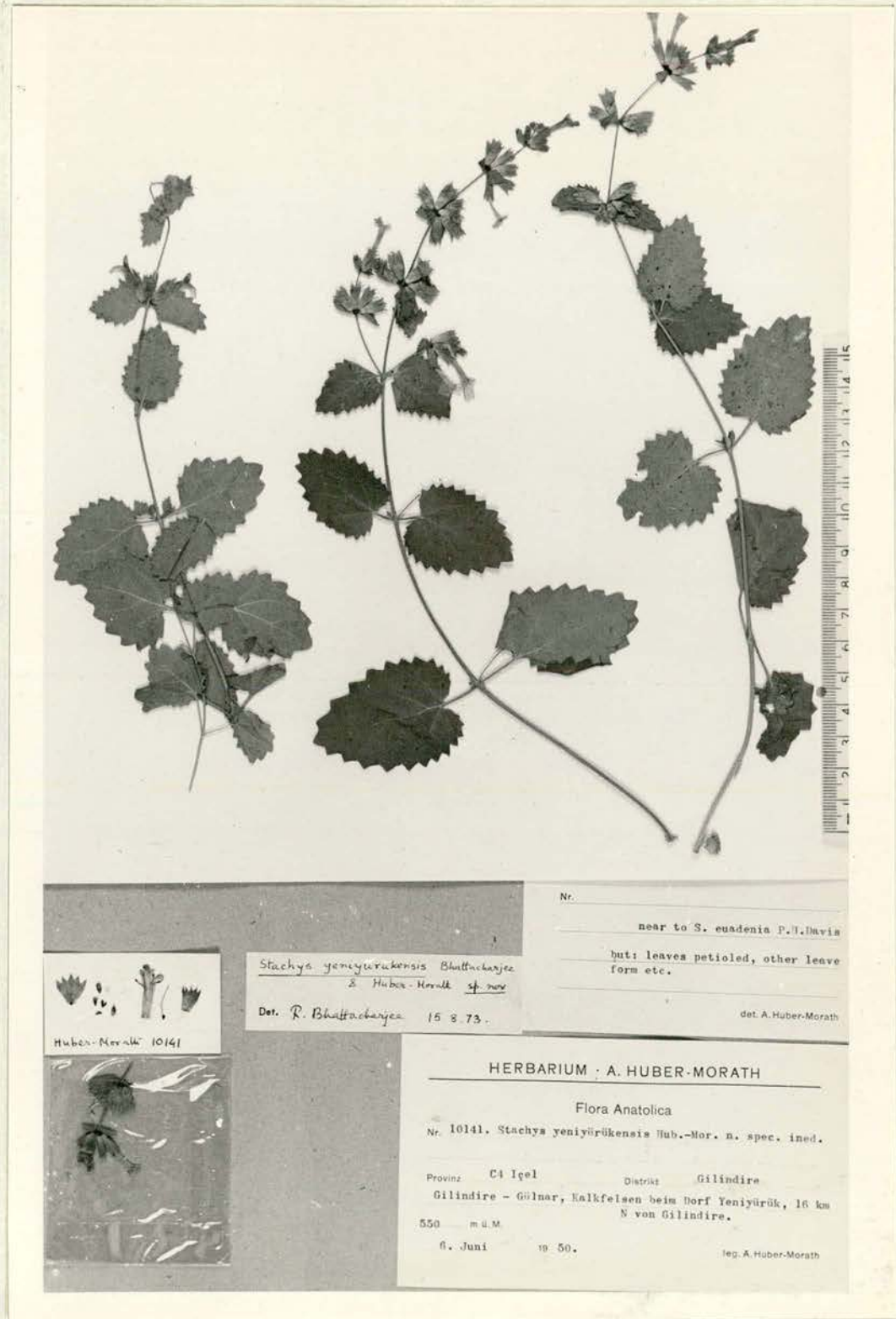
C3 Antalya: 5 km N.W. of Dosemealte, 300 m, Hennipman 509! Burdur: 30 km from Antalya A, 220 m, Dudley, D.35700!

Endemic. E. Mediterranean element.

This species is related to S. yenyurukensis but differs from it in having densely spicate inflorescences, stouter stems, and shorter calyx teeth.

32. S. yenyurukensis Bhattacharjee & Huber-Morath, sp. nov. (Map 17).

Affinis S. longiflorae Boiss. et S. pinardii Boiss.; a priori verticillastri 4-6-floris \pm 2 cm distantibus differt, ab altera inflorescentia laxa labiis corollae minoribus recedit.



Pl. 17. *Stachys yeniyrükensis* Bhattacharjee & Huber-Morath (Holotype)

Suffrutescent perennial, woody at base. Flowering stems slender, 30-55 cm, pendant, fragile at base, \pm simple with few branches, sparsely and patently pilose with glandular and eglandular hairs. Cauline leaves ovate to ovate-orbicular, 1-5 x 0.8-4.5 cm, margin crenate-dentate to dentate, apex \pm obtuse, cordate at base, thin and herbaceous with sparsely pubescent to glabrescent surface, petiole 2-5 cm. Floral leaves ovate, 0.5-3 x 0.4-2.8 cm, dentate, apex acute, cordate to cuneate at base, shortly petiolate to sessile 0.2-1.2 cm, gradually shorter than verticillasters above. Verticillasters remote, 1-3.5 cm apart, rest 2-3 approximate above, ebracteate. Pedicels 2-2.5 mm. Calyx sub-bilabiate, subcampanulate, 9.5-10.5 mm, c. 12 mm in fruit, herbaceous, sparsely hairy to glabrescent; teeth unequal, triangular, softly spinescent tipped, upper and lower teeth 1.5-2.5 and 3-4 mm respectively, \pm half as long as tube; mouth straight and glabrescent. Corolla 20-22 mm, white, tube exserted, exannulate, upper and lower lips 5 and 3 mm respectively. Nutlets elongate, trigonous, 3 x 1.6 mm, apex round. Fl. May-June.

Habitat: Limestone gorges and crevices, 50-550 m.

$\sqrt{\text{Turkey}}$
Type/ $\sqrt{\text{C4 Içel}}$: Gilindire, Gilindire-Gülner, Kalkfelsen beim Dorf Yeniyürük, 16 km N. Von Gilindire 550 m, 6. vi. 1950, ¹⁰¹⁴¹Huber-Morath (holo. hb. Huber-Morath, Basel!).

S. Anatolia

C4 Içel: Kesliturkmenli, \pm 65 km S.W. of Mersin, 50 m, Hennipman 1075!

Endemic. E. Mediterranean element.

33. S. glechomifolia Nábělek in Publ. Fac. Sc. Univ. Masaryk Brno. 70: 61 (1926)
(Map 17).

Suffrutescent perennial. Flowering stems 10-60 x 0.15-0.25 cm, usually

erect sometimes pendant, fragile at base, simple or branched, densely foliate from base above. Stem indumentum usually densely and patently pilose (c. 1-2 mm) with long eglandular and short glandular hairs, sometimes sparsely pilose towards base. Cauline leaves usually broadly ovate, few rotund at base, 0.5-3 x 0.4-2.8 cm, margin crenate-dentate, rarely undulated, apex acute, few obtuse, cordate to subcordate at base, petiole 0.1-0.3-(0.6) cm. Floral leaves sessile to sessile, similar but smaller than cauline leaves, usually larger than the verticillasters, few as long as calyces. Leaf indumentum tomentose on both surfaces. Verticillasters usually remote throughout, rarely few approximate above, 1-3.5 cm apart, (2)-4-8-flowered. Bracts lanceolate to linear-lanceolate, 2-12 mm, herbaceous, pilose, not spinescent at tip. Pedicels 1-3 mm. Calyx ± regular, tubular to infundibuliform, 7-14 mm, glandular pilose; teeth subequal, triangular = lanceolate, half as long as tube, sometimes as long as tube, tip not spinescent. Corolla 16-20 mm, yellowish, tube exerted, annulate. Nutlets obovate, trigonous, 2.5 x 1.5 mm, slightly winged at margin, more frequently near the base, apex slightly retuse. Fl. May-July.

Habitat: Sloping limestone rocks and cliff crevices, 450-1500 m.

Type Turkey C9 Hakkari: Crescit in Kurdistaniae Turcicae distr. Hakkari: mons Choarra-Sia prope pagum Hasitha dit. Gulamerik, in fissuris, rupium calcar, alt. ca. 1500 m, 16.vi.1910, Nábělek 1551 (holo. Bratislava Photo!, iso. (fragments) E!).

E. & S.E. Anatolia

B7 Malatya: Malatya to Arabkir, 69 km N. of Malatya, 780 m, Huber-Morath 8961!

C8 Mardin: 4 km E. of Mardin, 1200 m, D.28575! Mt. Notre Dame, Sintenis 1888:

1135! Siirt: Gorge of Botan Çay, S. of Siirt, 450 m, D.43056!

Endemic. Irano-Turanian element.

This widely variable species is closely related to S. fragillima but differs from it in having \pm subsessile (petiole c. 1-6 mm), ovate cauline leaves with crenate-dentate margin, usually shorter yellow corolla and nutlets usually without prominent marginal wings and deeply notched apex. Besides these, the species shows transitions between pendant and erect habit, while S. fragillima is always pendant. The type specimen from Hakdari is a depauperate form of the species, having about 10 cm long flowering stems, 2-4-flowered and few verticillasters, and calyx about $\frac{1}{3}$ as long as the corolla. The rest of the specimens have shorter corollas and larger calyces, the ratio being 3:4, and the verticillasters usually with 6-8 flowers.

34. S. brantii Benth. in DC., Prodr. 12: 463 (1848).

Syn. Betonica brantii (Benth.) Boiss., Fl. Or. 4: 750 (1879).

Perennial. Flowering stems erect, c. 30 cm, simple. Indumentum densely and patently pilose with large eglandular and short glandular hairs. Cauline leaves ovate, 3.4-5 x 2-3 cm, crenate-dentate, apex acute, cordate to subcordate at base, petiole 0.2-0.4 cm. Floral leaves subsessile to sessile, similar but smaller than cauline leaves, 2.5-3.2 x 1.5-1.8 cm, longer than verticillasters. Verticillasters congested into a dense and globose head 6-10-flowered. Bracts linear-lanceolate, 5-12 mm, herbaceous, pilose with soft, non-spinescent tip. Pedicels 0.5-1.5 mm. Calyx \pm regular, tubular to infundibuliform, 12-14 mm, herbaceous; teeth subequal lanceolate-subular, as long as tube, herbaceous, not spinescent tipped, recurved at maturity. Corolla 16-18 mm, sulphur yellow, tube exserted. Nutlets oblong 2.2 x 1.3 mm, slightly winged at base.

Type [Turkey] Hab. in Kurdistania, Brant (holo. K!).

Endemic. Irano-Turanian element.

No specimen except the type has been examined. The species is very close to S. glechomifolia from which it differs in the presence of larger c. 5 x 3 cm leaves, densely spicate inflorescence and recurved calyx teeth. The exact spot of collection in Turkey could not be traced out but the expedition map of Brant's journey in Kurdistan shows that he collected mostly in S.E. Anatolia within the boundary of modern Turkey.

35. S. megalodonta Hausskn. & Bornm. ex Davis subsp. mardinensis Bhattacharjee, subsp. nov. (Map 17).

A typo caulibus dense foliosis, foliis minoribus brevius petiolatis, verticillastris minus distantibus recedit.

Suffrutescent perennial. Flowering stems 12-30 cm, erect to pendant, fragile at base, branched. Indumentum short, sparsely or densely retrorse-pubescent with eglandular hairs and sessile glands. Cauline leaves ovate to ovate-lanceolate, 0.5-2.8 x 0.4-1.9 cm, crenate-dentate, apex acute rarely obtuse, subcordate to cuneate at base, petiole 0.2-0.5 cm. Floral leaves subsessile to sessile, similar to but smaller than cauline leaves, as long as or larger than verticillasters. Verticillasters remote, 1-2.5 cm apart, 6-8-flowered. Bracts linear to lanceolate, 3-8 mm, herbaceous, pilose, not spinescent at tip. Pedicels 1-2 mm. Calyx \pm regular, tubular to infundibuliform, 9-12 mm, sparsely pubescent; teeth lanceolate-subulate, herbaceous, not spinescent tipped, \pm as long as the tube. Corolla 12-15 mm, yellow, tube subexserted. Nutlets oblong, trigonous, 2.2 x 1.3 mm, slightly winged near base. Fl. June-August.

Habitat: Sloping limestone rocks and cliff crevices, 1000-2550 m.

Type [Turkey C8 Mardin]: Mardin: Khurs in parietibus rupium, 13 vi.1888,

Sintenis 1030 (holo. Ld!).

S.E. Anatolia

B8 Bitlis: Kamboş Dağ above Hürmüz, 1524 m, D. 23448! and Southern slope of
Kamboş Dağ above Tutu, 1000 m, McNeill 613!

C8 Mardin: between Diyarbakir and Mardin, 7.vi.1971, A. & T. Baytop 20069!

C9 Hakkari: Elkiyayala Dağ, above pass between Marunis and Beytüşşebap,
2550 m, D.45342!

Endemic. Ireno-Turanian element.

With the discovery of this subspecies, S. megalodonta is recorded from Turkey for the first time. The Turkish species is distinguished from subsp. megalodonta (from N. Iraq d. Erbil) in having smaller leaves with shorter petioles, densely foliate flowering stems and verticillasters 1-2.5 cm apart throughout. Subsp. mardinensis is somewhat intermediate between S. glechomi-
folia and S. megalodonta subsp. megalodonta, and is partly sympatric with the former.

36. S. ballotiformis Vatke in Bot. Zeit. 33: 445 (1875).

Syn. S. plebeia Vatke 1 c. (1875).

S. benthamiana Boiss. var. clinopodioides Boiss., Fl. Or. 4:
735 (1879). (Map 18).

Suffrutescent perennial. Flowering stems erect, 18-50 cm, simple or with few branches above, fragile towards base. Indumentum sparsely and retrorsely pubescent, usually eglandular. Cauline leaves ovate to ovate-lanceolate,

0.7-2 x 0.4-1.5 cm, serrate-dentate, acute, truncate to subcordate at base with 2-10 mm long petiole. Floral leaves subsessile to sessile, lanceolate, 0.7-1.8 x 0.45-0.7 cm, subentire to entire, cuneate at base, \pm longer than verticillasters. Verticillasters 1-2 remote below, the rest \pm approximate above, 4-8-flowered. Bracts few, 1-2 mm, setaceous, glabrescent. Pedicels c. 2 mm. Calyx \pm regular, campanulate, 7-11 mm; teeth lanceolate, \pm half as long as tube, rigid, with curved mucicous tip, margin eglandular. Corolla 15-17 mm, lemon yellow, tube subexserted, annulate. Nutlets oblong, trigonous, 2 x 1.4 mm. Fl. March-July.

Habitat: Limestone cliffs and crevices, and on rocky slopes, 1160-2600 m.

Type [Iran]: In montibus Pir Omar Gudrun Kurdistaniae Persicae, 1219 m, June 1867, Hausknecht 805 (holo. MW, iso. G!).

S.E. Anatolia

C9 Mardin: Cudi Dağ above Hessana, 1200-1400 m, D.42843!

C10 Hakkari: Sat Dağı between Vargöz and Sat Gölü, 2400-2600 m, D.45635!

External distribution: W. Iran, N. Iraq. Irano-Turanian element.

This species has affinity with S. benthamiana Boiss. but differs from it in not having glandular hairs on calyx and stem, and in the verticillasters being congested upwards into a dense head.

37. S. kurdica Boiss. & Hohen. in Boiss., *Diagn. Ser.* 1 (5): 31 (1844)

Syn. S. subnuda Mont. & Auch. var. kurdica Boiss., *Fl. Or.* 4: 734 (1879)!

S. benthamiana Boiss. sensu Hand.-Mazz. in *Ann. Nat. Hofmus. Wien.*

27: 414 (1913) non Boiss. (1879) (Map 18).

Suffrutescent perennial. Flowering stems 18-36 cm, erect, branched above. Indumentum sparsely pubescent or sometimes glabrous with sparsely glandular hairs. Cauline leaves oblong-lanceolate to lanceolate, 0.6-4.6 x 0.25-0.8 cm, weakly serrate-dentate to subentire, apex acute, subcordate to cuneate at base, with 0.2-0.7 cm long petiole. Floral leaves similar but smaller, shortly petioled to sessile, lower leaves larger than verticillasters, gradually becoming smaller than calyx above. Verticillasters remote, (2)-4-(8)-flowered. Bracts few, setaceous, c. 2 mm. Pedicels 2-3 mm. Calyx \pm regular, infundibuliform, 10-11 mm, herbaceous; teeth subequal, broadly triangular to oblong lanceolate with \pm obtuse mucicuous apex, as long as or slightly shorter than tube, rarely half as long. Corolla 14-15 mm, yellow, subexserted. Nutlets 2.5 x 1.5 mm. Fl. March-July.

Key to varieties :

1. Calyx teeth broadly triangular, $1/5-1/4$ as long as tube var. brevidens
1. Calyx teeth broadly oblong-lanceolate, as long as or slightly less than the tube var. kurdica

var. kurdica (Map 18).

Habitat: Steep sandstone or limestone slopes, or on cliffs and crevices, 762-1350 m.

Type $\sqrt{N. Iraq/W. Iran}$: Hab. in rupibus montis Gora Kurdistaniae 10.viii.1841, Kotschy 390 (holo. G! iso. K!).

S.E. Anatolia

B9 Van: 8 km N. of Satak, 22.vii.1954, D.22977!

C9 Hakkari: Çukurca, 1200 m, D.44766B

External distribution: N. Iraq, W. Iran. Irano-Turanian element.

var. brevidens Bornm. ex Bhattacharjee, var. nov. (Map 18).

A typo calycis dentibus late triangularis, tubum valde ($1/5-1/4$) brevioribus divergit.

Habitat: Limestone gorges and rock crevices, 1200-3800 m.

Type [N. Iraq]: Kurdistania: Riwandous (ad fines Pers.) in m. Sakri Sakran reg. aysrna, 2200 m, 23.vi.1893, Bornmiller 1670 (K! LD!).

S.E. Anatolia

C9 Hakkari: Zap gorge beneath Hakkari, 1250 m, D.45361!

External distribution: N. Iraq. Irano-Turanian element.

S. kurdica is closely allied to S. subnuda from which it differs in having oblong-lanceolate median cauline leaves and broadly triangular/^{to}oblong-lanceolate, herbaceous and unrigid calyx teeth with blunt obtuse apices. Var. brevidens apparently unpublished before, seems quite distinct in the key character given.

38. S. viscosa Mont. & Auch. in Ann. Sci. Nat. 2(6): 49 (1836) (Map 18).

Suffrutescent perennial. Flowering stems 40-50 cm, erect, branched. Indumentum sparsely pubescent with eglandular hairs and glandular papillae, rarely with few glandular hairs. Cauline leaves ovate to ovate-lanceolate, 1-3.4 x 0.8-2.4 cm, crenate to serrate-dentate, apex acute, truncate to cuneate at base, petiole 0.15 to 1.7 cm. Floral leaves subsessile to sessile, ovate-lanceolate to lanceolate, 1-1.8 x 0.3-1.4 cm, subentire to entire, shorter than verticillasters above. Verticillasters remote, 1.5-5.5 cm distant, (2)-4-(10)-

flowered. Bracts few, lanceolate, 2-5 mm, setaceous, sparsely hairy to glabrous. Pedicels 1-2 mm. Calyx \pm regular, campanulate, 9.5-12 mm; teeth lanceolate, erect, $\pm \frac{2}{3}$ as long as tube, tip spinescent. Corolla 16-18 mm, yellow, tube subexserted. Nutlets oblong, trigonous, 2.5 x 1.4 mm, with faint marginal wing towards base. Fl. May-August.

Habitat: Steep screes and crevices and sloping rocks. 960-1800 m.

Key to varieties :

1. Calyx with copious sessile to sessile glands and less eglandular hairs; leaf margin crenate-dentate var. viscosa
1. Calyx with more glandular hair and few sessile glands; leaf margin acute serrate var. odontophylla

var. viscosa (Map 18).

Habitat: Steep screes and sloping rocks. 900-1800 m.

Type [Turkey B7]: Hab. in convalle Euphratis superioris Cappadocia orientalis, Montbret 2196 (holo. MW, iso. K!)

N. and E. Anatolia

A7 Gümüşane: Monastir, Sintenis 1894: 573!

Giresun: d. Sebin Karahisar, 4 km N. of Sebin Karahisar, 1260-1300 m,

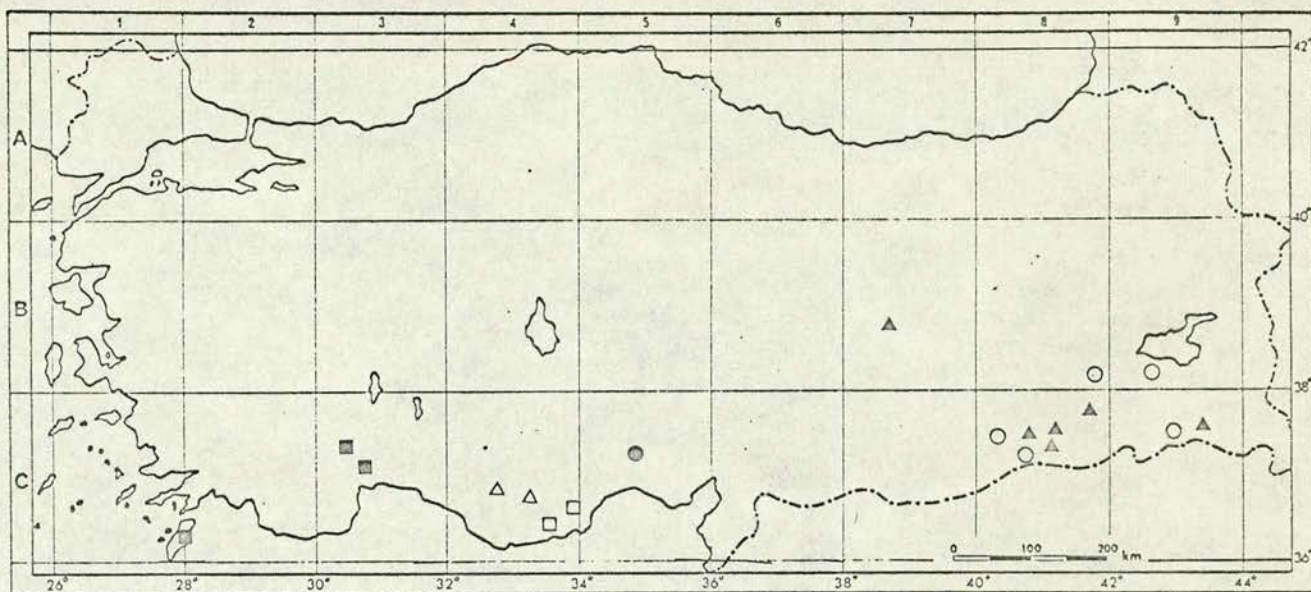
Huber-Morath 14180!

A8 Artvin: d. Yusufeli, between Sarigözü and Barhal, 900-950 m, D. 47675!

