

OBSERVATIONS ON THE TRIBE MERIANDREAE OF THE LABIATAE

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ABSTRACT. The three Labiate genera assigned to the tribe Meriandreae of the Stachyoideae, *Meriandra*, *Dorystoechas* and *Peroyskia* were examined morphologically and anatomically to determine whether they did form a natural group and if they could be considered as allies of *Salvia*. The genus *Horminum* of the tribe Hormineae was similarly examined from the point of view of its possible relationship with *Salvia*. On the basis of an appreciable amount of evidence the conclusions reached were that all four were distinct and isolated genera, that the tribe Meriandreae was an unnatural taxon and that links with *Salvia* were either non-existent or not proven. The anatomical information that came to light suggested that similar investigations would be profitable in other Labiate genera. In this instance, the four genera studied could be easily recognised solely on the anatomical characters of stem, leaf lamina and petiole.

INTRODUCTION

The Labiatae contains many genera and groups of genera that are apparently natural, distinct, fairly homogeneous and without obvious affinities to other genera. Numerous examples could be given from different regions of the world. In SW Asia, where over fifty genera are represented (about one third of the family total) the following few can be cited: *Chamaesphacos*, *Hypogomphia* and *Zataria*, morphologically distinct relict genera with very limited distributions; *Salvia* and *Scutellaria*, large almost cosmopolitan genera; and, as examples of distinct generic groups, one can mention that of *Phlomis* and *Eremostachys* or the complex containing *Nepeta*, *Dracocephalum*, *Lallemantia*, *Lophanthus*, *Kudrjaschevia* etc. All these genera or groups of genera are very distinct, easily recognised and defined but in all cases it is extremely difficult to suggest what their relatives are. One of the main difficulties in assessing relationships is, of course, lack of information on a world basis. Even at the gross morphological level, information is uneven. And although there is an ever-increasing volume of knowledge about "micro-characters" such as those of pollen, embryology and fruit structure it is clearly going to be a very long time before all the essential information is likely to be available in order to attempt an overall system of classification that is not largely speculative or provisional.

Anatomically the family has been rather neglected and one of the original reasons for this study was to determine whether this was a promising field of investigation. Accordingly as a test case and stemming from the interest of one of us in the genus *Salvia*, it was decided to study a few small genera which have on occasions been mooted as putative allies of that vast genus. The other aim was to attempt to evaluate the inter-relationships of the selected genera and their possible connections with *Salvia*.

Dorystoechas, *Peroyskia* and *Meriandra* are generally placed together in accounts of the Labiatae. Bentham & Hooker (1873-76) put them in the tribe Monardeae along with *Salvia*, *Salviastrum*, *Audibertia*, *Rosmarinus*,

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Monarda, *Blephilia* and *Ziziphora*. The only character common to all these genera is that of 2 fertile stamens. Briquet (1897) subsequently split up the Monardeae into smaller groups and *Dorystoechas*, *Perovskia* and *Meriandra* emerged as the only members of the Meriandreae. Recently, El-Gazzar & Watson (1970) conducted a sampling survey of the Labiatae, together with the Verbenaceae, using a substantial amount of available data and subjecting this information to computational analysis. One of their resultant groups contained the five genera *Perovskia*, *Dorystoechas*, *Meriandra*, *Rosmarinus* and *Salvia*.

In addition to investigating *Dorystoechas*, *Perovskia* and *Meriandra*, *Horminum* was also studied. It differs from the other genera, *inter alia*, in having four stamens. It is normally placed separate from the other three genera in family accounts but generally not distant from them. In Briquet's classification, it was placed in the subtribe Stachyoideae-Hormineae together with the New World (with one species in Hawaii) genus *Sphacele*.

The first part of this paper deals with the general characters, distribution and floral structure of the genera under review (I.C.H.); the second part covers the anatomical investigation (M.H.B.); the final part assesses the information (I.C.H.).