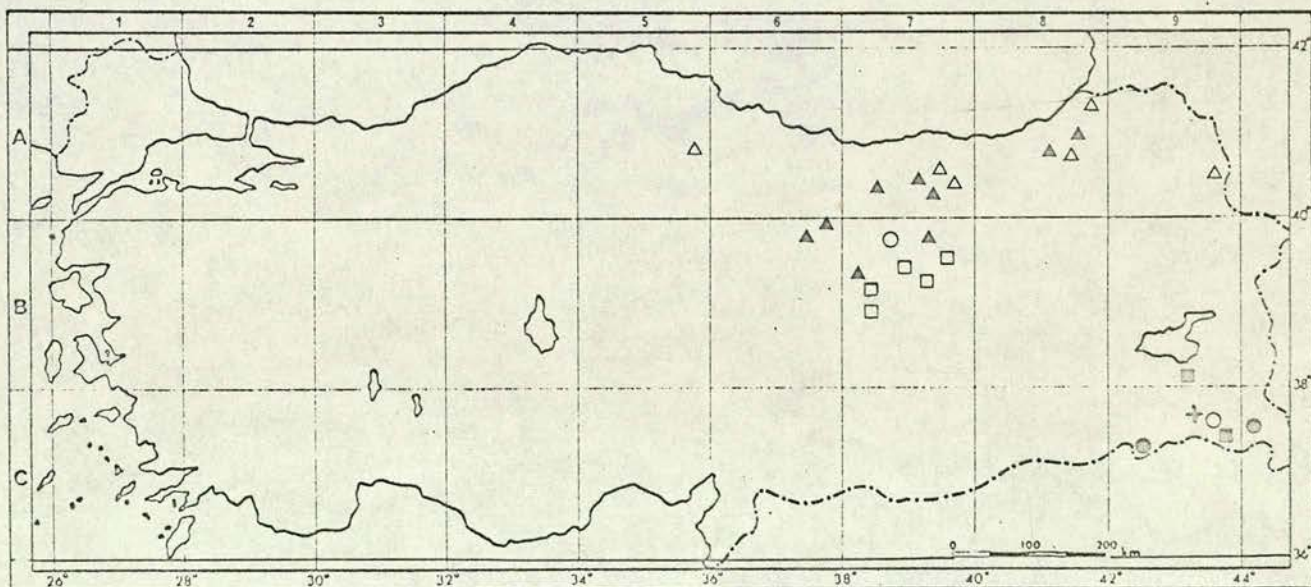
B6 Sivas: Zara to Susehri, D. 20452A!

B7 Erzincan: Nerakiep, Sintenis 1889: 1044! Surek, Sintenis 1889: 1067!

External distribution: N.W. Iran. Irano-Turanian element.



Map 17. ● S. longiflora;
 ■ S. pinardii;
 ▲ S. glechomifolia;
 ▲ S. euadenia;
 □ S. yeni-yurukensis;
 ○ S. megalodonta ssp. mardinensis



Map 18. ● S. ballotiformis;
 ▲ S. viscosa var. viscosa;
 ▲ var. odontophylla;
 ■ S. kurdica var. kurdica;
 ○ S. subnuda;
 □ S. laetivirens;
 + var. brevidens;

var. odontophylla (Freyn) Rech. fil. in Bot. Jahrb. 71: 530 (1941)

syn. S. odontophylla Freyn, Ost. Bot. Zeitschr. 41: 59 (1891): (Map 18).

Habitat: Rocky slopes and fissures. 400-1100 m.

Type [Turkey A6 Amasya] Amasya: in rupestribus regionis calidae in fissuris rupium 4-600 m, 12.vi.1889, Bornmüller 663 (holo. MW. iso. K! LD!)

N. Anatolia

A7 Gümüsane, Bourgeau 227: 1100 m, 4.vi.1969, Bayton 15387: R. Gorz. 351:

A8 Artvin: Artvin Woronow s.n.

Endemic. Irano-Turanian element.

This species is most closely allied to S. laetivirens from which it differs in having subsessile to sessile glandular indumentum throughout the plant body, less dense (6-10-flowered) verticillasters, and \pm slender stems.

39. S. laetivirens Kotschy & Boiss. ex Rech. fil. in Bot. Jahrb. 71: 529 (1941)

Syn. S. laetivirens Kotschy & Boiss. nomen nudum in sched. impr.

S. viscosa Mont. & Auch. var. elatior Boiss., Fl. Or. 4: 734 (1879)

(Map 18).

Suffrutescent perennial. Flowering axis 55-60 cm, erect, branched, light green, sparsely and retrorsely pubescent, with eglandular hairs and rarely with few sessile glands. Cauline leaves ovate-lanceolate, 1-4 x 0.6-2 cm, crenate-dentate, apex acute, subcordate to truncate at base, petiole 0.2-1 cm. Floral leaves subsessile to sessile, triangular lanceolate 0.6-2 x 0.35-1.6 cm, as long as or larger than verticillasters. Verticillasters remote, (8)-12-16-flowered. Bracts few, linear setaceous 1-3 mm. Pedicels 1.5-2.5 mm. Calyx \pm regular, campanulate, 7-10 mm; teeth \pm equal, rigid and erect, triangular

lanceolate, \pm half as long as tube with spinescent tip, indumentum eglandular haired. Corolla 13-14 mm, yellow, tube subexserted. Nutlets elongate trigonous 2.5 x 1.5 mm with faint marginal wing. Fl. May-July.

Habitat: On gravelly river banks, on schist and on limestone slopes and gorges. 1000-2300 m.

Type [Turkey B8/9 Mus]: In faucibus versus Teng ad latera montium, 1524 m; plantae ex schistosis in alpibus prope Musch (Mus) lectae, 9.ix.1859, Kotschy 509 (holo. MW, iso. K!)

S. Anatolia

B7 Tunceli: Tunceli to Pülümür, 17 miles from Tunceli, 1100 m, D.29232!

Munzur Dağ above Ovacık, 1700 m, D.31156!

Malatya: 5-10 km below Kemaliye, 880-920 m, Huber-Morath 8989!

Erzincan: Egin, 13.v.1890, Sintenis 2265! sub. S. odontophylla Freyn.

Endemic. Irano-Turanian element.

The species shows affinity with S. viscosa Mont. & Auch. but differs in having a much-branched flowering axis, \pm eglandular indumentum and more flowered verticillasters.

40. S. subnuda Mont. & Auch. in Ann. Sci. Nat. 2 (6): 50 (1836). (Map 18).

Suffrutescent perennial. Flowering stems 26-40 cm, erect, usually unbranched or branched above with fragile base. Indumentum sparsely retrorse pubescent with eglandular and few glandular hairs. Cauline leaves ovate 0.6-2 x 0.4-1.6 cm, faintly crenate-dentate, apex acute, truncate to subcordate at base with short 0.1-0.4 cm petiole. Floral leaves subsessile to sessile, ovate-lanceolate to lanceolate 0.3-1.2 x 0.2-0.8 cm, subentire to entire, as long as or shorter

than verticillasters. Verticillasters remote, 4-6-(8)-flowered. Bracts few, setaceous 1-3 mm. Pedicels 1-2 mm. Calyx \pm regular, subcampanulate 7.5-9 mm; teeth rigid, erect, triangular lanceolate, \pm half as long as tube, \pm glabrescent, faintly ten nerved, with softly spinescent tip. Corolla 12-14 mm, lemon yellow, tube subexserted. Nutlets obovoid, 2-1.5 mm. Fl. June-August.

Habitat: Limestone crevices and gorges. 1220-3200 m.

Syntype [Turkey B7 Erzincan]: Hab. in Euphratem superiorem et circa Erzinghan (Erzincan) in Armenia, Montbret 2254 (holo. MW), ibidem Aucher-Eloy 1702, 1703 (iso. BM!)

E. Anatolia

C9 Halkkari: Cilo Dag, between Diz deresi and Cilo yayla, 2438 m, D.24248!

Endemic. Irano-Turanian element.

The species shows a close affinity to S. kurdica from which it is distinguished by \pm rigid, ten-nerved, glabrescent calyx with erect and rigid triangular-lanceolate teeth with softly spinescent tip.

Sect. ZIETENIA (p. 144)44. S. lavandulifolia Vahl., Symb. Bot. 1: 42 (1790)Syn: Zietenia orientalis Gled. in Mem. Acad. Berl. 22: 9 (1766)non S. orientalis L. (1753)Sideritis calycantha Bieb., Fl. Taur. Cauc. 3: 393 (1819)Stachys orientalis C. Koch in Linnaea 21, 1: 694 (1848) non

Linn. (1753)

S. zurandica Rzazade in Fl. Azerb. 7: 611 (1957) (Map 19).

Suffrutescent perennial with basal rosettes of sterile shoots. Flowering stems numerous, 25-30 cm. Indumentum sparsely to densely pilose, sometimes absent, rarely white-tomentose with unequal stellate hairs. Basal leaves subsessile to sessile, oblong-lanceolate to oblanceolate, 2-6 x 0.4-1.5 cm, margin entire to faintly serrate and attenuate at base. Cauline leaves similar. Floral leaves oblong to ovate, 1.2-2 x 0.25-0.8 cm, shorter than verticillasters. Verticillasters usually remote or remote below \pm approximate above, (2-)-4-6-flowered. Bracts few, linear, 2-3 mm, hirsute. Pedicels, 1.5-2 mm. Calyx \pm regular, subcampanulate, 15-28 mm; teeth subequal, lanceolate to lanceolate-subulate, tip softly spinescent, teeth/tube ratio 1.2-3.6; indumentum on teeth patently pilose. Corolla, 13-15 mm, purple to mauve, tube subincluded. Nutlets obovoid 2.5-3 x 2-2.5 mm. Fl. May-August.

Habitat: Limestone to igneous rocky slopes and screes. 1200-3658 m.

Key to varieties:

1. Calyx/teeth/tube ratio 2-3.8; indumentum on leaf sericeous-tomentose or absent; cauline leaves lanceolate with acute apex
2. Leaf and stem \pm glabrescent with few subsessile to sessile glands var. glabrescens

2. Leaf and stem sericeous-tomentose with glandular

hairs var. lavandulifolia

1. Calyx teeth/tube ratio 1-1.2; indumentum on leaf short whitish-tomentose; cauline leaves oblanceolate with \pm obtuse

apex var. brachyodon

var. lavandulifolia

Type: Habitat in Oriente. Juxta herbarium Vaillantii descripsi Vahl.

Mainly E. & S. Anatolia

A5 Amasya, Manissadjian 1033!

A7 Erzincan: Kelkit, 1200 m, Karamanoglu 66-49!

A8 Gümüşane: Balburt, Bourgeau 229!

A9 Kars: Karakurt, 1600 m, Baytop 19986!

B6 Malatya: Akçadagh to Darende, 1400 m, Huber-Morath 8966!

B7 Erzincan: Sipikordag, 1219-1524 m, Sint. 1889: 1179!

B8 Erzurum: 20 km from Hınıs to Pasınlar, 1900 m, D. 31389

B9 Bitlis: Şemaran, 9.viii.1906, B. Post 807!

B10 Kars: Grand Ararat, Sardar Bulaak, 2591 m, 10.viii.1910, B. Post 2066!

C3 Isparta: Davros (and Ghei) Dağ, 1219-1829 m, 1825, Heldr.!

C4 Içel: d. Mut, Magras Dağ, 1300 m, Coode 791!

C5 Içel: Bulgar Dağ, 2438 m, Kotschy 1853: 108b & 228a!

C10 Hakkari: Nehil Çayı, Hakkari to Yüksekova, 1750 m, D. 44915!

External distribution: Caucasia, Iran, Afghanistan. Irano-Turanian element.

var. brachyodon Boiss., Fl. Or. 743 (1879)

Syn: S. tomentosa Bunge, Lab. Pers. 71 (1873) non Benth. (1834)

S. boissieri Kapeller in Not. Syst. Geogr. Inst. Bot. Tphilis,

fasc. 16: 17 (1951).

Type: [Persia]: Hab. ad lacum Ourniah, Seidlitz 188

E. Anatolia

B9 Agri: 2 km SW of Hamur (Murat Valley), 1670 m, D.44016!

Van: pass between Hosap and Baskale, 2660 m, Huber-Morath 11390!

Bitlis: N. slope of crater on Nemrud Dag, 2600 m, McNeill 590!

B10 Van: 6 km from Özalp to Saray, 2250 m, D.44378!

C10 Hakkari: Cilo Dag, 3658 m, D.24220!

External distribution: N.W. & W. Iran, Transcaucasia. Irano-Turanian element.

var. glabrescens Huber-Morath & Bhattacharjee, var. nov.

A varietate typico foliis et caulibus glabriusculis, glandulis paucis sessilibus et subsessilibus recedens.

Type [Turkey B9 Van]: Hügel Toprak Kale ob Van, 1900 m, 30.v.49, Huber-Morath 8969!

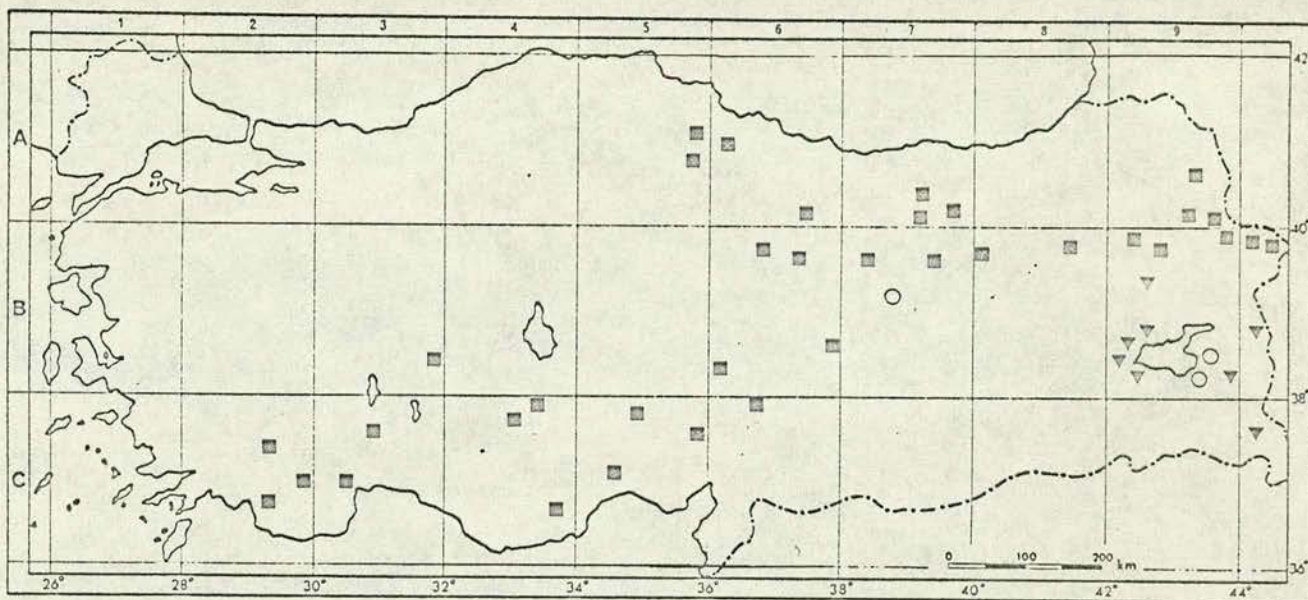
E. Anatolia

B7 Erzincan: Egin (Kemaliye), Pashtash at Euphratem, Sint. 1889: 947!

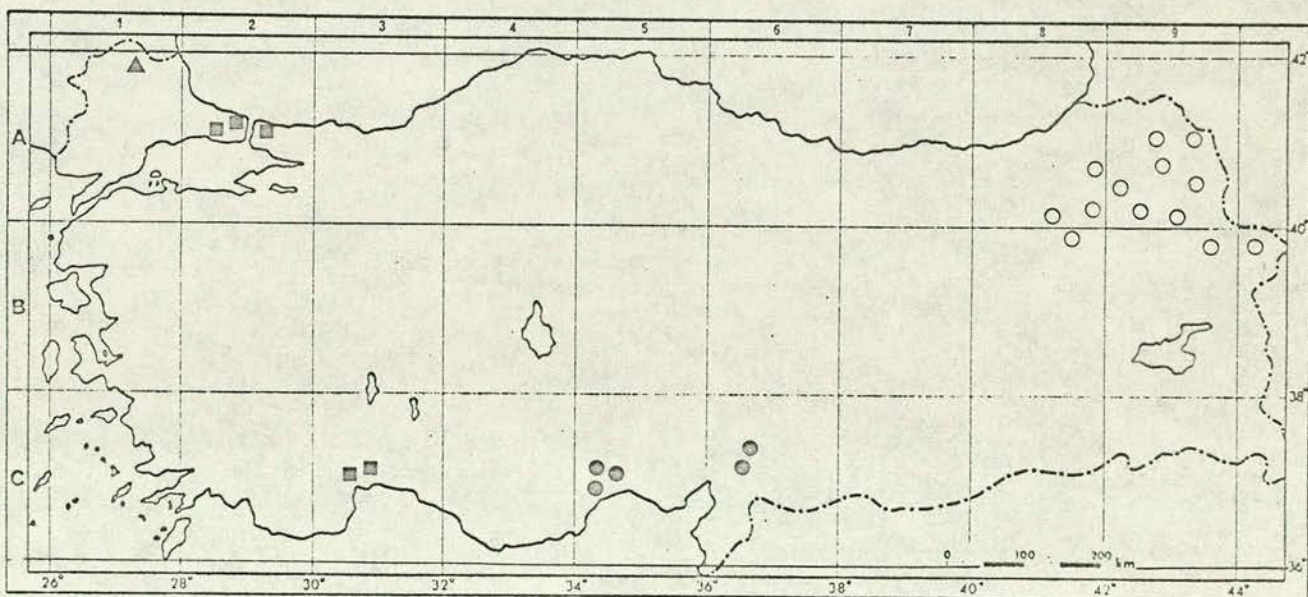
B9 Van: Pelli Dag, 54 km W.S.W. of Van, 2500 m, Edmondson 622!

External distribution: N. Iraq, Iranian Azerbaijan. Irano-Turanian element.

Variety lavandulifolia is distributed throughout the species' range while the other two varieties are more localised. The former is very variable in indumentum density, height of flowering stems, density of inflorescences and calyx teeth/tube ratio. The range of population variability occurring in the North-Eastern part of Turkey (from A6/B6 to A9/B9) differs from the Southern population (from C2 to C6 occurring exceptionally and rarely in B6 and A5) in the length of flowering stems and density of indumentum. The former is more elongate and sparsely hairy than the latter, whereas the calyx teeth/tube ratio varies equally in both. As the characters may well be influenced by habitat differences, the two groups are not given formal taxonomic recognition here.



Map 19. \blacksquare S. lavandulifolia var. lavandulifolia;
 \blacktriangledown var. brachyodon ; \circ var. glabrescens



Map 20. \blacksquare S. recta;
 \blacktriangle S. angustifolia;
 \circ S. atherocalyx;
 \bullet S. sparsipilosa

Sect. OLISIA (p. 127)

42. S. recta L. subsp. subcrenata (Vis.) Briq., Lab. Alp. Mar. part 2: 257 (1893)

Syn. S. subcrenata Vis. in Flora I, Ergänzungsbl.: 15 (1829)

S. recta var. major Ten., Fl. Nap. Syll. 2. 242 (1831) non Briq. (1893)

S. czernjajevii Schost. in Not. Syst. (Leningrad) 8 (9): 152 (1940)

(Map 20).

Suffrutescent perennial. Stem procumbent, branched, 18-60 cm. Indumentum sparsely and antrorsely adpressed pubescent. Lower and median cauline leaves oblong to linear-lanceolate, sometimes oblanceolate 1-5 x 0.1-0.5 cm, faintly serrate to subentire, apex acute with spinescent tip, attenuate to cuneate at base. Floral leaves linear-lanceolate to ovate-lanceolate, 0.3-1.6 x 0.15-0.5 cm, entire, apex spinescent. Verticillasters remote, 2-5 cm, distant, few ± approximate above. Bracts few, setaceous, 1-1.5 mm. Pedicels c. 1-1.2 mm. Calyx sub-bilabiate, campanulate, 7-9 mm; teeth triangular-lanceolate, slightly shorter than the tube; mucro 1-1.5 mm. Corolla 12-14 mm, creamy-yellow, tube exserted. Stamens exserted more than half way along upper corolla lip. Nutlets obovoid, trigonous, 2.2 x 1.8 mm. Fl. May-August.

Habitat: Maritime sands and dunes.

Type: In collibus Dalmatiae montanae, Visiani.

N.W. Turkey and S.W. Anatolia

A2(E) Istanbul: Scoumroukeuy (Uskundrukoy), 3.viii.1902, Aznavour!

Kilia, 26.vii.1891, Aznavour!

A2(A) Istanbul: Riva, 12.vi.1893, Aznavour!

C3 Antalya: Antalya, June 1961, Atay 53! & 31!

External distribution: S.E. Europe. E. Mediterranean element.

This species is the only representative of S. recta in Anatolia and

characterised from two other subspecies, subsp. labiosa (South Europe and W. Balkan peninsula) and subsp. recta (throughout Europe and Caucasus) in having longer calyces (7-9 mm) and narrowly lanceolate, faintly sessile to entire margined median cauline leaves. Near relatives of S. recta in Anatolia is S. atherocalyx, from which it is distinguished by shorter calyx teeth/tube ratio (less than 1:1) and broadly lanceolate lower and median cauline leaves. In Anatolia disjunction in its distribution has been found. Distribution in N.W. Turkey is frequent while it has been reported from Antalya (Atay, 53, 31) only once.

43. S. atherocalyx C. Koch. in Linnaea 21: 691 (1848).

Syn: S. sideritoides C. Koch. op. cit. (1848) non Gill ex Benth. (1848)

S. linearifolia C. Koch. op. cit. (1848)

S. patula Gris., Spicil. 2: 142 (1844)

S. recta L. var. sideritoides Boiss., Fl. Or. 4: 730 (1879)

S. acanthodonta Klok. in Fl. R.S.S. Ucr. 9: 648 (1960) (Map 20).

Suffrutescent, erect to procumbent perennial, 40-85 cm. Indumentum sparsely and adpressedly hirsute. Lower and median cauline leaves oblong-lanceolate to lanceolate, 4-10 x 0.4-1.5 cm, base attenuate, margin crenate-serrate, apex acute. Floral leaves linear-lanceolate, 0.9-5.5 x 0.3-0.7 cm, subentire to entire, aristate-tipped, base broad and sessile, uppermost ones as long as or slightly longer than verticillasters. Verticillasters remote below \pm approximate above for the most part, (4)-6-8-flowered. Bracts lanceolate to linear, 2-6 mm, herbaceous or setaceous, \pm half as long as calyx tube. Calyx sub-bilabiate, tubular to subcampanulate, 12-14 mm, densely hirsute, teeth erect to subpatent, lanceolate-subulate, 6-8 x 0.8-1 mm, with long aristate tips; aristae yellow 1.5-2 mm, glabrous. Corolla 14-18 mm, yellow, tube exserted. Stamens exserted more than half way along upper lip. Nutlets obovoid, 2-2.5 mm. Fl. May-August.

Habitat: Rocky slopes, steppes, sometimes in meadows, fallow fields on roadside banks, 1500-2150 m.

Type [Caucasia] Im Kaukasus, in Transkaukasien und im Tschorukgebiete sehr häufig, und zwar auf allen Bodenarten von 150-1676 m C. Koch.

N.E. and E. Anatolia

A8 Erzurum: Erzurum to Tortum, 2030 m, Huber-Morath 15286!

A9 Kars: Kisir Dağ above Susuz, 2000 m, D.30513!

B8 Erzurum: C 14 km from Erzurum to Pasinler, 2000 m, D.47449!

B9 Ağrı: Suluçem to Balik G, 2150 m, D.47253!

B10 Kars: N.E. slope of Ağrı Dağ, below Serdar Bulak, 1500 m, D.43699!

External Distribution: Iran, Caucasia, Crimea, N. part of Balkan peninsula and Romania.

This species belongs to steppic pontic element of Euro-Siberian region.

44. S. angustifolia Bieb., Fl. Taur. Cauc. 2: 52 (1808)

Syn: S. tenuifolia Pallas in Link, Enum. Hort. Berol. 2: 109 (1800)

non Willd. (1800). (Map 20). p.

Suffrutescent erect perennial, 40-45 cm. Flowering stems slender, branched, usually glabrous with few short glandular hairs. Lower cauline leaves lacinate to pinnatipartite, 3-4.5 x 0.1-0.2 cm, entire, passing into linear, entire upper cauline to floral leaves, 0.2-3 cm long. Floral leaves, as long as or slightly less than verticillasters, shortly spinescent tipped. Verticillasters 2-flowered, remote, 0.5-3.5 cm distant. Bracts setaceous, minute 0.5-1.5 mm. Pedicels 2-4 mm. Calyx ± regular, subcampanulate, 6-7 mm, teeth ± equal, half as long as tube; mouth thinly hairy. Corolla 14-16 mm, pink, tube exserted. Nutlets obovoid 1.5-2.5 mm. Fl. June-July.

Habitat: Rocky substrate; on hills and mountains.

Type: [Grimeg] Hab. in Tauriae meridionalis petroses sylvatica circa pagum Temirdschu, Bieberstein.

N.W. Anatolia:

A1(E) Kirklareli: near Dereköy, Baytop 14160!

External Distribution: Bulgaria, Greece, Romania, Crimea and Southern part of European Russia. Euro-Siberian element.

The nearest relative of this species is S. iberica Bieb., from which it differs strikingly in having linear and pinnati-partite cauline leaves, glabrescent stems and 2-flowered verticillasters.

45. S. sparsipilosa Huber-Morath & Bhattacharjee sp. nov.

Syn: S. leucoglossa Griseb. var. anatolica Boiss. Diagn. ser. 2(4):

41 (1859)!

S. iberica Bieb. var. pallidiflora Boiss. Fl. Or. 4: 731 (1879)

nom. illegit. (Map 20).

Affinis S. ibericae Bieb. sed in fructu pedicellis longioribus, calyce deinde glabro dentibus longe aristatis tubum aequantibus.

Suffrutescent perennial with woody caudices. Flowering stem erect to slightly ascendant, 30-60 cm; stem densely or sparsely adpressed-pilose below, glabrescent above. Lower and median cauline leaves oblanceolate to lanceolate, 2.5-5 x 0.3-0.8 cm, crenate-serrate to subentire, base attenuate, apex obtuse gradually becoming acute above. Floral leaves lanceolate to linear-lanceolate, 0.8-2.5 x 0.2-0.3 cm, with spinescent tip; spine 0.5-1 mm. Verticillasters remote, 0.5-3.5 cm distant, (2)-4-6-flowered. Bracts few, linear, 1.3 mm, setaceous. Calyx sub-bilabiate, subcampanulate, 6-8 mm, glabrescent to sparsely hairy; teeth lanceolate, 2.5-4.6 mm, glabrous with 0.5-2 mm long mucronate tip, recurved in fruit. Corolla 12.5-14 mm, mauve to pale pink, tube subexserted, rarely whitish with pink markings. Stamens slightly exserted from corolla tube, outer and inner pairs 3.2 and 2.7 mm. respectively. Nutlets obovoid, 2-2.3 x 1.8 mm, trigonous with faint marginal wing towards base. Fl. May-July.

Habitat: Steep limestone slopes, undergrowth of Pinus brutia forest, alt. 400-1006 m.



Pl. 18. Stachys sparsipilosa Bhattacharjee & Huber-Morath (Holotype)

Type Turkey C5 Içel Gülek Boğhaz, Coteaux dominant le village de Gülek Boghas, pres de defilé des Portes Ciliciennes, 24.vi.1855.

Syntype of S. leucoglossa Griseb. var. anatolica Boiss (1859) Balansa 513 (holo. E! iso. K!).

S. Anatolia (Cilician Taurus and N. Amanus)

C5 monte Tauro, Kotschy 1836: 443! (Syntype of S. leucoglossa var. anatolica Boiss. (1859)

C5 Içel: Gülek Depé, 1100 m, Siehe 1896: 444!

Cilician Taurus, Bütöcek, 1006 m, Balls 1244!

C6 Adana d. Bahçe: Osmanoik - Fevzipasa, 23 km E. above Osmanoik, 400 m,

Huber-Morath 14188!

Endemic, E. Mediterranean element.

The species shows affinity with S. iberica Bieb. subsp. iberica and subsp. georgica Rech. fil. but differs from them in having long-pedicelled and glabrous fruiting calyx (6-8 mm long) with the teeth as long as the calyx tube; from the former it is further distinguished by having linear-lanceolate floral leaves with an aristate tip.

Boissier treated this species as distinct from S. iberica Bieb. and S. recta L. and first described it as S. leucoglossa Griseb. var. anatolica Boiss. (1859). Later he transferred it to S. iberica Bieb. naming it var. pallidiflora Boiss. (1879) which is an illegitimate name. Rechinger in his treatment of the species S. iberica Bieb. (Feddes Rep. 53: 838 1924), raised the variety of Boissier, S. iberica var. stenostachya Boiss. to sub-specific rank and provided it with a short description. When doing so he had not seen the type specimen of var. stenostachya and included the type specimen of S. leucoglossa Griseb. var. anatolica Boiss. under S. iberica

ssp. stenostachya. However, all the materials cited as seen by him under ssp. stenostachya (Boiss.) Rech. fil. are referrable not^{to} that subspecies but to this new species S. sparsipilosa, because they agree with S. sparsipilosa in having the characters of the latter, whereas the identity of the type of S. iberica ssp. stenostachya has been misinterpreted by Rechinger.

46. S. iberica Bieb., Fl. Taur.-Cauc. 2: 51 (1808).

Syn. S. congesta Urv. in Mem. Soc. Linn. Par. 1: 324 (1822)

S. arenaria Benth., Lab. Gen. et Sp. 557 (1834) non Vahl (1791)

S. caucasica C. Koch in Linnaea 21: 693 (1848) (Map 21).

Suffrutescent perennial, 20-60 cm, erect or procumbent. Indumentum densely or sparsely adpressed-pilose. Lower and median cauline leaves subsessile to sessile, oblong to oblanceolate, 1.5-5.5 x 0.4-1.2 cm, margin crenate to faintly crenate-serrate, rarely entire, base attenuate. Floral leaves subsessile to sessile, oblong-lanceolate to narrowly lanceolate, gradually becoming ovate-lanceolate above, uppermost ones as long as or shorter than verticillasters, apex blunt acute rarely soft-spinescent. Verticillasters remote below, few \pm approximately above, 1-5 cm distant, (2-)-4-8-flowered. Bracts few, small and setaceous, 1-3 mm. Pedicel short, 0.5-1 mm, not conspicuously enlarging in fruit. Calyx sub-bilabiate, sub-campanulate to tubular, 5-10 mm, sparsely or densely pilose; teeth subequal, erect to subrecurved, triangular-lanceolate, \pm half as long as tube, mucronate at tip, mucro 0.2-1 mm. Corolla 14-18 mm, purplish pink to creamy-white with pink markings, tube subexserted. Stamens slightly exserted from corolla tube. Nutlets obovoid, 2.2 x 1.8 mm, trigonal with faint basal margins. Fl. May-August.

Habitat: Sloping limestone or serpentine rocks and screes, streams and river sides, steppes and igneous banks. 800-2400 m.

Key to subspecies and varieties :

1. Corolla mauve to pink; flowering stems usually ascendant, rarely erect; calyx teeth as long as or slightly less than tube, aristae 0.5-2 mm
2. Plant ascendant, stout and dwarfish, c.13-35 (45) cm, darker green in colour; median cauline leaves oblanceolate with obtuse apex subsp. iberica
3. Median cauline leaves usually distinctly crenate to crenate-dentate, leaves and stems sparsely hairy; corolla dark mauve to purple var. iberica
3. Median cauline leaves usually entire to subentire; leaves and stems densely hairy; corolla pale pink var. densipilosa
2. Plant \pm erect, slender and elongate c. (24)-38-65 cm paler green in colour; median cauline leaves lanceolate with acute apex subsp. georgica
1. Corolla creamy yellow to white with pink markings; flowering stems usually erect, rarely ascendant; calyx teeth usually \pm half as long as tube or less, aristae 0.2-1 mm
..... subsp. stenostachya

subsp. iberica var. iberica

Habitat: Sloping limestone rocks and screes, river banks, igneous banks.
950-2400 m.

Type [Caucasia]: Habitat in Ibericae apricis ficcis, Bieberstein

Mainly N.E. and S. Anatolia

A6 Ordu: above Aybasti, 1100 m, Tobey 1386!

A7 Trabzon: Hamisköy, Civarındaki Kuruk yerler, T. Baytop 4686!

Gümüşane: Boejukodere above Artabir, Sintenis 1894: 7022!

A8 Rize: İkizdere, 2100 m, D.21006!

Erzurum: 20 km E. of Ispir, 1981 m, Barclay 1000!

A9 Çoruh (Artvin): Kordeyan Dağ, 2200 m, D.30213!

B9 Ağrı: E. side of Tahir Pass, 19 km from Eleskirt to Horasan, 2400 m, D.47219!

C6 Maraş: d. Göksun, Hobek Dağ, 1500 m, D.20218!

Hatay: Hasanveyli, 1219-1524 m, Haradjian 2251!

External distribution: N. Syria, Caucasus, Crimea and Greece. Irano-Turanian element.

Subsp. iberica var. densipilosa Bhattacharjee, var. nov.

A var. iberica folliis angustioribus (13-30 mm), subintegris, indumento caulium et foliorum densiore recedit.

Habitat: Sloping limestone screes. 800-2200 m.

Type [Turkey A3 Bolu]: Abant Gölu, 17.vii.1960, B. Post!

N., Central and S.W. Anatolia.

A4 Bolu: Ala Dağ on Kartal Kaya tepe, 2100-2200 m, D.37349!

Kastamonu: 1 km W. of town, 850 m, Edmondson 551!

Çankiri: 46 km S. Karabük, 800 m, Sorger 69-8-36!

B3 Konya: Sultan Dağ above Akşehir, 1900 m, Huber-Morath 8151!

C3 Isparta: Dedegöldağ, 1500 m, Sorger 65-43-142!

Endemic. Irano-Turanian element.

Subsp. georgica Rech. fil. in Feddes Rep. 53: 84 (1944)

Habitat: Rocky igneous slopes, edge of meadows. 1400-2300 m.

Type [Georgia Caucasica] In pratis montosis Georgiae Caucasicae, Tul. 1835

Hohenaker!

Mainly E. Anatolia

A9 Kars: Yalnızçam Dağları above Yalnızçam, 2100-2300 m. D.32511!

B8 Muş: Çayler, 1600 m, D.46365!

B9 Ağrı: Karaköse (Ağrı) to Erzurum, 2300 m, Birand & Karamanoglu 536/a

Bitlis: Bitlis to Tatvan, 1730 m, D.22341!

C9 Hakkari: Morinos Dere above Marunis, 1900 m, D.45374!

External distribution: Transcaucasia, Iran. Irano-Turanian element.

Subsp. stenostachya (Boiss.) Rech. fil. in Feddes Rep. 53: 84 (1944) quoad
typ. haud. specim. alter.

Syn. S. iberica var. memorabilis (haud nomen) apud Bieb., Fl. Taur-
Cauc 3: 400 (1819)

S. stenostachya Boiss. in Diagn. Ser. 2(4): 41 (1859)!

S. iberica var. brachyodonta Boiss., Fl. Or. 4: 731 (1879)!

S. iberica var. pallidiflora Boiss., Fl. Or. 4: 731 (1879) p.p.

excl. typ., nomen illegit.

S. euphratica Hayek in Feddes Rep. 21: 258 (1925)!

S. memorabilis Klok. in Fl. Ukr. RSR 9: 643 (1960)

Habitat: Igneous rocky slopes and serpentine screes, sometimes in field
banks, 450-1900 m.

Type [Turkey G5 Hatay/Syria]: Hab. in parte inferiori montis Cassii Syriae
borealis, Boissier (holo. G!)

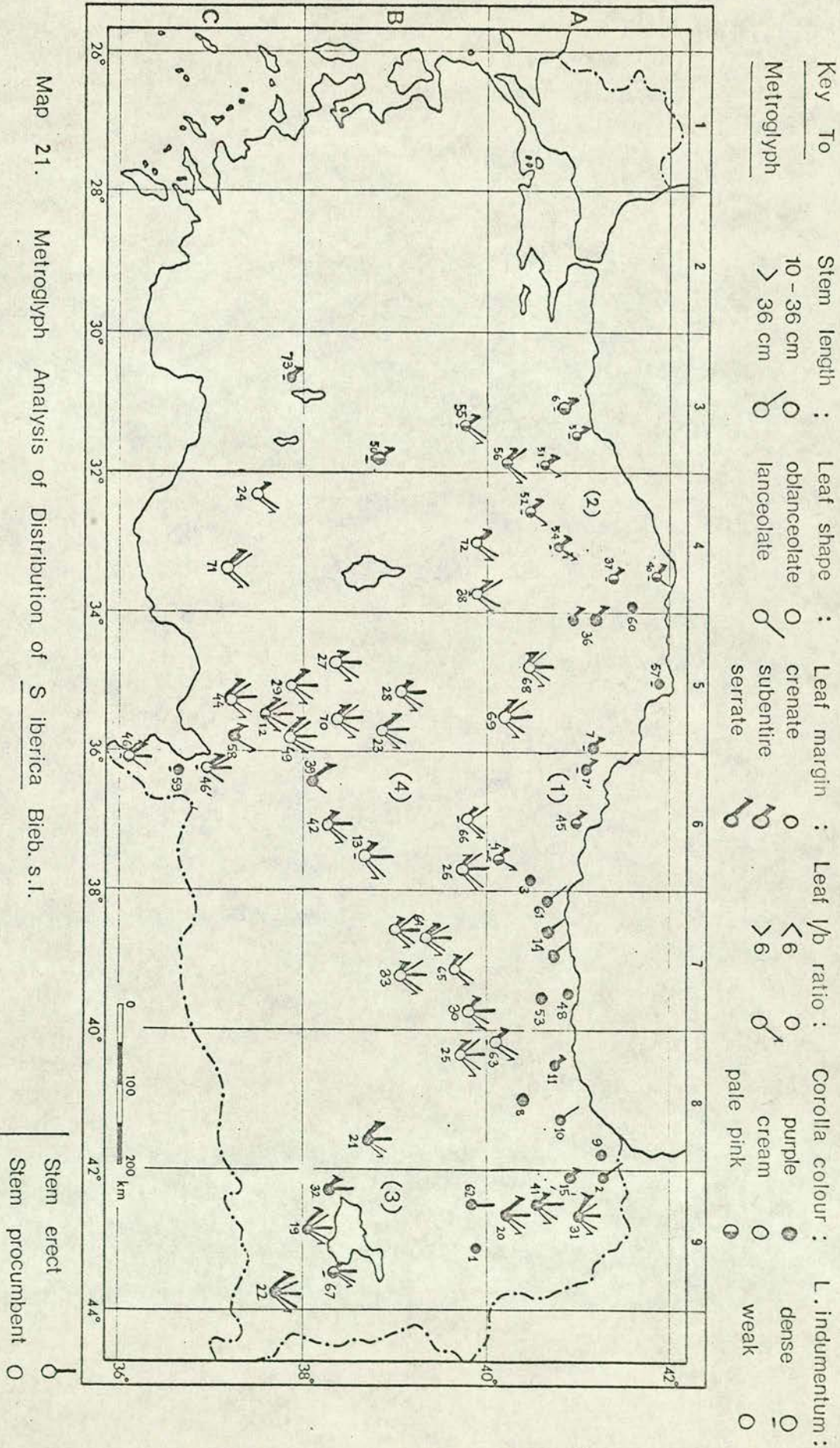
Mainly Inner and S. Anatolia

A5 Çorum: Boğazkale, 1000 m, Sorger 71-7-15!

A6 Ordu: Samsun to Trabzon road, 10 km from Unye, Jardine 415!

A8 Gümüşane: Baiburt, Bourgeau 225!

B4 Ankara: Ankara, Bornmüller 1892-93: 3182!



- B5 Kayseri: Bakir Dağ, between Kişge and Bakir Da, 1700 m, D.194.92!
 B7 Erzincan: Egin (Kemaliye) Paschtash at Euphratem, Sintenis 1889: 934
 (Typ. S. euphratica Hayek.)!
 B9 Van: 5 km W. Gevas, 1670-1700 m, Huber-Morath 11392!
 C4 Konya: Karaman to Mut, 1430 m, Huber-Morath 1724.9!
 C6 Hatay: Mons Amanus, Haradjian 308!

External distribution: Caucasia, Crimea, Irano-Turanian element. This is the commonest race in Inner Anatolia.

S. iberica Bieb. is a very variable species in leaf shape, corolla colour, leaf margin, density of leaf indumentum and l/b ratio of leaf. Particularly, there are some races in this species which have pale creamy-yellow corollas with pink markings. On this character it can easily be confused with the closely related S. recta L. Close morphological investigation and comparisons of Turkish and European specimens of both these species reveal that they differ significantly in the relative length of stamens. In S. recta the stamens extend more than half way along the upper corolla lip, whereas S. iberica has stamens only slightly exerted from the corolla tube. In Turkey, S. recta occurs in very localised areas (Map 20) while S. iberica grown throughout.

The variable complex of S. iberica in Turkey comprises 3 subspecies recognised here. Two of them, subsp. iberica and subsp. georgica, have purple to pale pink corollas, while subsp. stenostachya has creamy ones. In leaf characters (particularly shape), and in the height of flowering stems, subsp. iberica differs from the other two in having \pm broadly lanceolate median cauline leaves with an obtuse apex and dwarfish procumbent flowering stems. The distinctions between these 3 subspecies are blurred by intermediates.

Recognition of formal taxonomic status seems justified after examining more than 100 different sheets. A pictorialised scatter diagram (Fig. 30) has been made of 73 such significant collections following character analysis (Table 10) and metroglyphs have been shown on a Turkish map (Map 21).

A key to 'typical' metroglyphs representing the subspecies and varieties have also been provided (Fig. 30, Map 21).

The subsp. iberica is commonest in the N.E. part of Anatolia (var. iberica), being largely replaced towards N.W. and W. side by var. densipilosa.

Subsp. georgica grows in E. Anatolia, extending towards Caucasia, whereas subsp. stenostachya is most abundant in Inner Anatolia.

In discussing the subspecies and varieties of S. iberica, the number used in the character table and the metroglyph map is put in brackets after the collectors number.

Sintenis 4567 (36) and Tobey 116 (7) from Kastamonu and Sinop of subsp. iberica are closer to var. densipilosa in their smooth margined and \pm densely hairy leaves; but the brighter corolla colour and broader lower cauline leaves show more affinity to the type variety. There is considerable overlapping of these characters throughout the range of this subspecies. Akman 963 (56) and Inuoplu 397 (35) from Ankara approach subsp. stenostachya in having lanceolate leaves with \pm serrated margin but are distinguished from the latter in their pale pink corollas. Subsp. georgica, as has been shown in the metroglyph map, is very close to subsp. stenostachya, differing mainly in corolla colour. Other differences, such as paler green and c. 50-70 cm stem and long aristae (c. 2mm) on the calyx teeth, though very characteristic of the former subspecies, sometimes break down in the adjacent geographical boundary of the latter, particularly in the provinces of Erzurum, Tunceli,

Adana etc. Davis 30849 (25), Siehe 552 (12), Stainton 5762 (26) and B. Post 284 (44) show intermediacy between those two subspecies. Besides these, Haradjian 2251 (59) and Sorger 62-68-7 (58) from Hatay and Adana show marked disjunction with the rest of var. iberica, being separated by the "Anatolian Diagonal"; D.20218 (39) from Marag has intermediate characters between var. iberica and subsp. stenostachya. All or some of the intermediates mentioned above may possibly have arisen through hybridisation in contact zones. Allowances have been made for these overlaps in adjacent populations and the main subspecies and varieties are maintained.

The Caucasian varieties (Grossheim, 1967) have not been checked by me, due to unavailability of specimens.

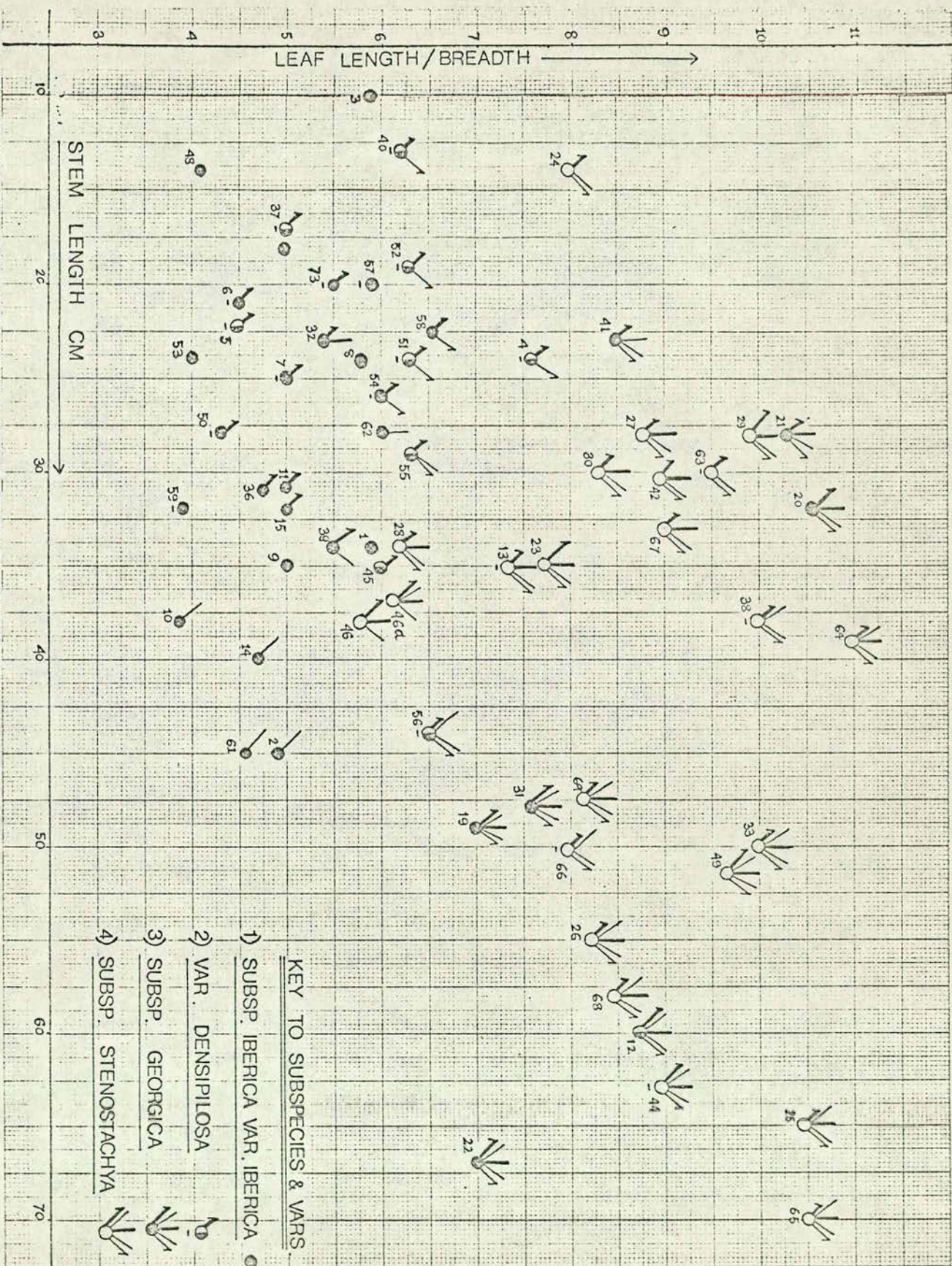
FIG. 30 SCATTER DIAGRAM OF *STACHYS IBERICA* BIEB. S.L.