GENERAL CHARACTERS

Dorystoechas Boiss. & Heldr. *D. hastata* Boiss. & Heldr. (fig. 1A), the only member of the genus, is a shrub up to about 1 m. It has simple, petiolate, lanceolate, finely crenulate, hastate leaves with a dense indumentum below of simple eglandular and glandular hairs. The inflorescence consists of dense terminal spikes made up of numerous, many-flowered, closely approximating cymes; the floral leaves are lanceolate, soon deciduous. The calyx is oblong-tubular, 4–5 mm, c. 12-nerved with an indumentum of eglandular and glandular hairs and sessile glands; the upper lip is subentire with three very closely connivent teeth; the lower lip is slightly shorter and 2-toothed, c. 2 mm; after anthesis the calyx expands in size up to c. 9 mm and is tubular, closed at the throat (fig. 1Af). The corollas are small, c. 5 mm, and white with oil glands on the upper and lower lip; the corolla tube is straight, glabrous within, c. 3 mm; the upper lip is scarcely curved, bifid; the lower lip is slightly longer than the upper with a c. 1.8 mm broad central lobe and two slightly smaller lateral lobes. The stamens are subincludid; the anthers each consist of two slightly curved and divergent thecae with no connective apparent; staminodes are absent. The ovules are borne on a conspicuous fleshy reddish-orange disc. The style is bifid at the apex with two equal rather flat lobes. The nutlets are relatively large, c. 3×1 mm, brown, oblong, triquetrous with an irregularly shaped apical beak; they are not mucilaginous on wetting.

Hermaphrodite and female flowers with aborted stamens occur on separate plants. Davis (1951) suggests that although *Dorystoechas* is morphologically gynodioecious it appears to be functionally dioecious in that hermaphrodite flowers do not set seed. Further field observations are however needed to confirm this.

D. hastata is only known from a small area of SW Anatolia where it is recorded from several localities in Antalya province, between 1000 and 1500 m, within the Mediterranean phytogeographical region.

Meriandra Benth. The genus consists of two readily distinguishable species: *M. bengalensis* Benth. (fig. 1B) and *M. strobilifera* Benth. (fig. 1C). Both are shrubs up to 1.5 m with a tomentose or floccose indumentum consisting of branched dendroid eglandular and glandular hairs especially thick on the lower surfaces of the leaves. The leaves are petiolate, oblong-lanceolate with serrulate or subentire margins and hastate or rounded at the base. The inflorescence consists in *M. bengalensis* of distinct many-flowered verticils whereas in *M. strobilifera* the inflorescence consists of dense 4-angled spikes; the floral leaves are ovate, acuminate, larger than the calyces in *M. strobilifera* but in *M. bengalensis* they are ovate, shorter than the calyces. The calyx in *M. bengalensis* is c. 5 mm and c. 3.5 mm in *M. strobilifera* and 9-11-nerved; the upper lip is subentire with two or three closely connivent teeth; the lower lip is two-toothed, c. 1.5 mm; the indumentum consists of simple and irregularly branched dendroid hairs; the calyces enlarge slightly after anthesis and are open at the throat. The corollas are small, white, c. 8 mm in *M. bengalensis* and c. 5 mm in *M. strobilifera*; the corolla tube is straight; in *M. bengalensis* there is a prominent annulus near the throat which almost closes it, whereas the corolla tube is exannulate in *M. strobilifera*; in *M. strobilifera* the corolla is 4-lobed with an entire upper lip and an equally 3-lobed lower lip whereas in *M. bengalensis* there is a clearly bifid upper lip and a 3-lobed lower lip (in this species flowers with an extra corolla lobe and one or two extra stamens occasionally occur). The stamens are clearly exserted or scarcely so; in *M. bengalensis* there is a distinct connective, 0.8-1 mm long (fig. 1Bd) but in *M. strobilifera* the connective is absent or nearly so (fig. 1Cd). Staminodes are present in *M. bengalensis* and absent in *M. strobilifera*. The ovules are borne on an inconspicuous disc. The styles are bifid at the apex in both species with equal or \pm equal lobes. The nutlets are obovate-elliptic and not mucilaginous in *M. bengalensis*; in *M. strobilifera* they are narrow oblong, apically pointed and mucilaginous.