Table 10. Character variations in *S. iberica* Bieb.

No. of sheets	Stem length	Stem pro-cumbent/erect	Leaf shape	Leaf margin	L/b ratio of leaf	Leaf indumentum	Corolla colour
1. (B9)	34 cm	pro-cumbent	oblanceolate	crenate	5.9	gla-brescent	mauve
2. (A9)	45 cm	"	"	"	4.8	"	purple-pink
3. (A6)	10 cm	"	"	weak-crenate	5.9	"	"
4. (A6)	24 cm	"	"	sub-entire	7.6	hirsute	pale pink
5. (A3)	22 cm	"	"	"	4.5	"	"
6. (A3)	21 cm	"	"	"	4.5	"	"
7. (A5/6)	25 cm	"	"	"	5	"	purple-pink
8. (A8)	24 cm	"	"	crenate	5.8	gla-brescent	"
9. (A8)	35 cm	"	"	"	5	± hirsute	"
10. (A8)	38 cm	"	"	"	3.8	gla-brescent	"
11. (A8)	31 cm	"	"	sub-entire	5	"	"
12. (C5)	60 cm	erect	lanceolate	serrate	8.8	"	pale pink
13. (B6)	35 cm	"	"	sub-entire	7.5	hirsute	"
14. (A7)	40 cm	pro-cumbent	oblanceolate	crenate	4.7	gla-brescent	purple-pink
15. (A9)	32 cm	"	"	sub-entire	5	"	"
19. (B9)	49 cm	erect	lanceolate	serrate	7	"	"
20. (A9)	32 cm	"	"	faintly serrate	10.6	"	mauve
21. (B8)	28 cm	"	"	serrate	10.3	"	"
22. (C9)	67 cm	"	"	"	7	"	"
23. (B5)	35 cm	"	"	"	7.7	"	creamy
24. (C4)	14 cm	pro-cumbent	"	sub-entire	8	"	"
25. (B8)	65 cm	erect	"	"	10.5	"	"
26. (B6)	55 cm	"	"	"	8.2	"	"
27. (B5)	28 cm	"	"	"	8.8	"	"
28. (B5)	34 cm	"	"	"	6.2	"	"
29. (C5)	28 cm	"	"	serrate	10	glabrous	"

Table 10. (contd)

No. of sheets	Stem length	Stem pro-cumbent/erect	Leaf shape	Leaf margin	l/b ratio of leaf	Leaf indumentum	Corolla colour
30. (B7)	30 cm	erect	lanceolate	entire	8.3	glabrous	creamy
31. (A9)	48 cm	"	"	faintly serrate	7.6	gla-brescent	mauve
32. (B9)	23 cm	"	oblanceolate	sub-entire	5.4	"	purple-pink
33. (B7)	50 cm	"	lanceolate	"	10	"	pale pink
36. (A5)	31 cm	pro-cumbent	oblanceolate	sub-entire	4.8	hirsute	purple
37. (A4)	17 cm	"	"	"	4.5	"	pale pink
38. (B4)	38 cm	"	lanceolate	"	10	gla-brescent	creamy
39. (B6)	34 cm	"	"	serrate	5.5	hirsute	purple
40. (A4)	13 cm	"	oblanceolate	entire	6.2	"	pale pink
41. (A9)	23 cm	erect	lanceolate	"	5.4	gla-brescent	purple
42. (B6)	62 cm	"	"	serrate	9	hirsute	creamy
43. (C5)	36 cm	"	"	"	6	"	"
44. (C5)	62 cm	"	"	"	9	"	"
45. (A6)	35 cm	pro-cumbent	oblanceolate	sub-entire	6	glabrous	pale pink
46. (C5)	38 cm	erect	lanceolate	serrate	5.8	hirsute	creamy
48. (A7)	14 cm	pro-cumbent	oblanceolate	crenate	4.1	"	purple
49. (C5)	50 cm	erect	lanceolate	serrate	10	gla-brescent	creamy
50. (B3)	28 cm	pro-cumbent	oblanceolate	sub-entire	4.3	hirsute	pink
51. (A3)	24 cm	"	"	"	6.3	"	pale pink
52. (A4)	19 cm	"	"	"	6.3	"	"
53. (A7)	24 cm	"	"	"	4	"	purple
54. (A4)	26 cm	"	"	"	6	"	pink
55. (B3)	29 cm	"	lanceolate	"	6.3	"	pale pink
56. (A3)	44 cm	"	"	"	6.5	"	"
57. (A5)	20 cm	"	oblanceolate	crenate	5.9	"	pink
58. (C5)	23 cm	"	"	sub-entire	6.5	gla-brescent	purple

Table 10 (contd)

No. of sheets	Stem length	Stem pro-cumbent/erect	Leaf shape	Leaf margin	L/b ratio of leaf	Leaf indumentum	Corolla colour
59. (C5)	32 cm	pro-cumbent	oblanceolate	crenate	3.8	hirsute	purple
60. (A4)	17 cm	"	"	"	5	gla-brescent	"
61. (A7)	45 cm	"	"	"	4.7	"	"
62. (B9)	28 cm	erect	"	sub-entire	6	"	pink
63. (A8)	30 cm	pro-cumbent	lanceolate	"	9.5	hirsute	creamy
64. (B7)	39 cm	erect	"	"	11	gla-brescent	"
65. (B7)	70 cm	pro-cumbent	"	"	10.5	"	"
66. (B6)	50 cm	"	"	"	8	hirsute	"
67. (B9)	33 cm	erect	"	"	9	"	"
68. (A5)	58 cm	"	"	"	8.5	"	"
69. (A5)	48 cm	"	"	"	8	glabrous	"
70. (B5)	50 cm	"	"	"	8.2	"	"
71. (C4)	45 cm	pro-cumbent	"	serrate	7.5	"	"
72. (B4)	32 cm	"	"	sub-entire	7	"	"
73. (C3)	20 cm	"	oblanceolate	"	5.5	"	purple

47. S. aleurites Boiss. et Heldr. in Boiss., Diagn. ser. 1(12): 79 (1853)
 Syn. S. tengwalliana Rech. fil. in Öst. Bot. Zeitscht. 99: 46 (1952)!
 (Map 22).

Suffrutescent, erect perennial, 50-60 cm. Flowering stems \pm simple and unbranched. Indumentum thin, arachnoid-canescens, sometimes stem glabrescent below. Lower cauline leaves ovate to ovate-lanceolate, 2-4 x 1.5-2.5 cm, crenate-serrate, base subcordate to truncate, petiole 2-3.5 cm, gradually passing into shorter, subsessile to sessile, lanceolate, subentire, median cauline and floral leaves. Floral leaves spinescent at tip, as long as or slightly longer than verticillasters. Verticillasters 8-12-flowered, 1-2 uppermost \pm approximate. Bracts lanceolate 9-12 x 1.5-2 cm, as long as calyx tube, spinescent tipped. Pedicels 0.2-0.5 mm. Calyx sub-bilabiate, tubular to subcampanulate, 11-13.5 mm; teeth lanceolate-subulate, \pm as long as tube, with long spinescent tip, recurved in fruits. Corolla 13-15 mm, creamish yellow, tube subexserted. Nutlets obovoid 2-2.5 mm. Fl. April-July.

Habitat: Calcareous rocks near the coast, 10-300 m.

Type: $\overline{\text{Turkey C3 Antalya}}$ Hab. and rupes maritimas ad Adalia Pamphyliae,
 5 v 1845, Heldreich (G!)

S.W. Anatolia

C3 Antalya: between Çukular and Sogut Yaylâ, near N. foot of Sivri Dag,
 300 m, D. 15439!

: Konya Alti, 10 m, Tengwall 438 (type of S. tengwalliana)!

Adalia (Antalya), 30 iv 1866, Bourgeau 210!

Endemic to S. Anatolia, Eastern Mediterranean element.

48. S. bombycina Boiss., Diagn. ser. 1(12): 79 (1853). (Map 22).

Suffrutescent perennial, 45-50 cm. Indumentum densely floccose to woolly tomentose. Lower cauline leaves ovate to ovate-lanceolate, 1.5-2 x 1-1.3 cm, with dense floccose indumentum on both surfaces, margin crenate-dentate, base rounded to subcordate, petiole 1-2.5 cm. Upper cauline and floral leaves oblong-lanceolate 0.5-1.5 x 0.4-0.8 cm, shortly petioled or sessile to sessile. Verticillasters usually 1-2(-3), remote, 8-12-flowered. Bracts ovate-lanceolate, 7-7.5 mm, densely tomentose, tip \pm blunt to shortly spinescent. Calyx sub-bilabiate, subcampanulate, 8-11 mm; teeth subequal, lanceolate-subulate, as long as or shorter than tube, tip softly spinescent. Corolla 9-13 mm, creamish yellow, tube subexserted. Nutlets obovoid 2-2.5 mm. Fl. May-June.

Habitat: Limestone rocks near seashore and in Pinus brutia woods, 10-15 m.

Type: Hab. in Syria (Sic) loco non notato, Pestalozza (holo. G!).

S.W. Anatolia

C3 Antalya: Kara Dağ, 30 m, Truman 47!

distr. Kemer: Gökük, 10-50 m, D.15015!

Endemic, E. Mediterranean element.

Pestalozza did not collect in Syria or in Lebanon, so we can assume that the type came from S.W. Anatolia.

49. S. distans Benth. var. oiligica Huber-Morath & Bhattacharjee var. nov.

(Map 22).

A typo dentibus calycis longioribus lanceolato-subulatis longius mucronatis, indumento caulium et foliorum et calycium albo-tomentoso recedit.

Suffrutescent perennial. Flowering stems erect, branched, rarely simple, 30-70 cm. Indumentum densely white-lanate. Lower and median cauline leaves

ovate to ovate-oblong, 1-3.2 x 0.5-2 cm, serrate, truncate to cuneate, petiole 0.2-2 cm; indumentum thinly adpressed canescent on upper surface and canescent below. Floral leaves subsessile to sessile, ovate-lanceolate to lanceolate, entire to faintly serrate, gradually becoming bract-like above, 1-2.5 x 0.2-0.5 cm. Verticillasters 1-4, remote, 8-12-flowered, subsessile. Bracts oblong-lanceolate to lanceolate-subulate, 6-9 mm with spinescent tip. Calyx subbilabiate, tubular, 8-13 mm; teeth subequal, lanceolate-subulate, 3-7 mm including 1.8-2 mm long mucro, teeth recurved in fruit. Corolla 9-12 mm, yellowish white with purple streaks, tube subexserted. Stamens exserted more than half way along upper lip. Nutlets obovoid, 1.8-1 mm. Fl. April-May.

Habitat: Dried up river bed near aqueduct, seaside on rocky ruins, 10 m.

Type [Turkey C4 Içel] 17.vi.1950, Huber-Morath 10142 (holo. Hb. Hub.-Mor. Basel!)

S. Anatolia

C5 Içel: 27 km E Silifke, 10 m, Sorger 71-13-7!

External Distribution: Lebanon. E. Mediterranean element.

With the discovery of this variety, S. distans Benth. has been reported from Turkey for the first time. It is distinguished from var. distans, var. oxydonta Boiss. and var. teucriifolia Boiss. in the nature of its calyx teeth and indumentum. The calyx teeth are narrowly lanceolate-subulate with 1.8-2 mm long mucro, the teeth being as long as or slightly longer than the calyx tube. The indumentum is glandular and adpressed white-tomentose throughout the plant body. In other varieties the upper part of the plant is usually glabrescent and the calyx is either glabrescent or glandular with short teeth.

Geographically this new variety is intermediate between other varieties of S. distans Benth. growing in Syria, Lebanon and Palestine on one side and S. aleurites Boiss., S. bombycina Boiss. on the other endemic to S.W. Anatolia.

50. S. maritima Gouan, Fl. Monspel. 91 (1764) (Map 26).

Suffrutescent perennial with basal sterile rosettes. Flowering stems procumbent, simple or branched, 5-35 cm, retrorsely adpressed-pubescent. Basal leaves ovate to ovate-oblong or oblong elliptic, 0.5-3.5 x 0.4-1.8 cm, apex obtuse, subcordate to cuneate at base, petiole 0.8-4.5 cm. Cauline leaves ovate-lanceolate to oblanceolate, 0.7-3 x 0.4-1.5 cm, weakly crenate to subentire, shortly petioled to sessile. Floral leaves sessile to sessile, oblong-lanceolate, gradually becoming smaller than verticillasters. Verticillasters usually approximate for most part, 1-2 remote below, 6-8-flowered. Bracts few, setaceous, 1-2.5 mm. Pedicels 1-1.5 mm. Calyx subbilabiate, subcampanulate, 8-9 mm, \pm gibbous at base in fruit; teeth triangular with soft spinescent tip, $\frac{1}{3}$ as long as tube, indumentum densely adpressed-pubescent. Corolla 13-15 mm, creamy, tube subexserted, saccate at base. Nutlets ovoid, 2 x 1.8 mm. Fl. April-July.

Habitat: Maritime sands, dunes, sea level to 15 m.

Type: Habitat Monspeliensis versus mare and stagna, a Manguio, Perauls, Lattes, (S. France).

N.W. Turkey

A2(E) Istanbul: Sceumbroukeuy (Uskunderkuy), 10.viii 1905, Aznavour!

Kirklareli: Kasatura, A. & T. Baytop 11875!

A2(A) Istanbul: Drace to Kartal, 27.vi.1897, Aznavour!

Kocaeli: Hereke, N. Tanker 6328!

A3 Sakarya: Karasu, A. Baytop 18612!

External distribution: S. Europe (Spain, France, Corsica, Italy, Yugoslavia, Bulgaria) Caucasus, Black sea coast. Mediterranean element.

This species is closely related to S. annua (L.) L. but differs from it

in having shorter calyx teeth and congested spicate inflorescence. Probably these two species have evolved from a common ancestral stock, S. maritima being differentiated later from a maritime ecotype of the more variable S. annua in response to particular habitat condition.

51. S. annua (L.) L. Sp. Pl. ed. 2, 813 (1763)

Syn: Betonica annua L., Sp. Pl. ed. 1, 573 (1753)

S. betonica Crantz, Strip. Austr. ed. 2 (4): 264 (1769)

S. pubescens Ten., Fl. Nap. 1, Prodr. 34 (1811), Ic. vol. 5:
14 tab 239 (1835)

S. balbissi Link, Enum Hort. Berol. 2: 110 (1821)

S. maritima Urv. in Mem. Soc. Linn. 1, 324 (1822) non L. (1767)

S. decumbens Willd. ex Benth. in Linnaea 11: 336 (1837) non Pers.
(1806)

S. micrantha C. Koch in Linnaea 21: 690 (1848)

S. adenocalyx C. Koch op. cit. (1848)

S. neglecta Klok. apud. Koccko in Fl. BSSR 4: 289 (1955) (Map 23).

Suffrutescent perennial, biennial or annual with or without basal sterile rosettes. Flowering stems usually procumbent, simple or branched c. 8-50 cm.

Stem densely or sparsely retrorse-pubescent sometimes glabrous at base or throughout, rarely patent glandular haired from base to apex. Basal leaves ovate-oblong to ovate-lanceolate 1-4.5 x 0.5-2.5 cm, crenate, cordate or subcordate to cuneate or attenuate at base, petiole 1-5 cm. Cauline leaves ovate-rhomboid, broadly lanceolate to oblanceolate 1-3 x 0.5-1.5 cm, crenate-dentate, cuneate to attenuate at base, shortly petioled to sessile c. 1 cm.

Floral leaves elliptic to linear-lanceolate 1-2 x 0.5-0.8 cm, weakly crenate or entire, subsessile to sessile, as long as or slightly longer than verticillasters above. Leaf indumentum sparsely adpressed pubescent sometime glabrescent with sessile glands. Verticillasters usually remote 1.5-4 cm distant, few \pm approximate above, 4-6-8)-flowered. Bracts few setaceous 1-2 mm. Pedicels 1-1.5 mm. Calyx sub-bilabiate, subcampanulate to campanulate, 10-11 mm, \pm gibbous at base in fruit; teeth triangular subulate to lanceolate with 0.5-2 mm long hairy, spinulescent tip, $\frac{1}{2}$ - $\frac{3}{4}$ as long as calyx tube, inner and outer calyx lip curved inwards and outwards the calyx mouth respectively. Calyx tube densely villous to adpressed pubescent, sometimes glabrescent, tube densely to sparsely adpressed pubescent rarely glabrescent with or without glandular hairs. Corolla 13-19 mm, creamy-yellow with red markings; tube exerted, saccate at base. Nutlets obovoid 2-1.3 mm

Key to subspecies and varieties :

1. Plant annual
2. Stem procumbent, glabrescent below, adpressed pubescent above with glandular hairs or sessile glands or glabrescent throughout
3. Stem glabrescent with sessile glands; calyx teeth lanceolate-subulate with 0.5-1 mm long shortly haired spinulescent tip
..... subsp. annua var. annua
3. Stem glabrescent below adpressed pubescent above with few glandular hairs; calyx teeth triangular subulate with 1-2 mm long densely setulose tip
..... subsp. ammophila
2. Stem erect, patently glandular haired throughout subsp. cilicica
1. Plant perennial or sometimes biennial

4. Calyx tube patently pilose in lower part with c. 2 mm long hairs

..... subsp. annua var. lycaonica

4. Calyx tube adpressed pubescent throughout and with few patent hairs

..... subsp. annua var. annua

subsp. cilicica (Boiss.) Bhattacharjee, stat. nov.

Syn. S. cilicica Boiss., Diagn. Ser. 2 (4): 42 (1859)

S. annua var. cilicica (Boiss.) Boiss., Fl. Or. 4: 746 (1879)

Fl. May-June

Habitat: Rocky sea-shore. Sea level-1200 m.

Type: [Turkey C5 Içel] Hab. in fauce Guzeldere supra Sedichig in Cilicia littorali, 4.v.1855, Balansa 589 (holo. G!)

S. and N. Anatolia, local.

A5 Amasya: Mersifon to Değir Dağ near Derecy, 8.vi.1909, Post!

Kastamonu: Tossia, prope Sekor, Sintenis 1892: 3914!

C5 Içel: Gülek Depe, 1200 m, Siehe 1896: 457!

Endemic. E. Mediterranean element.

subsp. ammophila (Boiss. et Bl.) Sam. in Ark. Bot. 5: 376 (1957)

Syn. S. annua var. ammophila Boiss. & Bl. in Boiss. Diagn. Ser. 2 (4):

43 (1859)

Fl. January-May.

Habitat: Rocky slopes and fallow fields of loamy or sandy soils. 5-730 m.

Type: [Lebanon] Hab. in arenosis saepe maritimis circa Beyrouth et Tripoli Syriae, Blanche (holo. G! iso. K! Edin!).

S. Anatolia

C3 Antalya: Lara \pm 10 km S.E. of Antalya, 5 m, Hennipman et al. 167!

C5/6 Adana: Ceyhan to Osmaniye, 500 m, D.26701!

C6 Hatay: Dörtyol, Rabat, 100 m, Coode 499!

Antakya, 28.iv.1957, 150 m, D.27198!

External distribution: N. Syria, Lebanon. E. Mediterranean element.

subsp. annua var. lycaonica Bhattacharjee, var. nov.

A var. annua calycis tubo inferne patentem villosis pilis c. 2 mm longis divergit. Fl. May-September.

Habitat: Edge of cultivated fallow fields, stream sides, denuded forest, limestone gorges and slopes, gravelly banks and sea-shore cliffs, 50-2050 m.

Type [Turkey B2 Kütahya] Kütahya: Gediz to Kütahya, 18 km S. of Kütahya, 1100 m, limestone gorges and slopes, 7.vii.1962, Davis & Coode D.36929 (holo. E!)

Mainly C. Anatolia

A2 Bilecik: 14 km N. Bilecik, 600 m, Sorger 62-17-11

A3 Ankara: Ankara to Beypazarı, 700 m, Akman 96!

A4 Ankara: Ankara, Bornmüller 1893: 3090!

B3 Eskesehir: 3 km W. Sivrihisar, 1100 m, Sorger 64-32-33!

B5 Nevşehir: Göreme, 1130 m, D.42224!

B6 Sivas: Divrigi, 2.vi.1968, T. Baytop 13004!

C2 Denizli: Kizilcaböyük to Denizli, 1000 m, Dudley, D.35339b

C3 Konya: 61 km S. of Konya, 1350 m, Sorger 70-42-11!

C4 Konya: Beyşehir to Konya, 4 km from Beyşehir, 1100 m, Dudley, D. 35841!

C5 Adana: at Siambeyli (Hadjin), Manissadjian 33b!

External distribution: W. Iran. Irano-Turanian element.

var. annua

var. annua

Fl. March-September.

Habitat: Dry igneous to shady slopes, mixed forest and fallow fields. 400-2200 m.

Type: Habitat in Germania, Helvetia, Gallia ad Agrorum margines, Linn.

Hb. 736.18!

Widespread

A2(E) Iatanbul: Halkali, 27.v.1894, Aznavour 1772!

A2 Bursa: Bursa to Keles, 1000 m, Dudley 34792!

A3 Bolu: 26 km W. Gerede, 1100 m, Sorger 71-2-6!

A4 Kastamonu: Küre to Inebolu, 732 m^{t.}, D.21600! Tossia, Sintenis

Vallei de Djmil (Lazistan) var. 200 m, vii.1866, Boiss. 8891! 1892: 4568!

A5 Sinop: Sinop, 15 m, Tobey 19A

A6 Amasya: in incultis, 4-600 m, Bornmüller 1889: 658!

A7 Gümüşane, 21.v.1862, Bourgeau!

A8 Erzurum: Pasinlar to Horasan, 1650 m, D.29432!

A9 Çoruh: Ziyaret Dağ, between Aradhan to Artvin, 2200 m, D.30288!

B3 Isparta, d. Igirdir: Barla Dağ, foot hills, Khan 417!

B5 Yozgat: Sorgun to Sekerek, 1200 m, Coode 1558!

B6 Sivas: Zara to Şerefiye Yaylâ, 1660 m, Huber-Morath 12553!

B7 Elazığ: Kharput (Harput), Sintenis 1889: 676!

B9 Bitlis: Tatvan, 1759 m, D.22199!

B10 Van: 5 km N.E. of Başkale, 2150 m, D.45939!

C2 Denizli: Honaz Dağ, Denizli to Tavas, 1300 m, Huber-Morath 5259!

C3 Isparta: d. Sütçüler, Cimen ova on W. side of Sarp Dağ, 1500 m, D.15808!

C5 Niğde: Near Maden village, 1676 m, Darrah 405!

C6 Maraş: Zeytun, 1219 m, Balls 1011!

C10 Hakkari, 10 km from Yüksekova on Gevar Ovasi, 1950 m, Duncan & Tait 144!

External Distribution: Europe (C.E.W. & S.), USSR & S.W. Asia. Mediterranean, Irano-Turanian and Euro-Siberian element.

Much confusion has arisen regarding the taxonomic status of the widely distributed and variable S. annua. Linnaeus (1753) described the species first under Betonica and later (1763) transferred it to Stachys. He mainly diagnosed the species on its annual and glabrescent habit and lanceolate 3-nerved leaves with a cuneate base. Later Tenore (1815) described S. pubescens from Italy, which he kept separate on its perennial habit with basal sterile rosettes, dense indumentum and ovate basal leaves with cordate base. These two 'species' originally seemed quite distinct.

In the present investigation, as I was dealing with a huge and widely variable collection of S. pubescens sensu Boiss. and S. annua L. from Anatolia and adjacent regions, the main diagnostic characters of these two species was found to break down at almost every level, including annual and perennial habit. In practice, it is very difficult to differentiate the annual and perennial specimens, as they frequently show intermediate conditions. Besides that, there are some apparently biennial plants which connect the annuals with the perennials, sometimes in the same population. With a view to coming to a definite taxonomic^{con-} conclusion, I examined all the available European material of both these species of S. annua and S. pubescens, including their respective type material in Linn. Herb. and BM. The retrorsely adpressed hairs on stem and very characteristic shape of calyx, (the lower teeth curved inwards and upper teeth \pm curved outwards in fruit, cf. Fig. 10 L) seem to be the most important and constant character throughout the whole range of distribution.

In typical S. annua L. (described from Europe) though the stem is \pm glabrescent, the insertion of the hairs is the same as that of S. pubescens Ten., which has densely pubescent stems. To me these two well known but much confused taxa are conspecific, the annual S. annua being nothing but an annual form of the perennial S. pubescens (of mountainous and steppic habitats) which has arisen in

Pl. 19. Variation in habit in S. annua (L.) L. s.l.

(Explanation in the text)

A - S. annua ssp. cilicica (annual); B - S. annua var. annua
(annual); C - S. annua var. annua (annual); D - S. annua
var. annua (perennial); E - S. annua var. lycaonica (perennial).



Pl. 19. Variation in habit in S. annua (L.) L. s.l.

response to the temporary and disturbed habitat conditions of cultivated and semi-cultivated fields. (Pl. 19).

Two annual subspecies (ammophila and cilicica) and a perennial variety (subsp. var. lycaonica) have been recognised here, based upon a few other morphologically correlated characters, whereas S. annua var. annua (including S. pubescens) remains as a variable taxon including annual, biennial and perennial plants with glabrescent to densely pubescent stems and with or without basal sterile rosettes of variable leaves. S.W. Asia, particularly Anatolia, is the place where the diversification of the species is greatest, rendering taxonomy very difficult; in Europe the species has lost much of its variability, being represented only by var. annua where the annual and perennial forms remain distinct.

Subsp. cilicica shows disjunction between the Cilician Taurus and N. Anatolia. This ^{is} associated with Mediterranean enclaves in the Euxine province. A few species of var. annua from Bursa and Bolu are more glandular throughout the plant body (Dudley, D.34792, Sorger 71-2-6 and others), though some amount of overlap is detectable in the provinces of Samsun, Kastamonu and Zonguldak, particularly in the glandulosity of the calyx tube and teeth. Subsp. annua var. lycaonica is morphologically and geographically separated from the rest of the subspecies and has probably arisen in adaptation to the more arid conditions of C. Anatolia.

52. S. inanis Hausskn. et Borm. in Feddes Rep. 22: 187 (1925) (Map 22).

Biennial (?), erect, ± glabrescent or sparsely puberulent to pruinose glandular. Flowering axis slender, partly paniculate, 46-50 cm. Basal leaves forming rosettes, petiole 0.6-5.5 cm, lamina ovate to rotund 3.5-4 x 2-3.7 cm, shallowly crenate, base cordate to subcordate, apex obtuse. Cauline and floral

leaves subsessile to sessile, lanceolate to linear 2.5-10 x 1.5-3 mm, entire, attenuate, apex blunt. Verticillasters 2-flowered, remote, 0.4-4 cm apart, ebracteate. Pedicels 1-2.5 mm. Calyx \pm regular, subcampanulate, 4-4.5 mm; teeth \pm equal, triangular-lanceolate, shortly mucronate, \pm half as long as tube. Corolla 9-11 mm, white, tube subexserted. Nutlets obovoid 2-3 x 1 mm, brown, smooth. Fl. June-July.

Habitat: Limestone screes and steppes. Alt. 1530-1570 m.

Syntypes [Turkey B7 Erzincan] Egin, Pasch-Tasch Gebirge 26.vi.1889 Sintenis 948!; Egin, Salachlii, in collibus nudis, 25.vi.1890 Sintenis 2756!

E. Anatolia

B7 Erzincan: Susehri, 1570 m, Huber-Morath 12761!

Endemic. Irano-Turanian element.

Allied to S. munzurdagensis Bhattacharjee (q.v. p. 315).

53. *S. munzurdağensis* Bhattacharjee, sp. nov.

(Map 22).

Affinis *S. inani* Hausskn. et Bornm. sed habitu perenni, caulibus minus ramosis, foliis basalibus ad basin cuneatis vel rotundatis, foliis floralibus ovato-rhomboides, verticillastris 4-6-floris, calyce longiore valde differt.

Strongly perennial, suffrutescent with branched woody caudices. Flowering stems several, erect, slender, 30-45 cm x 1-2.5 mm, laxly branched once or twice near base; \pm glabrescent below with few sessile glands, becoming densely pruinose above with sessile to short stalked glands and sparse, minute, patent, eglandular hairs; cauline leaves few, internodes 2-6 cm long. Basal leaves forming dense sterile rosettes, petiole 1.5-4.5 cm, lamina thick, oblong to ovate-oblong, 2-5 x 1.5-3 cm, base cuneate rotund, shallowly crenate, apex rounded, subglabrous with few sessile glands and very sparse and short eglandular hairs on both surfaces; lower cauline leaves oblong to oblanceolate, obtuse, 1.5-2.5 cm excluding 2-3.5 cm petiole, base cuneate to attenuate, distantly and faintly crenate-serrate; median cauline leaves sessile, oblanceolate to narrowly oblong-elliptic or oblong-lanceolate, 8-14.5 x 2-3.8 cm, attenuate, entire with obtuse apex; lower floral leaves similar to median cauline ones, gradually becoming rhomboid-ovate upwards, 6-8 x 2-3.5 mm, obscurely mucronate, \pm equal to or slightly shorter than verticillasters. Verticillasters remote, mostly 3-4.5 cm distant, upper 2-3 \pm approximate, 4-6-flowered, ebracteate. Pedicels 1-1.5 mm. Calyx \pm regular, tubular, 6-7 mm, \pm glabrescent or sparsely pruinose-glandular with very sparse eglandular hairs all over, mouth glabrous; teeth \pm equal, erect, ovate-triangular, shortly mucronate, upper and lower teeth 2-2.5 and 2.8-3 mm respectively, including the 0.3-0.5 mm micro; fruiting calyx similar but 8-8.5 mm. Corolla 10-5-12 mm, white, tube subexserted, shortly pubescent outside, tube oblique, 7-7.5 mm,



Pl. 20. Stachys munzuragensis Bhattacharjee (Holotype)

annulate; upper lip concave, entire, glabrescent outside, ovate 6.5 mm. Stamens slightly exserted from corolla mouth, outer and inner pairs 3 and 2.5 mm respectively. Nutlets obovoid, smooth, brown, 2-3 mm. Fl. June-July.

Type [Turkey B7 Tunceli]: Munzurdağ, above Ovacık, on limestone screes, 1800 m, 16. vii. 1957, Davis & Hedge D.31164 (holo. E, iso. BM)!

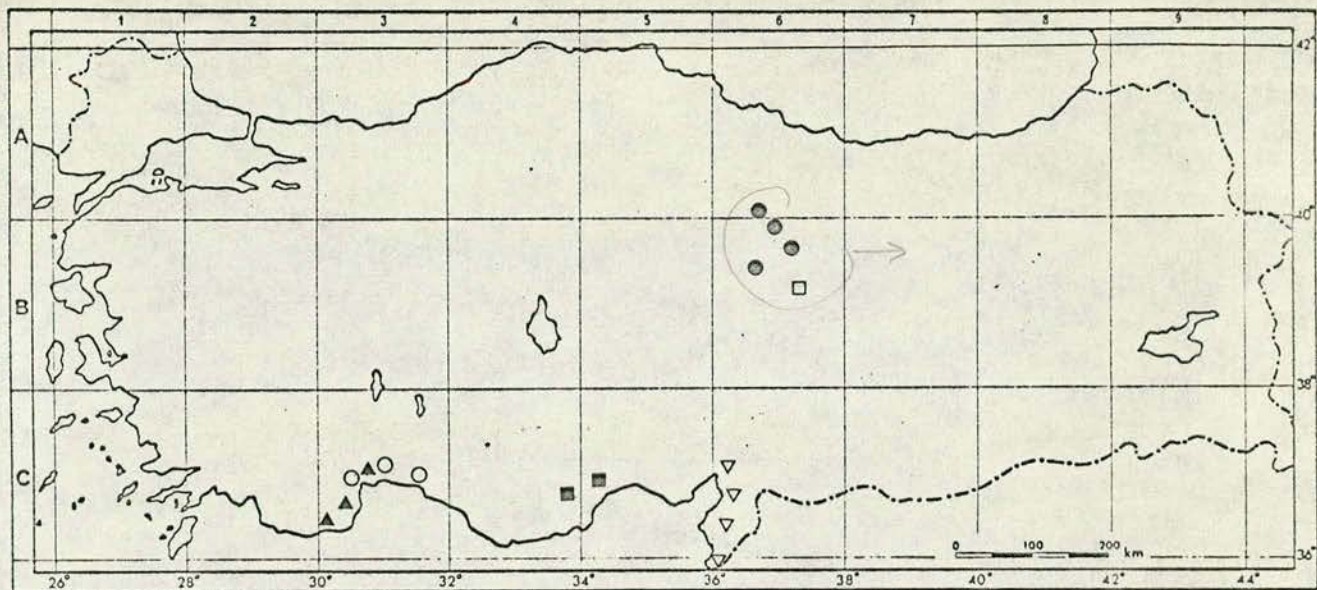
Endemic, Irano-Turanian element.

Known only from the type gathering but so distinct that there is no difficulty in distinguishing it.

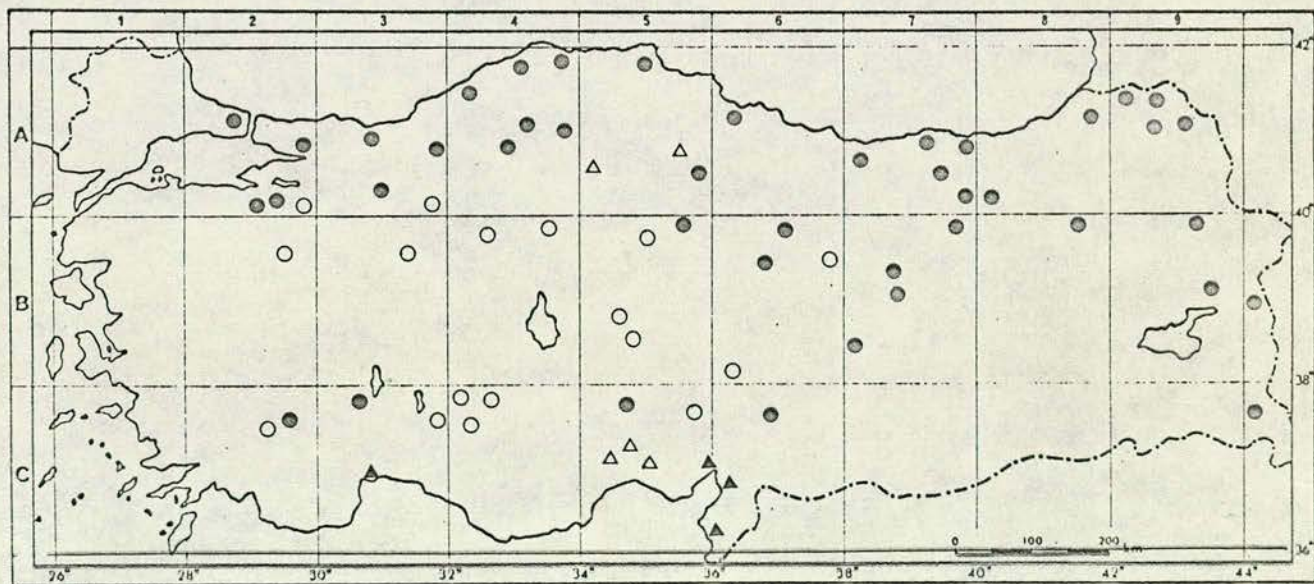
54. S. diversifolia Boiss., *Diagn. ser.* 1(12): 80 (1853). (Map 22).

Perennial with sterile basal rosettes. Flowering stems erect, unbranched below, 40-60 cm, glabrescent to sparsely adpressed-pubescent. Basal leaves ovate to oblong-elliptic, 0.6-5 x 0.4-1.5 cm, subentire to faintly serrate, cuneate to attenuate into 0.5-5 cm petiole, petiole and leaf surfaces with long adpressed hairs. Cauline leaves subsessile to sessile, oblanceolate to oblong-lanceolate 0.6-5 x 0.2-1 cm, entire, attenuate. Floral leaves similar to cauline, uppermost ones spinescent-tipped and as long as verticillasters. Verticillasters 1-2-flowered, remote below and 3-4.5 cm distant, \pm approximate above on simple or branched inflorescence axes. Bracts oblong-lanceolate, 2-4 mm, mucronate. Pedicels 1-1.5 mm. Calyx \pm regular, narrowly campanulate, 5-7 mm; teeth \pm equal, erect, c. half as long as calyx tube, glabrescent to minutely hirsute. Corolla 12-16 mm, pale pink, tube exserted. Stamens slightly exserted from corolla tube. Nutlets obovoid, 2-2.5 mm, brown, smooth. Fl. May-September.

Habitat: Rocky mountainous ground, river banks, sometimes in *Fagus-Quercus* community, 240-1500 m.



Map 22. ▽ S. diversifolia; ● S. inanis;
 □ S. munzurdagensis; ■ S. distans var. cilicica;
 ○ S. aleuritica; ▲ S. bombycina



Map 23. ● S. annua ssp. annua; ▲ ssp. ammophila;
 Δ ssp. cilicica; ○ var. lycaonica

Type [Latakya]: Hab. in dumosis regionis montanae in Syria inter Latakia et Aleppum sitae, Boissier (holo. G!).

S. Anatolia

C6 Hatay: Montis Amanus valley 240-914 m, Haradjian 4671!

C6 Seyhan (Adana): Osmaniye, N. Amanus, Yaglipivar S. of Yarpuz, 1430-1500 m, Huber-Morath 15276!

External distribution: W. of Syria (Latakia). E. Mediterranean element.

This species is very distinct, showing some affinity with S. inanis and S. munzurdagensis, but is readily distinguishable by its more or less simple flowering stems and oblong-lanceolate 2-4 mm long branches with mucronate tip. The inflorescence is a very characteristic one; it is either simple or sparsely branched above. In the simple type, one side of the verticillaster usually aborts so that the verticillaster becomes 1-flowered. The opposite side either remains barren or an axillary flowering branch develops there which repeats the same verticillaster development described above. Occasionally, instead of aborting or producing flowering branches, the opposite axil produces an ordinary flower bud and the verticillaster appears normal and 2-flowered. All these types occur either in the same or different plants in the same population. (cf. Fig. 9 F).

Sect. CAMPANISTRUM (p. 134)55. S. spinulosa Sibth. & Sm., Prodr. Fl. Graec. 1: 410 (1806)Syn: S. betonicifolia Desf. in Ann. Mus. Par. 10: 304 (1807), non Regel (1879). (Map. 24).

Erect to procumbent annual, 10-70 cm. Indumentum on stem sparsely and patently pilose to hispid above, \pm absent below and aculeolate at the angles. Cauline leaves ovate-elliptic to ovate, 1.6-7.5 x 1.5-4.6 cm, margin crenate, apex obtuse to acute, base cordate, petiole 0.6-6.5 cm. Floral leaves subsessile to sessile, ovate-oblong to oblong-lanceolate, 1.3-4.5 x 0.4-1.2 cm, margin serrated, apex acute with soft spinescent tip, base cuneate. Verticillasters remote, 4-6-flowered. Bracts linear, setaceous, often hairy, 1-2 mm. Pedicels 1-2 mm. Calyx sub-bilabiate, campanulate, 9-12 mm; teeth ovate-triangular with short spinescent tip, half as long as tube. Corolla 18-20 mm, yellow, tube exserted. Nutlets obovoid, 2 x 1.5 mm. Fl. April-June. Habitat: Limestone ledges and cliffs, clay fields near the sea coast. Sea level 20 m.

Type $\overline{\text{Crete}}$ In insula Creta, Sibthorp.

N.W., W. & S.W. Anatolia, Islands.

A2(A) Istanbul: Isle Halki (Heybeliada), sea-level, Aznavour 1776!A2(A) Istanbul: Haider Pacha, 19 v 1906, B. PostA2(A) Kocaeli: Pendik, sea-level, Aznavour 23!C2 Muğla: Marmaris, Hisarözü to Turgut, 20 m. D.41141!C3 Antalya: W. of Kale, sea-level, Huber-Morath 10130!Is: Icaria: Ag. Kyrikos, 10 m, D.40649!Rehinger 4364!

External Distribution: Southern part of ^{the} Balkan Peninsula and Aegean Islands.
E. Mediterranean element.

The species bears resemblances with the Balkan S. milanii Petrov. but differs in having hispid indumentum with aculeate hairs, lower cauline leaves with cordate base, lower corolla tube and shorter calyx teeth.

56. S. arabica Hornem., Jort. Hofn. 554 (1813-1815)

S. macrosperma Boiss., Diagn. ser. 1(12): 84 (1853) (Map 24).

Erect to procumbent annual, 40-55 cm, simple or branched. Indumentum \pm dense, patently pilose to hispid, glandular and eglandular. Cauline leaves broadly oblong-elliptic, 1.8-5.3 x 1.2-4 cm, margin crenate-serrate, base cordate, apex acute, petiole 2-4 cm. Floral leaves sessile, ovate to oblong-lanceolate, 1.4-5 x 0.3-2.3 cm, margin distinctly serrate, base rounded, larger than verticillasters. Verticillasters remote, \pm approximate above, 4-6-flowered. Bracts few, linear, setaceous, 1-3.5 mm. Pedicels 1-2 mm. Calyx \pm sub-bilabiate, campanulate, 14-16 mm; teeth lanceolate, as long as or slightly less than tube, spinescent tipped. Corolla 19-20 mm, purple, tube subexserted. Nutlets obovoid, 3.2-3 mm. Fl. March-May.

Habitat: In fallow fields, sea level 500 m. Originated from Syria.

S. Anatolia (Amanus)

C 5/6 Hatay, Djebel Seman, 610 m, Haradjian 2141:

External Distribution: Palestine, W. Syria and Lebanon, E. Mediterranean element.

57. S. arvensis (L.) L., Sp. Pl. ed 2, 2: 814 (1763)

Syn: Glechoma arvensis L., Sp. Pl. 2: 578 (1753)

Trixago cordifolia Moench, Meth. Plant. 398 (1794)

T. arvensis Hoffm. & Link., Fl. Postng. 1: 102 (1809)

Trixella arvensis Fourr. in Ann. Soc. Lin. Lyon N.S. 17: 135 (1869)

(Map 24).

Fl. March-September.

Habitat: Fallow fields, on serpentine soil etc., open sward in Pinus brutia forest, sea-level to 30 m.

Type: Described from Orient. Hb. Linn. 732.2!

NW, W & SW Anatolia, Islands

A2(A) Istanbul: Yakadjik (Yakacik), 23.v.1901, Aznavour! Prinkipo isle
(Büyükkada), 27.v.1905, B. Post!

C2 Muğla: Marmaris, 2 m, D.25294!

C3 Antalya d. Manavgat: Manavgat to Alanya, 5 m, Huber-Morath 17718!

Islands: Ikaria: 5-10 km E of Evdilos, 20 m, D.40622!

External distribution: SW & C Europe, N Africa, Lebanon, and Iranian Azerbaijan (?), extending into S Africa and America.

As this widely known annual species has a strikingly wide distribution throughout the continents (excepting Australia) a formal description has been omitted. The marked uniformity throughout the range of its distribution and morphological characters probably reflects its weedy and self-pollinating nature. The nearest relative is probably S. marrubifolia Viv. from W. Haly, Corsica and N Africa. S. arvensis has been widely introduced throughout the western hemisphere where a large amount of diversification has taken place; some closely related American species have been described (Epling, 1934).

Sect. SIDERITOPSIS (p. 138)58. Stachys pseudosideritis Huber-Morath & Bhattacharjee, nom. nov.Syn: Sideritis balansae Boiss., Diagn. ser. 2, 4: 35 (1859) (non Stachys balansae Boiss.) (Map 24).

Low growing annual, simple or divaricately branched near base, 8-24 cm. Indumentum patently pilose. Lower cauline and median leaves broadly obovate to elliptic, 1.5-4.2 x 0.5-1.5 cm, serrate, apex obtuse to broadly acute, base attenuate into 2-10 mm long petiole. Floral leaves subsessile to sessile, obovate to oblong, 1.2-2.5 x 0.5-0.8 cm. Verticillasters \pm congested, spicate, 0.5-2 cm apart, 4-6-flowered. Bracts linear to linear-lanceolate, herbaceous, softly spinescent, 6-8 mm, pilose. Pedicel 2-4 mm. Calyx deflexed from the point of attachment of pedicel, bilabiate, sub-campanulate, 9-12 mm, base gibbous, tube strongly nerved with sparse pilose hairs near base; teeth unequal, erect, oblong-mucronate, upper and lower teeth 3.5-4 5-5.5 mm respectively; mucron 1-1.5 mm. Corolla included (lip included in calyx teeth) 10-12 mm, pink. Stamens little exerted from corolla tube. Nutlets obovoid, 1.5 x 1.2 mm, rugose. Fl. May-June.

Habitat: Rocky limestone ridges, slopes or ravines, sometimes in Juniperus community, 1190-1600 m.

Type: [Turkey C5 Içel] Hab. in Gülek Boğhaz Ciliciae, Balansa (type of Sideritis balansae Boiss.)

Inner and S. Anatolia

A7 Gümüşane: Gümüşane, 1400 m, Stainton 8318!

B3 Afyon: 5 miles South of Emirdağ, 1200 m, Coode & Jones 2316!

B4 Ankara: Angora (Ankara), Bornm. 3097!

B6 Maras: Sardağı near Elbistan, 1500 m, D. 27657!

- B7 Elazığ: Kharput (Harput), Sintenis 1889: 678!
- C2 Denizli: Acipayam to Honaz Dağ, 1190 m, Huber-Morath 12733!
- C3 Antalya: Bozburun Dağ, between Taşlı Yayla and Kozlu dere, 1600 m,
D.15718! Isparta: W. of Beyşehir, 1150 m, Sorger 65-41-23!
- C4 İçel: Mut, Mut to Ermenek, summit of Adras Dağ, 200 m,
Coode & Jones 1001!

External Distribution: Lebanon, Coelestria.

This species is very distinct in itself but shows some resemblances to S. obscura Boiss. from which it is readily distinguished by its obovate leaves with attenuate base, linear-lanceolate bracts, short and included corolla, and downwardly deflexed calyx.

The species was wrongly placed by Boissier in Sideritis sect. Hesiodea Benth. (as Sideritis balansae Boiss.). Boissier presumably did not observe that the stamens are exerted beyond the mouth of the corolla tube and that the stigmatic lobes are subulate - both features which refer the species to Stachys and not to Sideritis (cf. Ch. III. p. 138 & Ch. IV. p. 169)

59. S. obscura Boiss. et Bal. in Boiss. Diagn. ser. 2 (4): 43 (1859).

Syn: S. arabica Hormen. var. minor Boiss., Fl. Or. 4: 747 (1879)

(Map 24).

Erect, annual, simple or sparsely branched above, 40-44 cm. Indumentum patently pilose. Lower and median cauline leaves ovate-oblong or ovate-elliptic to ovate, 2.5-3.5 x 1.2-2 m, serrate-dentate, apex obtuse or acute, base cordate, petiole 1-2.5 cm. Floral leaves narrowly lanceolate, falcate, 1.5-3 x 0.4-0.8 cm, longer than verticillasters. Verticillasters remote, few \pm approximate upwards, \pm 6-flowered. Bracts oblong-lanceolate, 9.5-10 mm,

herbaceous, tip spinescent. Pedicels 2-5 mm. Calyx bilabiate, 10-10.5 mm, strongly nerved; teeth unequal, erect, oblong-mucronate, mucron 0.5-1 mm. Corolla 14-15 mm, tube unclued, lips purple-pink. Nutlets obovoid, 2.5 x 1.8 mm. Fl. April-May.

Habitat: Lowland fields.

Type: Turkey C5 Iğel Hab. in arvis derelictis ad Mersina Ciliciae Cl.

Balansa 512 (holo. G! iso. E!).

S. Anatolia (Amarus)

C6 Hatay: Mons Cassius, 15 v 1933, Meinertzhagen!

External Distribution: Lebanon (Beirut). E. Mediterranean element.

Sect. SATUREIODES (p. 139)

60. S. satureioidesⁱ Mont. et Auch. in Ann. Sci. Nat. ser. 2, 6: 51 (1836)
(Map. 25).

Low growing annual, 12-35 cm, simple to divaricately branched. Indumentum of stem pruinose-puberulent to subglabrous, glandular or eglandular. Cauline leaves shortly petioled to sessile, narrowly oblong to oblanceolate, 1-5 x 0.2-1 cm, distantly crenate, serrate to subentire, attenuate at base. Floral leaves sessile to subsessile, linear-lanceolate, 8-16 x 2-3.5 mm, subentire to entire, attenuate at base, longer than verticillasters. Verticillasters remote, (2-)-4-6-flowered, ebracteate. Pedicels 1-1.5 mm. Calyx \pm regular, tubular, 7-10 mm, \pm pubescent with puberulent eglandular hairs; teeth \pm equal, subulate, tip spinescent, $\frac{1}{2}$ to $\frac{2}{3}$ as long as tube, recurved when young; mouth densely hairy. Corolla 12-15 mm, purplish-pink, tube exserted. Nutlets 1.5 x 1 mm. Fl. May-July.

Habitat: Calcareous steppes and limestone screes, 600-1646 m.

Syntype [Turkey C6 Gaziantep] Aintab (Gaziantep), in Syria septentrionali, Montbret 1912, Aucher 1699 (G! BM!).

E. Anatolia

B8 Siirt: 28 km from Siirt to Baykan, 800 m, D. 43071!

C7 Urfa: Suruç-Urfa, 20 km from Suruç, 600 m, D. 27989!

C8 Siirt: Botan Çay gorge, 1646 m, D. 43279!

External Distribution: N. Syria, Iran-Turanian element.

Very closely related to S. ramossissima Mont. et Auch. but distinguished by its more slender habit and very short puberulent to subglabrous stem.

61. S. ramosissima Mont. et Auch. in Ann. Sci. Nat. ser. 2, 6: 50 (1836).

(Map 25).

Low growing annual, simple or divaricately branched, 2-35 cm. Indumentum \pm dense, pubescent-tomentose with glandular and eglandular hairs, sometimes canescent. Cauline leaves subsessile to sessile, oblanceolate, 1.5-4.5 x 0.25-0.85 cm, margin subcrenate to entire, base attenuate. Floral leaves similar but sessile and smaller, longer than verticillasters. Verticillastera remote, \pm 4-flowered, abracteate. Calyx \pm regular, tubular, 7-8.5 mm, \pm densely hairy with eglandular and few glandular hairs, strongly nerved in fruits; teeth \pm equal, lanceolate-subulate c. $\frac{1}{2}$ as long as tube, patent when young. Corolla 12-14 mm, mauve-pink, tube exerted. Nutlets obovoid, 1.5 x 1 mm. Fl. June-July.

Habitat: steppes and plains, 920-1300 m.

Key to varieties :

1. Plant dwarf and slender, 2-12 cm; lower cauline leaves narrowly oblanceolate, 9-10 times longer than broad var. ramosissima
 1. Plant elongate and thicker, 20-35 cm; lower cauline leaves broadly oblanceolate, 4-5 times longer than broad var. elazığensis
- var. ramosissima

Syntypes [Turkey] Hab. in Cappadocia orientali ad Euphratem Montbret 1836:

2079 (K!) & Aucher 1669 (K!)

E. Anatolia

B6 Malatya: Darende to Gürün, 1330 m, Hub.-Mor. 12565!

B7 Elazığ: 5-7 km from Gölcük, 1180-1210 m, Hub.-Mor. 11396!

Erzincan: Kemaliye to Salihli, 1200 m, Hub.-Mor. 8965!

B7 Tunceli: Pertek to Tunceli, 1280 m, Hub.-Mor. 11397!

B7 Malatya, 3 km west of Malatya, 920 m, Hub.-Mor. 8964

Endemic, Irano-Turanian element.

var. elazigensis Bhattacharjee var. nov

A typo caulibus longioribus et crassioribus, foliis caulinis late oblanceolatis differt.

Type: Turkey B7 Elaziğ: Kharput (Harput) in planitie ad Mezre, 18. vi. 1889, Sintenis 788 (LD!).

E. Anatolia

B7 Elaziğ: Harput, Gunutschair, Sint. 1889: 702!; Khan Kimoor to Harput,

B. Post 630!; environs de Harput, B. Post 331!

Endemic, Irano-Turanian element.

Post 331 from Harput is different from other material of var. elazigensis in being more glandular-pubescent, and with a densely hairy calyx tube.

62. S. burgsdorffoides (Benth.) Boiss., Diagn. ser. 1, 12: 85 (1853).

Syn: S. satureioides var. burgsdorffoides Benth. in DC., Prodr. 12: 484 (1848). (Map 25).

Low growing annual, 12-45 cm, divaricately branched below. Indumentum shortly and patently hairy with glandular and eglandular hairs, densely pilose towards apex. Cauline leaves oblanceolate, 2-5.5 x 0.4-1 cm, margin \pm crenate-serrate to subentire, base attenuate, petiole 0.5-1 cm. Floral leaves \pm sessile, lanceolate and/or spatulate, 0.8-3.6 x 0.1-0.8 cm, \pm entire, longer than verticillasters. Verticillasters remote, 4-6-flowered. Bracts few, linear, 0.2-0.5 mm, sometimes caducous. Pedicels 0.2-0.5 mm. Calyx \pm regular, tubular, 6-9 mm; teeth \pm equal, lanceolate-subulate, erect, subpatent in fruit, $\pm \frac{1}{2}$ as long as tube; mouth densely hairy. Fruiting calyx distinctly 10-nerved. Corolla 10-11 mm, pink to mauve, tube subexserted. | Nutlets 1-7 x 1 mm. Fl. May-July.

Key to subspecies:

1. Calyx with long eglandular and glandular hairs, nerves \pm faint;
stem with dense or sparse glandular and eglandular
hairs throughout ssp. burgsdorffioides
1. Calyx with short and few eglandular hairs and sessile glands, rarely
with few short glandular hairs, nerves \pm prominent; stem \pm glabrescent
below, without glandular hairs or rarely with few glandular hairs
present ssp. ladanoides

subsp. burgsdorffioides

Habitat: Fallow and cultivated fields, steep conglomerate scree, basalt
knolls, river steps. 600-762 m.

Syntypes [Turkey C6 Gaziantep] Aintab (Gaziantep), Aucher 1698 (G!)

Montbret 1912; in Mesopotamia [B7 Diarbakir?] Kotschy no. 101 et ex parte?

E. (southern) Anatolia

C6 Gaziantep: environs of Kilis, 610-762 m, Haradjian 4478!

C7 Urfa: Urfa to Hilvan, 750 m, D.28221!

Adiyaman, 8 km from G8lbasi to Adiyaman, Alava 6959!

C8 Diyarbakir: Cinar to Diyarbakir, 700 m, D.28692!

Mardin: Mardin to Nusaybin, 600 m, D.28450!

External distribution: Iraq (Amadia), N. Syria. Irano-Turanian element.

Doubtfully recorded from Iranian Azerbaijan and Kurdistan (Parsa, Fl. Iran.
4: 802 1949).

subsp. ladanoides Hand.-Mazz. in Ann. Nat. Hofmus. Wien 27: 417 (1913).

Habitat: Fallow fields and screes. 1250 m.

Syntypes [Turkey B7 Sivas] In ditione oppidi Divriki, 1000 m, (Bornmüller

1892-1893: 3501, as S. burgsdorffioides); [B7 Erzincan] Egin: Kemergoep

in declivib ad Euphratem, Sintenis, 1890; 2640, as S. burgsd. (LD! BM!);

[B7 Urfa] Tell Pinar, Sintenis 1888: 779, as S. satureioides (LD!).

E. Anatolia

B7 Erzincan: Egin, Deliklutasek, Sint. 1889: 2032! Kamaliye-Salihli, 1200 m,
Hub.-Mor. 8966!

Endemic. Irano-Turanian element.

In the description of his subspecies ladanoides, Hand.-Mazzetti said that the plant is glabrescent throughout. On examining different specimens, this character is not found to be consistent throughout to separate this subspecies from the typical one. Rather, the indumentum on stem is glabrescent to puberulent below with very sparse to no glandular hairs. Sintenis 1888: 779 from Urfa cited by Hand.-Mazz. as one of the syntypes of the subspecies, differs from the rest in having \pm smooth nerved calyx.

63. S. melampyroides Hand.-Mazz. in Ann. Nat. Hofmus. Wien 27: 445 (1913).
(1879)

Syn: S. ramosissima auct. Boiss. Fl. Or. 4: 747/non Mont. et Auch. (Map 25).

Low growing annual, 10-25 cm, simple or divaricately branched. Indumentum pruinose glandular to puberulent, glabrescent below. Cauline leaves shortly petioled to subsessile, oblanceolate to lanceolate, 1.5-3.5 x 0.2-0.9 cm, faintly cuneate-dentate to subentire, attenuate at base. Floral leaves subsessile to sessile, oblong-lanceolate to ovate, 6-22.5 x 3-5 mm, subentire to entire, attenuate at base. Verticillasters \pm approximate in a dense spike, few remote, (2)-4-6-flowered. Pedicels .5-1 mm. Calyx \pm regular, tubular, 7-10 mm, ureceolate in fruit; teeth lanceolate-subulate recurved, tip spinescent, more than $\frac{1}{2}$ the length of calyx tube; mouth with dense hairy ring. Corolla 10-12 mm, purplish pink, tube exserted. Nutlets obovoid, 1.3-1 mm. Fl. May-July.
Habitat: Shaley screes and gullies of calcareous rocks, 900-1150 m.

Syntypes [Turkey C8 Mardin] Binibil, in vineis, 28. vi. 1888 Sintenis 1177
 as S. burgsdorffoides (Benth.) Boiss. (Lund! K!) and [N. Iraq] Riwandoms
 in Sakri Sakran 1700 m, Bornmiller 1663 (K!); in galeroosis and fluvium
 Zab Ala, Haussknecht (secund Boiss. et Bornm.)

S.E. Anatalia

B8 Bitlis: 13 km from Baykan to Bitlis, 1150 m, D.43153!

External distribution: N. Iraq. Irano-Turanian element.

Sect. THAMNOSTACHYS (p. 140).

64. S. fruticulosa Bieb., Tabl. d. Prov. Casp. Append. 1: 15 (1798); Fl. Taur.-Cauc. 2: 51 (1808). (Map 26).

Fruticulose perennial, woody at base. Indumentum puberulent. Flowering stem 20-40 cm, profusely branched near base and leaf axils. Cauline leaves subsessile to sessile, linear-lanceolate 0.5-1.5 x 0.2-0.4 cm, margin subentire to entire, apex acute, base attenuate. Floral leaves similar but shorter, margin entire, apex acute, as long as or shorter than verticillasters. Verticillasters remote, 2-flowered. Bracts minute, linear-subulate, puberulent. Pedicels 2-3 mm, enlarging to 5 mm in fruit. Calyx \pm regular, campanulate 7.5-9 mm; teeth \pm equal, as long as or slightly less than the tube, herbaceous, recurved with soft spinescent tip. Corolla 16-17 mm, pink-rose, tube subexserted; upper lip narrowed and forked. Nutlets obovoid 4.5 x 2.8 mm.

Fl. May-June.

Habitat: Rocky sandstone slopes.

Type [Caucasia]: Hab. in Caucasi orientalis et Iberiae lepidosis montosis.

M.B. 1808

N.E. Anatolia

A9 Kars: Aras valley (Grossheim 7, Map 415).

External distribution: Transcaucasia, Iranian Azerbaijan. Irano-Turanian element.

No specimens have been examined from Turkey. This species is distinguished from the allied species S. grossheimii Kap. and S. araxina Kap. in its herbaceous calyx with soft spinescent and widely recurved teeth, forked upper lip of corolla, and long exserted stamens.

65. S. sosnowskyi Kapeller in Not. Syst. Geogr. Inst. Bot. Tphlis, fasc. 16: 20 (1951). (Map 26).

Fruticose perennial with puberulent and pubescent indumentum.

Flowering stems branched, woody, 20-30 cm, less foliate and slender.

Lower cauline leaves rotund to ovate-elliptic 0.8-1 x 0.6-0.75 cm, margin crenate-dentate, apex obtuse, base attenuate to 0.75-1 cm petiole.

Median cauline leaves sessile, oblanceolate to narrowly elliptic, 1-1.5 x 0.15-0.2 cm, subentire to entire, apex \pm obtuse, base attenuate. Floral leaves shorter, denticulate to entire, \pm equal to calyx or shorter.

Verticillasters remote, 2-3, 2-flowered. Bracts minute, subulate. Pedicels 0.75-1 mm. Calyx oblique, bilabiate, 8 mm, minutely glandular; teeth unequal, upper and lower teeth 1 and 2 respectively. $\pm \frac{1}{3}$ as long as tube. Corolla pale rose, exserted. Nutlets obovoid, c. 2 mm long. Fl. May.

Habitat: calcareous rocks.

Type [Turkey A8 Erzerum]: Prov. Kars d. Olty: prope p. Ukjam, in rupestr. calc., 17.v.1912, Sosnowsky 217.3 (TBI Photo!, iso. K!).

Endemic to N.E. Anatolia. Irano-Turanian element.

No specimen except the type photograph and one calyx have been examined by me. From those it is apparent that this species though allied to S. araxina Kap., is very distinct in the nature of its woody habit, few and narrow-leaved stems, 2-3 verticillasters, strongly bilabiate and glabrous calyx.

66. S. araxina Kapeller in Not. Syst. Geogr. Inst. Bot. Tphilis, fasc.

16: 22 (1951)

Syn: S. multicaulis Mich. in Trudy Tphilis Bot. Sada 9 (1): 8 (1906)

non Benth (1848)

S. fruticulosa Bieb. var. macrocheilos Grossh. in Fl. Kavk. 3: 313

(1932) non Boiss (1878) quoad plantas a Prov. Kars et Prov.

Erivan dist. Surmalu (olim)

S. macrocheilos Sosn. in Trudy Azerb. Otd. Zakavk. Fil. Acad.

SSSR 1: 42 (1932) non Boiss. (1844) quoad plantas a Prov. Kars (olim)

Fruticulose perennial. Indumentum eglandular, puberulent to densely pubescent above. Flowering stems branched or unbranched, 20-40 cm. Cauline leaves sessile to sessile, oblanceolate to narrowly elliptic-lanceolate 1.5-3 x 0.4-1 cm, margin crenate-dentate to subentire, apex obtuse to acute, base attenuate, glabrescent to sparsely puberulent. Floral leaves shorter, subentire to entire, slightly longer or as long as verticillasters.

Verticillasters remote, 1.2-2 cm apart, 2-flowered. Bracts minute, subulate setaceous, caducous. Pedicels 1-2 mm. Calyx \pm regular, tubular to sub-campanulate, 7-9 mm; teeth \pm equal, erect, triangular, mucronate, $\pm \frac{1}{3}$ the length of the tube. Corolla 11-12 mm, subexserted, whitish-pink. Nutlets obovoid, 3.5-4 x 2.5-2.8 mm. Fl. June-July.

Habitat: Shaly and clayey hills, 1100-1450 m.

Type [Turkey A9 Kars]: Distr. Kaghyzman (Kağizman). In valle fl. Araxis.

Prope salinus in viciniis urb. Kaghyzman. 2.vi. 1904, Michalleiosky (TBI).

N.E. Anatolia

A9 Kars: Kağizman to Akçay (aras Valley) 1100-1200 m D. 46850!

: near Kotek. 1450 m. D. 46681!

External distribution: Transcaucasia. Irano-Turanian element.

This species shows a resemblance to S. grossheimii Kap. from which it differs in having longer cauline leaves with crenate-dentate margin, and calyx teeth $\frac{1}{2}$ as long as calyx tube and with slightly mucronate tips.

Sect. AMBLEIA (p. 145).

67. S. inflata Benth., Lab. Gen. et Sp.: 562 (1834); DC., Prodr. 12: 491 (1848)

Syn: S. stehlegleewii Sosn. in Grossh. Opred. Rast. Kavk. 339 (1949) (Map 26).

Suffrutescent perennial. Flowering stems numerous, usually simple, 16-50 cm. Indumentum densely felted white-tomentose with dendroid hairs. Cauline leaves subsessile to sessile, lanceolate to narrowly elliptic, 0.8-4 x 0.35-1.2 cm, margin entire, apex obtuse to acute, attenuate or cuneate at base. Floral leaves sessile, ovate-lanceolate, 1-1.5 x 0.3-0.6 cm, shorter than verticillasters. Verticillasters remote, 1-5 cm distant, 4-8-flowered. Bracts linear-lanceolate, herbaceous, 2-7 mm. Pedicels 0.5-2 mm. Calyx \pm regular, tubular 8-17 mm, inflated; teeth subequal, erect, triangular, incurved in fruit, 3-5 times shorter than the tube, \pm blunt to minutely mucronulate at tip. Corolla 20-24 mm, pink, tube subexserted. Nutlets obovoid, 2.5-3 x 1.8-2 mm. Fl. April-August. Described from 'Africa Septentrionali' (?)

N.E. Anatolia:

Armenia Minor & Kurdistan: Fl. URSS 21: 232 (1954)

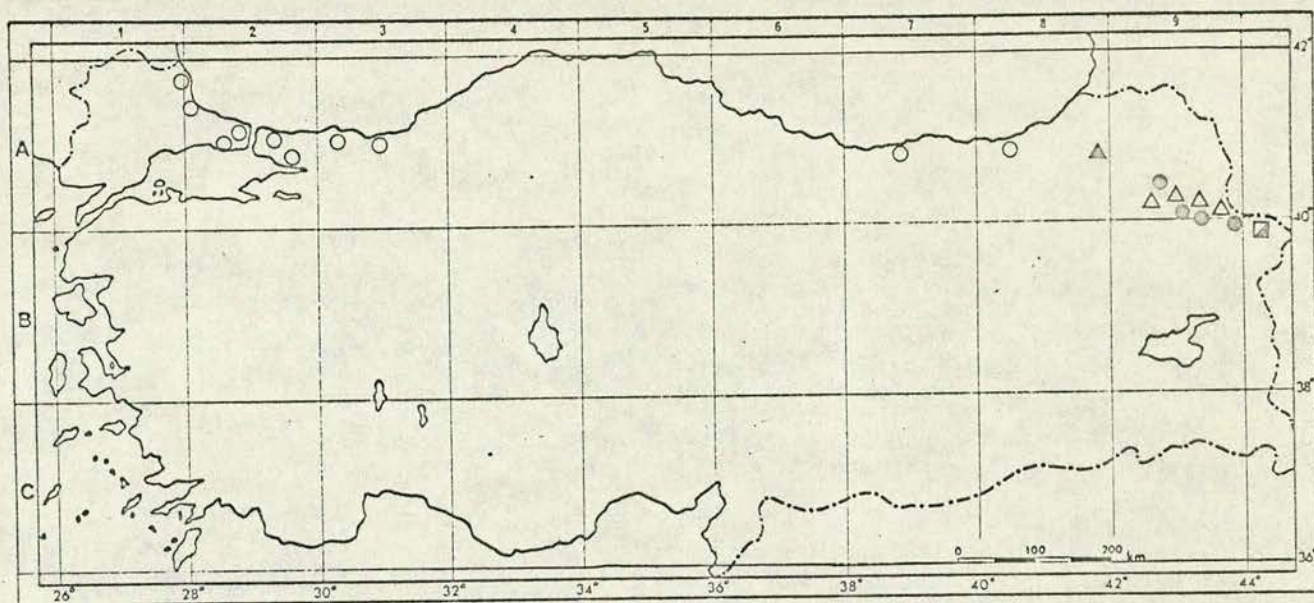
Armenia, ad Araxem, Radde 1871: Trautvetter in Acta Horti Petrop 4 (1871).

External distribution: Iran and Transcaucasia. Irano-Turanian element.

No specimens from Turkey have been seen by me, but there seems no reason not to accept the literature records. I have examined many specimens of this desertic species from the neighbouring areas, such as Iranian Azerbaijan and Transcaucasia. The species is so distinct in its densely felted tomentose indumentum with dendroid hairs and inflated calyx, that there is little possibility of misidentification.

Bentham in the original treatment of the species (Lab. Gen. et Sp. 1834) under the section Ambleia, recorded it from N. Africa with a query. As the

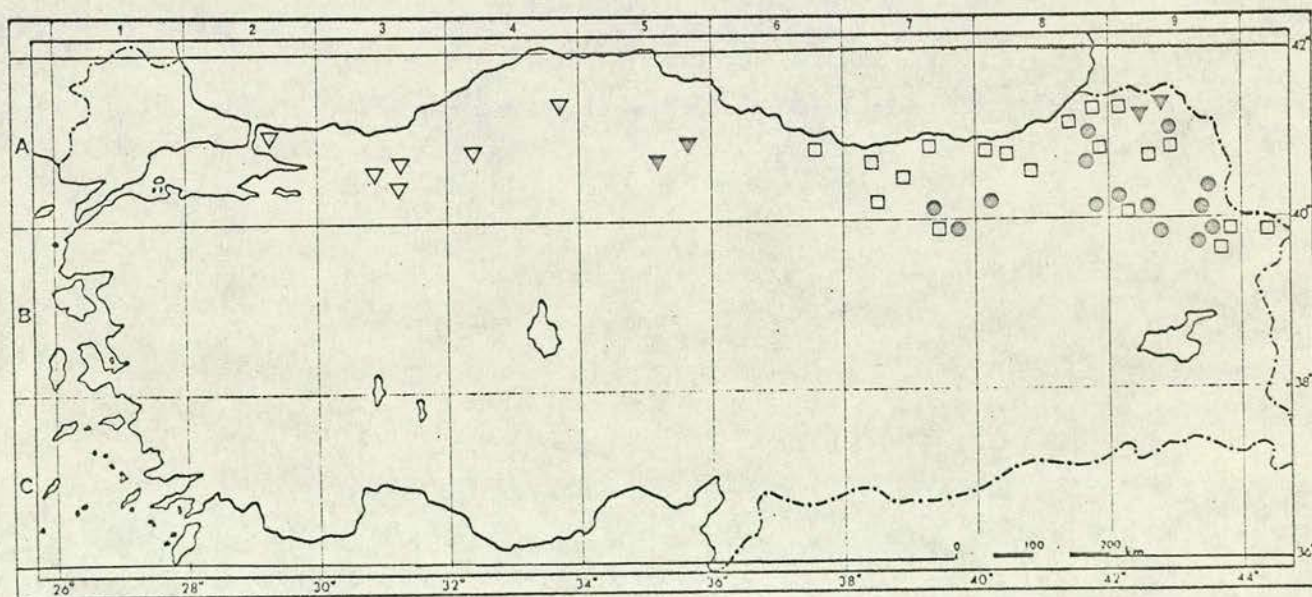
N. African species of Ambleia are quite distinct from S. inflata Benth. in different morphological characters, it is possible that Bentham dealt with a wrongly labelled specimen in his original description. Later he corrected the distribution record on several specimens of Aucher and Kotschy in DC. Prodrumus 12 (1848) and stated that the species occurs in Iraq.



Map 26.

- S. fruticulosa;
- △ S. araxina;
- S. maritima

- ▲ S. sosnowskyi;
- S. inflata;



Map 27.

- S. macrantha;
- S. macrostachya

- ▼ S. officinalis ssp.
- ▽ ssp. balcanica;

Sect. BETONICA (p. 148).

68. S. macrantha (C. Koch) Stearn in Gard. Chron. Ser 3, 130: 169 (1951)

Syn: Betonica grandiflora Willd. Sp. Pl. 3: 96 (1800)

S. grandiflora (Willd.) Benth., Lab. Gen. et Sp. (1834) non Host
(1831)

Betonica macrantha C. Koch in Linnaea 21: 682 (1848) (Map 27).

Herbaceous perennial with basal rosettes of leaves. Flowering stems erect, usually unbranched, 10-60 cm. Indumentum sparsely to densely hirsute. Basal leaves broadly ovate-triangular, lamina 2-15 x 1.5-10 cm, distinctly crenate, apex obtuse, base cordate, petiole 3-30 cm. Cauline leaves 1-2-paired, smaller with shorter petioles. Floral leaves subsessile to sessile, similar to cauline leaves, lower pair larger and the rest shorter than verticillasters. Verticillasters \pm approximate above, 1-2 remote below, c. 2-4 cm distant, 10-15-flowered. Bracts lanceolate, 4-15 mm, herbaceous with spinescent tip. Calyx sessile, \pm regular, tubular, 14-17 mm; teeth \pm equal, triangular-subulate, half as long as calyx tube, spinescent tipped. Corolla 30-35 mm, purplish-pink, tube exserted, exannulate. Nutlets flattened trigonal with marginal and irregularly lobed apical wings, 3.5-4 x 2.5-3 mm. Fl. June-September.

Habitat: Lush meadows, rocky slopes, edge of Pinus forest mixed with Fagus scrub, 1800-3300 m.

Type [Caucasus]: Habitat in Sibiria (sic) ad flumen Tereck (hb. Willdn. 10873)

Mainly N.E. Anatolia

A6 Ordu: below Çambasi, 1900 m, Tobey 1262!

A7 Trabzon: Ciganadagh, above Demerschikoei, Sintenis 1889: 1352!

Giresun: Balban Dağlari above Tamdere, 2700 m, D.20360!

A8 Trabzon: Harami Dağ, Haldizan, 3200 m, Balls 1884!

Rize: 45 km below top of İkizdere to Ispir Pass, Jenkins 2354!

Çoruh (Artvin): Savval tepe above Murgal, 2700 m, D.32276!

Erzurum: East of Terik Dağ, 2438 m, Barclay 9861!

A9 Kars: 6 km from Sarikamiş to Karakurt, 2150 m, D.46562!

B7 Erzincan: Sipikordagh, Sintenis 1889: 1181!

External distribution: Iranian Azerbaijan and Caucasia. Euxine element of Euro-Siberian Region.

69. S. officinalis (L.) Trevisan, Prosp. Fl. Euganea 26 (1842)

Syn: Betonica officinalis L., Sp. Pl. 2: 573 (1753)

S. betonica Benth., Lab. Gen. et Sp. 532 (1834) non Crantz (1769)

nec Scop. (1772); incl. S. bulgarica (Degen & Nejc.) Hayek,

Prodr. Fl. Balc. 2: 281 (1931) (Map 27).

Herbaceous erect perennial with basal rosettes of leaves. Flowering stems 15-100 cm, subglabrous to densely hirsute. Basal leaves ovate-oblong to oblong, 3-12 x 1.5-5 cm, coarsely crenate or crenate-dentate, apex obtuse, base cordate, petiole 2.5-9.5 cm. Cauline leaves similar but shorter and shortly petioled. Floral leaves subsessile to sessile, similar to cauline but smaller; lower pair larger, the rest as long as the verticillasters. Verticillasters in a dense spike, sometimes 1-2 remote below and 1.5-5 cm apart, 15-20-flowered. Bracts ovate-lanceolate to ovate-elliptic, 5-10 mm, herbaceous or hardened, margin \pm scarious, tip spinescent. Calyx sessile, \pm regular, tubular, 5-9-(12) mm, subglabrous; teeth triangular-subulate, $\frac{1}{4}$ - $\frac{1}{3}$ as long as the tube, tip spinescent. Corolla 12-18 mm, white to reddish

purple, tube exserted, exannulate. Nutlets flattened trigonal with marginal and apical wings, 2.5 x 0.7 mm. Fl. June-September.

Habitat: Damp meadows, marshy lake sides, rocky slopes in forest clearings, 800-1400 m.

Key to subspecies:

1. Corolla bright reddish-purple; calyx teeth $\frac{1}{3}$ - $\frac{3}{4}$ as long as the tube subsp. officinalis
 1. Corolla white; calyx teeth $\frac{1}{3}$ to as long as tube subsp. balcanica
 subsp. officinalis

Type: Described from Europe. Hb. Linn. 735.1 (Photo!).

N. Anatolia

A5 Amasya: Merzifon, July 1903, Manissadjan 4!

Samsun: at Ladik, 800 m, Bornmüller 1890: 2172!

External distribution: Most of Europe, USSR (East to Central Asia), Caucasia and N. part of Iran. Euro-Siberian element.

subsp. balcanica (Ball) Bhattacharjee, comb. et stat. nov.

Syn: Betonica haussknechtii Uechtr. ex Hausskn. in Nym., Consp. Fl.

Eur. Suppl. 2(2): 251 (1890)

S. haussknechtii (Uechtr. ex Hausskn.) Hayek, Prodr. Fl. Penin.

Balc. 2: 281 (1931) non Vatke (1875)

S. balcanica P.W. Ball in Bot. Journ. Linn. Soc. 65: 262 (1972)

Type: Greece. bor. Dolop. 1885, Haussknecht

N.W. & N. Anatolia

A2(A) Istanbul near Alemdagh, 10.vii. 1892 Aznavour!

A3(A) Bolu: Abant Gölü, 5.ix.1940, B. Post!

A4 Zonguldak: Kel tepe above Yenice, 1300-1350 m, D.38989! D.37800!

A4/5 Kastamonu: Karadere at Kuschuk to Ilgazdağ, Sintenis 1892: 4971!

External distribution: Balkan Peninsula (C. Greece and S.E. Bulgaria).

Euro-Siberian element.

S. officinalis (L.) Trev. shows affinity with the pale yellow flowered S. alopecurus L. from which it differs in having an exannulate corolla and ovate-oblong cauline leaves. As shown by ^{the} synonymy, the subspecies balcanica was formerly treated as a distinct species under three different binomials. The distinguishing characters of typical subsp. balcanica, i.e. white corolla and calyx teeth/tube ratio 1:1, may remain distinct in the Balkan Peninsula, but in Turkey, particularly in the province of Bolu, the calyx differences break down in different populations. Besides that, typical S. officinalis occurring towards the central part of N. Anatolia has been replaced by subsp. balcanica to the N. West. Considering the range of S. officinalis as a whole, it seems justifiable to reduce S. balcanica to subspecific rank.

Sect. MACROSTACHYA (p. 149).

70. S. macrostachya (Wend.) Briq. in Engler & Prantl, *Naturl. Pflanzenfam.*

4(3a): 261 (1895)

Syn: Betonica orientalis L., *Sp. Pl.* 573 (1753) non S. orientalis L. (1753)

B. macrostachya Wend. in *Flora* 9: 353 (1826)

B. hirsuta C.A. Meyer, *Verzeichn.* 95 (1831) non L. (1753)

S. longifolia Benth., *Lab. Gen. et Sp.* 533 (1834) (Map 27).

Herbaceous perennial with basal rosettes of leaves. Flowering stems erect, usually unbranched, rarely with 1-2 branches, 30-60 cm. Indumentum densely to sparsely hirsute with unequal stellate hairs. Basal leaves oblong-lanceolate, 3-10 x 1-2.8 cm, margin distinctly crenate, apex obtuse to acute, base cordate, petiole 3.5-9 cm. Cauline leaves similar, lamina 5-11 x 1.5-2.5 cm, petiole 3.5-9 cm. Lower floral leaves, 1-2 pairs, shortly petioled or subsessile, lanceolate, 1.8-6 x 0.9-2 cm, margin crenate-serrate, longer than verticillasters. Upper floral leaves sessile abruptly shorter than lower ones, bractae form, lanceolate, 0.8-0.14 cm, entire, as long as calyx. Verticillasters approximate for the most part, 1-2 remote, 1.5-10 cm apart, 12-16-flowered. Bracts numerous, lanceolate, 3-12 mm, herbaceous with mucronate tip. Calyx sessile, \pm regular, tubular, 12-15 mm; teeth \pm equal, triangular-subulate, \pm $\frac{1}{3}$ as long as tube with 0.5-0.8 mm long micro; mouth with dense hairy ring. Corolla 17-22 mm, purplish-pink, tube exserted, exannulate. Nutlets flattened trigonal with marginal and irregularly lobed apical wing. 3 x 0.7 mm.

Fl. July-August.

Habitat: Steep slopes, gullies and gorges of igneous rocks; in open meadows and pastures, 1450-2470 m.

Described from specimen grown in the garden in Marburg (Germany) from seeds.

N.E. & E. Anatolia

- A7 Gümüsane: Kosedagh Dere, Sintenis 1890: 3232!
 A8 Gümüsane: Baiburt, 28.vii.1862, Bourgeau!
 A9 Kars: 7 km from Karakurt to Kağızman, 1450 m, D.46458!
 B7 Erzincan: Sipikor in mountains near versus Orumserai, Sintenis 1890: 3233!
 B9 Agri: Tahir pass, 2470 m, Archibald 3241!
 B7/A7 Gümüsane: Erzincan to Kelkit, 2100 m, D. 31895!

External distribution: Transcaucasia and Iranian Azerbaijan. Euxine element of Euro-Siberian region.

This species shows resemblance with S. discolor Benth. but differs from it in not having white-lanate lower surface of leaves, upper floral leaves being shorter than calyx and corolla mouth not inflated.

VII. DISTRIBUTION AND ENDEMISM

A. DISTRIBUTION:

The internal Turkish distribution of each species is given on spot maps. In addition Table 11 shows in which phytogeographical regions in Turkey the taxa occur (cf. Davis, Fl. Turkey, Vol. 1, 1967). The main concentration is found to be in the Irano-Turanian region, and the Mediterranean region (Eastern province) comes close to it, their percentage being 50% and 43% respectively; the Euro-Siberian region (Euxine province) on the other hand has only 17% of the total number. The calculated figures are only approximate and future exploration of existing species from new areas or discovery of new species may change them considerably. Information is often insufficient to distinguish between truly biregional taxa and those characteristic of one region and occurring only as penetrants in another. In the table the penetrants are denoted by (+) signs. (Here again the Irano-Turanian elements dominate over the other two and out of 5 Irano-Turanian taxa, 1 is a penetrant in Euro-Siberian and the other 4 in the Mediterranean region.) S. balansae ssp. balansae, S. thirkei and S. pseudosideritis may be truly biregional species, S. annua ssp. annua is prevalent in all the 3 regions. A few taxa are of doubtful occurrence in a particular phytogeographical region, and have been indicated by "+?": These have not been considered in calculating the percentage of species occurring in each phytogeographical region.

Isoflor map:

Together with internal distribution of the species, external distribution in adjacent countries like Syria, Lebanon, Palestine, Iraq, Iran, Caucasia and the Balkan peninsula (including Aegean islands) have been carefully plotted from available specimens and floristic records, in order to give a fuller picture of distribution pattern. A grid map based on lines of latitude

Table 11). The Phytogeographical Distribution of *Stachys* species (including subsp. & vars.) in Turkey (Explanation in the text)

Name of taxa	E-S	Med	I-T	Name of taxa	E-S	Med	I-T
1. <i>S. germanica</i>				24. <i>S. spectabilis</i>			+
ssp. <i>bithynica</i>			(+)	25. <i>S. viticina</i>		+	
2. <i>ssp. heldreichii</i>		+		26. <i>S. longespicata</i>		(+)	+
3. <i>S. alpina</i>				27. <i>S. huetii*</i>			+
ssp. <i>macrophylla</i>	+			28. <i>S. bayburtensis*</i>			+
4. <i>S. balansae</i>				29. <i>S. rupestris*</i>		+	
ssp. <i>balansae</i>	+		+	30. <i>S. cataonica*</i>			+
5. <i>ssp. carduchorum*</i>			+	31. <i>S. petrokosmas*</i>		+	
6. <i>S. rizehensis*</i>	+			32. <i>S. amanica *</i>		+	
7. <i>S. huber-morathii*</i>	?	?	?	33. <i>S. pumila</i>		+	
8. <i>S. pinetorum</i>		+		34. <i>S. citrina</i>			
9. <i>S. obliqua</i>		+?		ssp. <i>citrina*</i>		+	
10. <i>S. libanotica</i>				35. <i>ssp. chamae-</i>			
var. <i>minor*</i>		+		<i>sideritis*</i>		(+)	+
11. <i>S. sericantha*</i>		+		36. <i>S. setifera</i>			
12. <i>S. tmolea*</i>		+		ssp. <i>setifera</i>	(+)		+
13. <i>S. cretica</i>				37. <i>ssp. lycia*</i>			+
ssp. <i>anatolica*</i>		(+)	+	38. <i>S. menthoides</i>			+
14. <i>ssp. smyrnaea*</i>		+		39. <i>S. sylvatica</i>	+		
15. <i>ssp. mersinaea*</i>		+	(+)	40. <i>S. palustris</i>	+		
16. <i>ssp. cassia</i>		+		41. <i>S. longiflora*</i>		+	
17. <i>ssp. vacillans</i>		+		42. <i>S. euadenia*</i>		+	
18. <i>ssp. lesbiaca*</i>		+		43. <i>S. pinardii*</i>		+	
19. <i>ssp. trapezuntica*</i>		+		44. <i>S. yenyurukensis*</i>		+	
20. <i>ssp. garana</i>			+	45. <i>S. glechomifolia</i>			+
21. <i>ssp. bulgarica</i>		+?		46. <i>S. brantii*</i>			+
22. <i>S. thirkei</i>	+	+		47. <i>S. megalodonta</i>			+
23. <i>S. byzantina</i>	+		(+)	ssp. <i>mardinensis*</i>			+
				48. <i>S. ballotiformis</i>			+
				49. <i>S. kurdica</i>			+
				var. <i>kurdica</i>			+

Table 11 (contd.)

Name of taxa	E-S	Med	I-T	Name of taxa	E-S	Med	I-T
50. var. brevidens			+	73. ssp. ammophila		+	
51. S. viscosa				74. S. inanis*			+
var. viscosa*			+	75. S. munzurdagensis*			+
52. var. odontophylla			+	76. S. diversifolia		+	
53. S. laetivirens*			+	77. S. spinulosa		+	
54. S. subnuda*			+	78. S. arabica		+	
55. S. lavandulifolia				79. S. arvensis		+	
var. lavandulifolia			+	80. S. pseudosideritis		+	+
56. var. glabrescens*			+	81. S. obscura		+	
57. var. brachyodon			+	82. S. satureioides			+
58. S. recta				83. S. ramosissima			
ssp. subcrenata		+		var. ramosissima*			+
59. S. atherocalyx	+			84. var. elazigensis*			+
60. S. angustifolia	+			85. S. burgadorffioides			
61. S. sparsipilosa*		+		ssp. burgadorffioides			+
62. S. iberica				86. ssp. ladanoides*			+
ssp. iberica				87. S. melampyroides			+
var. iberica		(+)	+	88. S. fruticulosa			+
63. var. densipilosa*			+	89. S. sosnowskyi*			+
64. ssp. stenostachya			+	90. S. araxina*			+
65. ssp. georgica			+	91. S. inflata			+
66. S. aleurites*		+		92. S. macrantha	+		
67. S. bombycina*		+		93. S. officinalis			
68. S. distans				ssp. officinalis	+		
var. cilicica		+		94. ssp. balcanica	+		
69. S. maritima		+		95. S. macrostachya	+		
70. S. annua							
ssp. annua	+	+	+				
71. var. lycaonica*			+				
72. ssp. cilicica*		+					

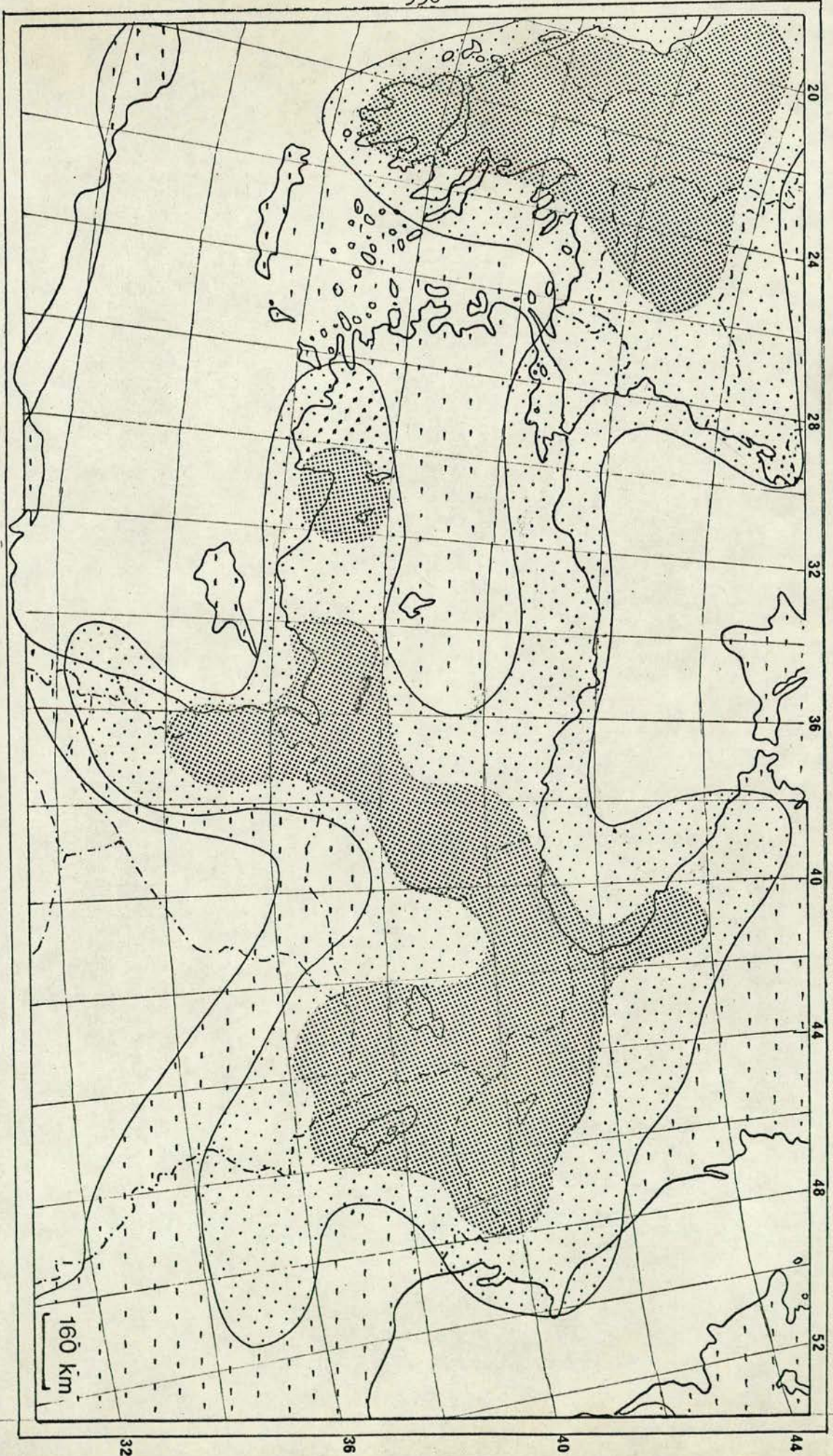
Key: E-S - Euro-Siberian, Med - Mediterranean, I-T - Irano-Turanian
 an phytogeographical regions, * Endemic taxa, + occurrence,
 (+) exceptional occurrence, ? doubtful occurrence.

and longitude at 2° intervals has been used, and an isoflor map has been constructed (Map 28) to demonstrate the maximum concentration of species in the area cited above. Two main centres of morphological diversity (assessed by maximum number of species) have been demonstrated. One is confined to S. & E. Anatolia (with a minor disjunction), Caucasia, N.W. Iran and N. Iraq; and the other to the Balkan peninsula. But so far as sectional diversity is concerned, the former has 14 and the latter only 9 sections. The Asiatic part mainly embraces two phytogeographical regions, namely Irano-Turanian and Mediterranean, while the European is mainly Mediterranean but partly Euro-Siberian. Lack of many floristic records from Syrian Desert, Arabia and the Libyan Desert may be due to under-collecting or desertic condition, probably to the latter. The genus scarcely penetrates into the Sahara-Sudanian region sensu Zohary, 1963) and may be absent from the southern border of the map.

Disjunction in distribution has been found to occur mostly at infra-specific and once at specific level. S. cretica subsp. cassia grows on Mt. Cassius as well as in C. Greece, S. iberica var. iberica, whose major distribution is in the Northern and N.E. part of Anatolia, also occurs in the Amanus mountains (not a very unusual distribution in Turkey), and S. annua subsp. cilicica shows disjunction between South and North Anatolia. On the other hand, S. byzantina, mainly growing from N.W. to N. Anatolia (up to Ordu) has a break in N. Eastern part and is distributed again in Caucasia and N. Iran.

B. ENDEMISM:

For convenience, the political frontiers of different countries have been mainly used for calculating the percentage of endemic species, although it is quite evident that Lebanon and N.W. Syria are floristically much more related to S. Anatolia (Amanus) than to other parts of Syria; N. Iraq and W. Iran to S.E. Anatolia (Provinces of Mardin, Hakkari, Bitlis etc.), and N.W. Iran and



Map 28.

Isoflor map of Stachys species

Caucasia to N.E. Anatolia. Of particular mention is Mt. Cassius which straddles the frontier of S. Anatolia and N. Syria. It is floristically part of the Amanus mountain flora rather than of the N. Syrian one; so in this particular instance the whole Cassius area has been included within the floristic boundary of Turkey (as it is in fact, in the Flora of Turkey).

Endemism has been analysed for specific as well as for infraspecific taxa, as has been shown in Table 11 and marked with asterisks. Of the 70 species accepted in this account, 26 are endemic to Turkey, the percentage being 37%. If the infraspecific taxa are taken into consideration, the percentage rises up to 45%. They are discussed in the following paragraphs under their respective sections.

Sect. Eriostomum: In this section there are 13 endemic taxa of which 9 are very localised and the rest more widely distributed. In S.W. Anatolia (Antalya) S. sericantha is a common pine forest species, its nearest relative being S. libanotica from Lebanon, S. Syria and Palestine, living with the endemic var. minor in S. Turkey (Mt. Cassius). From this variety S. sericantha is allopatrically isolated. Of the W. Anatolian localised endemics, S. huber-morathii from the province of Çorum/Amasya, S. cretica subsp. lesbiaca from Dardanalles and S. tmolea from Mt. Tmolus and Bithynia have their nearest relatives growing widely outside and inside Turkey. In E. and N.E. Anatolia, S. bayburtensis from Gümüşane, S. rizehensis from Rize, S. huetii from Erzurum and S. cretica subsp. trapezuntica from Trabzon are restricted endemics with Anatolian relatives. These restricted endemics are mostly allopatrically, less often sympatrically but ecologically isolated from their nearest relatives. As an example of the latter case, S. huber-morathii has overlapped in distribution with its nearest relative S. balansae and S. alpina subsp. macrophylla. Of the 4 widely distributed endemics, 3 subspecies of S. cretica namely subsp.

anatolica, subsp. mersinaea and subsp. smyrnaea grow widely throughout the Western and S. Western provinces, while S. balansae subsp. carduchorum occurs in Eastern Anatolia. These endemics grow sympatrically with near relatives such as S. cretica and S. balansae respectively.

Sect. Olisia: Of the 8 endemics belonging to this section 7 are localised and 1 wide. In S. Anatolia, particularly from the province of Antalya, two closely related sympatric endemics, S. bombycina and S. aleurites have their other nearest relative S. distans extending from S. Anatolia (Içel) to Lebanon and W. Syria and distributed allopatrically from them. S. inanis and S. munzurdagensis from E. Anatolia are related to each other but isolated sympatrically, having another relative, S. diversifolia occurring in the province of Hatay and N. Syria. Two other taxa, S. sparsipilosa and S. annua subsp. cilicica, are restricted endemics of S. Anatolia (Amanus region) and overlap with their widespread relatives S. iberica and S. annua.

Sect. Fragilicaulis: Ten taxa are ± localised endemics in this section. Four of them, S. euadenia, S. yenyurukensis, S. longiflora and S. pinardii, are restricted in S. Anatolia and isolated from each other either allopatrically and possibly ecologically and have no relatives outside Anatolia. Of the remaining six, S. glechomifolia, S. megalodonta subsp. mardinensis and S. brantii have their nearest relatives S. fragillima, S. lanigera and S. megalodonta subsp. megalodonta in N. Iraq and N.W. Iran, whereas S. laetivirens, S. viscosa var. viscosa and var. odontophylla are related endemics with more or less overlapping distribution. All these species grow either in open screes or gravelly soil, and very rarely on cliffs and gorges; unlike the S. and S.W. Anatolia endemics in this section (Subsect. Fragiles), they are ± widely distributed and show some amount of overlap in their distinguishing characters.

Sect. Satureioides: This annual section has three closely related and allopatrically and sympatrically distributed endemic taxa, S. ramosissima var. ramosissima, var. elazigensis and S. burgsdorffioides subsp. ladonoides. Their nearest relatives are S. satureioides, S. burgsdorffioides subsp. burgsdorffioides and S. melampyroides, which grow in Turkey, N. Iraq and S. Syria. All these taxa grow in rocky places and under rather similar climatic conditions. Their diversification seems to be related to allopatric isolation.

Sect. Infrarosularis: Apart from S. pumila which extends beyond the N. Syrian border of Turkey, the other 6 taxa are probably endemic to S. Anatolia (including Cassius). The members are closely related to each other, and usually ecologically restricted to cliffs and crevices of rock communities. They are related vicariants, but the isolated position of this section from others suggest that the group has been isolated from the rest of the genus for a very long time.

S. sosnowskyi and S. araxina of Sect. Thamnostachys and S. lavandulifolia var. glabrescens of Sect. Zietenia are localised endemics of N.E. and E. Anatolia and have their relatives (S. fruticulosa and S. lavandulifolia var. lavandulifolia respectively) both inside and outside Turkey, and have overlapping distributions with them. Some of the endemics like S. sosnowskyi, S. munzurdagensis, S. huetii, S. brantii, S. petrokosmos and S. rizehensis are still only known from their type gatherings, and further exploration is needed to confirm their restricted distribution and assess their variation.

The available evidence shows that most of these endemics are geographically isolated from their relatives. Geographical isolation presumably played a role in their speciation. Unfortunately nothing is known about

the extent of cytogenetical barriers between these endemics and their allies and no chromosome counts are available for them. It seems that in Turkey, E. Anatolia and S. Anatolia have been the most active centres of speciation in this genus; this has been accentuated by rugged topography, extremely xerophytic climatic conditions, and presence of restricted ecological habitats like cliffs and gorges.

VIII. APPENDIXA. LIST OF SPECIES SURVEYED FOR ANATOMICAL, STEREOSCAN
AND DEVELOPMENTAL STUDIES

Names of the species are arranged according to alphabetical order;

'+' sign indicates the organ studied.

Name of species	Development			Petiole	Stem	Pollen scanning	Nutlet	
	Flower	Hair	Stomata	Anatomy	Anatomy	S.E.M.	S.E.M.	Anatomy
<i>Stachy acerosa</i>					+			
<i>aegyptica</i>						+	+	
<i>alopecuroides</i>				+				+
<i>alpina</i>			+	+				
<i>annua</i>				+		+	+	+
<i>araxina</i>						+	+	
<i>arvensis</i>	+			+		+	+	+
<i>atherocalyx</i>				+				
<i>balansae</i>			+					
<i>ballotiformis</i>						+	+	+
<i>betoniciflora</i>				+				+
<i>burgs-</i>								
<i>dorffloides</i>				+		+	+	+
<i>byzantina</i>				+				+
<i>candida</i>					+			
<i>circinata</i>						+	+	+
<i>citrina</i>			+	+		+	+	
<i>corsica</i>						+	+	+
<i>decumbens</i>					+	+	+	
<i>discolor</i>				+				+
<i>euadenia</i>								+
<i>fontqueri</i>					+			
<i>fragillima</i>						+	+	+

B. A NEW SPECIES FROM IRAQS. iragensis Bhattacharjee sp. nov.

Affinis S. setiferae C.A. Meyer sed foliis floralibus haud aristatis, apicibus bractearum molliter herbaceis, dentibus calycis brevius mucronatis (mucrone 0.2-0.5 mm longo) tandem erectis differt.

Herbaceous perennial (or annual?). Flowering stem 25-50 cm, straggly, usually simple, branched upwards. Indumentum softly and petently pilose with eglandular and few short glandular hairs. Cauline leaves oblong-lanceolate to lanceolate, 2-5 x 0.65-1.6 cm, margin very faintly serrate to almost entire, cuneate at base, apex acute and herbaceous to soft spinescent, petiole 0.1-0.5 cm. Floral leaves subsessile to sessile, ovate-lanceolate, 0.8-2 x 0.4-1.2 cm, entire, base cuneate, apex acute and herbaceous, softly pubescent. Verticillasters 4-6-flowered, remote, 1-4 cm distant, few \pm approximate above. Bracts linear to linear-lanceolate, 1-4.2 mm, herbaceous, tip soft herbaceous. Pedicels 0.5-0.8 mm. Calyx sub-bilabiate, campanulate to subcampanulate, 6-7 mm, softly pubescent near base; teeth subequal, broadly triangular to oblong, more than half as long as tube enlarging in fruiting calyx as long as the tube; tip softly spinescent, mucro 0.2-0.5 mm. Fruiting calyx 7.5-8 mm, teeth 3.5-3.7 mm, teeth \pm erect, mouth not hairy. Corolla 10-11 mm, light brown in sicco; tube 5-5.7 mm, subexserted, annulate; upper and lower lip 2.5-3 and 4.3-4.5 mm respectively; upper corolla lip slightly retuse, concave. Stamens slightly exserted from the tube, outer and inner pair 2 and 1.5 mm respectively. Nutlets broadly rhomboid-ellipsoid, 1.5-1.7 x 1.2-1.3 mm, smooth, blackish-brown, apiculate with prominent ventral ridge.

Type: \sqrt{N} . Iraq $\sqrt{7}$ d. Mosul Liwa, Garagu, near Sarang, on waste ground by stream and irrigated cultivation, annual, 8.viii. 1961, Agnew & Haines 800 (holo. E! iso E!).



Pl. 21. Stachys iragensis Bhattacharjee (Holotype)

Although the field label describes the plant as annual, the base of the plant was not present and, judging by its affinity, a perennial habit seems more possible.

IX. INDEX OF THE SECTIONS AND SPECIES

(Accepted names are not italicised. When two page references are given, the first one refers to the position of the species in the general classification (Ch. III C), and the second to the account of Turkish species or infraspecific taxa (Ch. VI. C). Synonyms (italicised) are only cited for Turkish species. When illustrated, the page numbers of the figures are cited in brackets).

Name	Page
Genus <i>Stachys</i> L.	106
Subgen. <i>Betonica</i> (L.) Bhattacharjee	147
Sect. <i>Betonica</i> (L.) Benth.	148, 340
" <i>Macrostachya</i> Bhattacharjee	149
Subgen. <i>Stachys</i>	107
Sect. <i>Ambleia</i> Benth.	145, 337
" <i>Aucheriana</i> Bhattacharjee	142
" <i>Campanistrum</i> (Habrl.) Reichenb.	134, 320
" <i>Candida</i> Bhattacharjee	120
" <i>Corsica</i> Bhattacharjee	136
" <i>Eriostomum</i> (Hoffm. & Link) Dumort.	108, 200
" <i>Infrarosularis</i> Bhattacharjee	115, 241
" <i>Fragilicaulis</i> Bhattacharjee	124, 262
" <i>Mucronata</i> Bhattacharjee	114
" <i>Neurocalyx</i> Bhattacharjee	139
" <i>Olisia</i> Dumort.	127, 283
" <i>Roseostachys</i> Bhattacharjee	116
" <i>Satureioides</i> Bhattacharjee	139, 326
" <i>Setifolia</i> Bhattacharjee	117, 255
" <i>Sideritopsis</i> Bhattacharjee	138, 323
" <i>Stachys</i>	118, 259

Name	Page	
Sect. Swainsoniana Bhattacharjee	121	
" Thammostachys Kapeller	140, 330	
" Zietenia (Gled.) Benth.	144, 279	
<u>Stachys acanthodonta</u> Kolk.	285	
<i>acerosa</i> Boiss.	143	Fig. (22, 27)
<i>acutifolia</i> Bory & Chaub.	110	
<u><i>adenocalyx</i></u> C. Koch	306	
<i>aegyptica</i> Pers.	146	Fig. (30)
<i>albanica</i> Markgrof	130	
<i>aleurites</i> Boiss.	131, 302	Fig. (41)
<i>alopencuros</i> (L.) Benth.	148	Fig. (14, 53)
<i>alpina</i> L.	110	Fig. 27, (37, 43, 54, 67, 78)
ssp. <i>macrophylla</i> (Alb.) Bhattacharjee	204	
<i>amanica</i> Bornm. ex Davis	116, 248	
<i>angustifolia</i> Bieb.	130, 286	
<u><i>angustifolia</i></u> Gilib.	260	
<i>anisochila</i> Vis & Pancic	123	Fig. (22)
<i>annua</i> (L.) L.	131, 306	Fig. (27, 40)
ssp. <i>ammophila</i> (Boiss. et Bl.) Sam.	308	
" <i>annua</i> var. <i>annua</i>	310	
" <i>cilicica</i> (Boiss.) Bhattacharjee	308	
var. <i>lycaonica</i> Bhattacharjee	309	
<i>arabica</i> Hornem.	135, 321	
<i>araxina</i> Kapeller	142, 335	Fig. (37)
<i>arenaria</i> Vahl.	130	
<u><i>arenaria</i></u> Benth.	290	
<i>arvensis</i> (L.) L.	135, 322	Fig. (22, 43, 46, 47, 49, 54, 68, 84)

Name	Page	
<i>asterocalyx</i> Rech. fil.	126	
<i>atherocalyx</i> C. Koch	130, 285	Fig. (41, 68)
<i>aucheri</i> Benth.	143	
<u><i>balcanica</i></u> P.W. Ball	342	
<i>balansae</i> Boiss. & Kotschy	110, 205	Fig. (41)
<i>ssp. balansae</i>	206	
" <i>carduchorum</i> Bhattacharjee	207	Fig.(79)
<u><i>baicalensis</i></u> Fisch.	260	
<i>balbisii</i> Link	306	
<i>ballotiformis</i> Vatke	126, 270	Fig. (54)
<i>bayburtensis</i> Bhattacharjee & Hub.-Mor.	111, 238	
<i>beckiana</i> Dörfler & Hayek.	130	
<i>benthamiana</i> Boiss.	126	
<u><i>betonica</i></u> Benth.	341	
<u><i>betonica</i></u> Crantz	306	
<i>betoniciflora</i> Rupr.	149	Fig. (41, 53, 67, 73)
<u><i>betonicifolia</i></u> Desf.	320	
<u><i>bithynica</i></u> Boiss.	200	
<i>bombycina</i> Boiss.	131	
<u><i>boissieri</i></u> Kapeller	280	
<u><i>bornmulleri</i></u> Hand.-Mazz.	249	
<i>brachyclada</i> de Noe ex Cosson	135	
<i>brantii</i> Benth.	126, 268	
<i>burgsdorffioides</i> Boiss.	140, 328	Fig. (22, 49)
<i>ssp. burgsdorffioides</i>	329	

Name	Page	
ssp. <i>ladanoides</i> Hand.-Mazz.	329	
" <i>byzantina</i> C. Koch	111, 231	Fig. (60)
<u><i>canariensis</i></u> Jacq.	259	
<i>candida</i> Bory & Chaub.	121	
<i>canescens</i> Bory & Chaub.	123	
<u><i>cassia</i></u> Boiss.	219	
<i>cataonica</i> Bhattacharjee & Hub.-Mor.	116, 245	
<u><i>caucasica</i></u> C. Koch	290	
<i>chrysantha</i> Boiss. & Heldr.	121	
<i>chamaesideritis</i> Boiss. & Bal.	252	
<u><i>cilicica</i></u> Boiss.	308	
<i>circinata</i> L'Herit	120	Fig. (54)
<i>citrina</i> Boiss. & Heldr.	116, 251	Fig. (79)
ssp. <i>citrina</i>	252	
" <i>chamaesideritis</i> (Boiss. & Bal.) Bhattacharjee	252	
<u><i>congesta</i></u> Urv.	290	
<u><i>cordata</i></u> Klok.	200	
<u><i>cordata</i></u> Gilib.	259	
<i>corsica</i> Pers.	136	
<i>cretica</i> L.	111, 219	Fig. (14)
ssp. <i>anatolica</i> Rech. fil.	227	
" <i>bulgarica</i> Rech. fil.	224	
" <i>cassia</i> (Boiss.) Rech. fil.	221	Fig. (43)
" <i>garana</i> (Boiss.) Rech. fil.	222	
" <i>lesbiaca</i> Rech. fil.	223	

Name	Page	
<i>ssp. mersinaea</i> (Boiss.) Rech. fil.	226	
" <i>smyrnaea</i> Rech. fil.	225	
" <i>trapezuntica</i> Rech. fil.	223	
" <i>vacillans</i> Rech. fil.	224	
<u><i>czernjajevii</i></u> Schost.	283	
<u><i>daenensis</i></u> Gandoger	256	
<u><i>debilis</i></u> Bornm.	248	
<i>decumbens</i> Pers.	123	
<i>demanwendica</i> Bornm.	146	
<u><i>dictyoneura</i></u> Rech. fil.	171	
<i>discolor</i> Benth.	149	Fig. (53)
<i>distans</i> Benth.	131	
var. <i>cillicica</i> Bhattacharjee & Hub.-Mor.	303	
" <i>distans</i>	304	
<i>ssp. teucriifolia</i> Boiss. & Kotschy	304	
<i>diversifolia</i> Boiss.	132, 317	Fig.(37, 47)
<i>durandiana</i> Coss.	120	
<i>durioei</i> de Noe	135	
<i>ehrenbergii</i> Boiss.	110	
<u><i>elata</i></u> C. Koch	232	
<i>eusadenia</i> Davis	126, 262	Fig. (54)
<i>euboica</i> Rech. fil.	123	
<i>euphratica</i> Hayek	293	

Name	Page	
<i>floccosa</i> Benth.	110	
<u><i>floribunda</i></u> Mont. & Auch.	249	
<u><i>foetida</i></u> Gueld.	259	
<i>fontqueri</i> Pau	130	Fig. (47)
<i>fragillima</i> Borrm.	126	Fig. (54)
<i>fruticulosa</i> Bieb.	142, 333	Fig. (68)
<u><i>garana</i></u> Boiss.	222	
<i>germanica</i> L.	110, 200	
ssp. <i>bithynica</i> (Boiss.) Bhattacharjee	202	
" <i>heldreichii</i> (Boiss.) Hayek.	201	
" <i>tymphaea</i> (Hausskn.) Bhattacharjee	202	
<i>glechomifolia</i> Nábělek	126, 266	Fig. (54)
<i>glutinosa</i> L.	143	
<u><i>grandiflora</i></u> Benth.	340	
<i>graveolens</i> Nábělek	126	Fig. (72)
<i>grossheimii</i> Kap.	142	Fig. (40)
<i>guyoniana</i> de Noe	120	
<u><i>haussknechtii</i></u> (Uechtr. ex Hausskn.) Hayek	342	
<u><i>heldreichii</i></u> Boiss.	200	
<u><i>heterodonta</i></u> Klok.	200	
<i>heraclea</i> All.	110	
<i>hissarica</i> Rgl.	110	
<i>huber-morathii</i> Bhattacharjee	110, 210	
<i>huetii</i> Boiss.	111, 236	

Name	Page	
<i>hydrophila</i> Boiss.	120	
<u><i>hypoleuca</i></u> C. Koch	232	
<i>iberica</i> Bieb.	130, 290	Fig. (18, 40, 49, 72)
ssp. <i>iberica</i> var. <i>iberica</i>	291	
var. <i>densipilosa</i> Bhattacharjee	292	
ssp. <i>georgica</i> Rech. fil.	292	
" <i>stenostachya</i> (Boiss.) Rech. fil.	293	
<i>inensis</i> Hausskn. & Bornm.	133, 313	Fig. (27)
<i>inflata</i> Benth.	147, 337	Fig. (30, 40)
<i>ionica</i> Halacsy	123	
<i>iraqensis</i> Bhattacharjee	118	
<i>iranica</i> Rech. fil.	256	
<u><i>italica</i></u> Benth.	219	
<i>iva</i> Griseb.	121	
<i>ixodes</i> Boiss.	143	
<u><i>janiana</i></u> Ces	229	
<i>kotschyii</i> Boiss.	146	
<i>kurdica</i> Boiss.	126, 271	
var. <i>brevidens</i> Bornm. ex Bhattacharjee	273	
" <i>kurdica</i>	272	
<i>laetivirens</i> (Boiss.) Rech. fil.	126, 276	
<u><i>lanata</i></u> Jacq.	231	
<u><i>lanata</i></u> Crantz	200	

Name	Page	
<i>lunigera</i> Rech. fil.	126	
<i>lavandulifolia</i> Vahl	144, 279	Fig. (27, 30, 43, 54, 68, 76)
var. <i>brachyodon</i> Boiss.	280	
" <i>glabrescens</i> Bhattacharjee & Hub.-Mor.	281	
" <i>lavandulifolia</i>	280	
<i>laxa</i> Boiss.	146	
<i>leucoglossa</i> Griseb.	130	
<i>libanotica</i> Benth.	110	Fig. (41)
var. <i>libanotica</i>	215	
" <i>minor</i> Boiss.	215	
<u><i>linearifolia</i></u> C. Koch	285	
<i>longiflora</i> Boiss. et Bal.	126, 262	Fig. (43, 47, 54, 72)
<u><i>longifolia</i></u> Benth.	344	
<i>longispicata</i> Boiss. & Kotschy	111, 234	Fig. (47)
<u><i>lycia</i></u> Gandoger	256	
<u><i>lycopsiformis</i></u> C. Koch	255	
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