M. bengalensis, despite its name, is native in Ethiopia but is cultivated in India and W Pakistan for the same purposes as is *Salvia officinalis* in Europe. *M. strobilifera* grows in the Kumaon region of India.

Perovskia Karel. (fig. 1D). The six or seven currently recognised species are all very closely related to each other and, for the most part, are separated only on differences of leaf shape (Kudrjaschew, 1936; Hedge & Lamond, 1968). They are shrubs up to 1 m or more with simple to bipinnatisect scarcely petiolate leaves; the indumentum consists of small tufted dendroid eglandular hairs and sessile oil glands. The inflorescence is much branched consisting of 2-6-flowered cymes distant or somewhat approximating; the floral leaves are very small, c. 1 mm. The calyx is tubular campanulate, 5-8 mm, 7-9-nerved with an indumentum of dendroid and simple eglandular hairs and sessile oil glands; the upper lip usually has three closely connivent teeth and the lower lip has two short broad teeth; after anthesis, the calyx scarcely enlarges and is open at the throat. The corollas are 9-12 mm, violet-blue, sparsely covered with small simple and dendroid hairs and sessile glands; the tube is exserted and straight with a conspicuous annulus; the upper lip is 4-lobed of which the two lateral lobes are larger than the two central lobes; the lower lip is entire, 1-lobed, \pm equal to the upper. The stamens are exserted or included with exserted or included upwardly

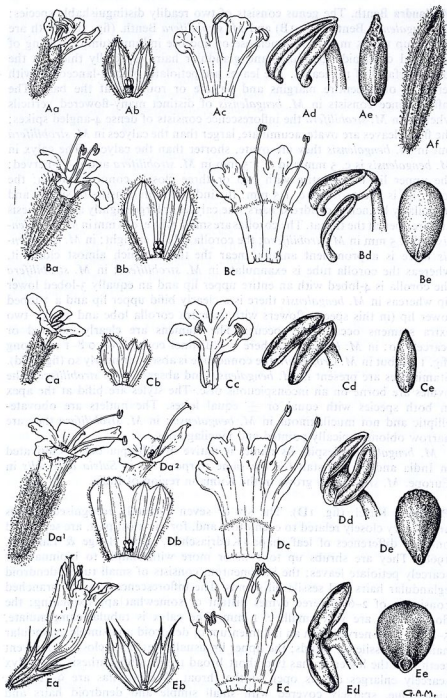


FIG. 1. Floral parts of: Aa-Af, *Dorystoechas hastata*; Ba-Be, *Meriandra bengalensis*; Ca-Ce, *M. strobilifera*; Da-De, *Perovskia atriplicifolia*; Ea-Ee, *Horminum pyrenaicum*. a, flower; b, calyx dissected; c, corolla dissected; d, anther; e, nutlet; f, fruiting calyx. Da¹ form with included style, and Da² with exserted style. A-D: a, b, c x 4; d, x 20; e, x 10; f, x 3.5. E: a, b, c, x 1.8; d, x 15; e, x 10.

curved slightly divergent thecae; there is no connective; staminodes are present. The ovules are borne on a small fleshy disc. The style is bifid at the apex with two equal rather thick broad spreading lobes. The nutlets are c. 2.5×1 mm, brown, broadly obovate, slightly flattened, rounded at the apex, not mucilaginous on wetting.

In *P. atriplicifolia*, and probably in the other species of the genus (cf. Kudrjaschew, 1936), dimorphic flowers occur on different plants: either the corollas have exerted styles with included anthers (fig. 1Da²) or else there are short-styled corollas with exerted anthers (fig. 1Da¹).

Perovskia is a late-flowering genus very characteristic of the arid Central Asiatic-Afghanistan region, extending eastwards to Kashmir and in the south and west to West Pakistan and Iran.

Horminum Benth. The genus consists of one species, *H. pyrenaicum* L. (fig. 1E). It is a scapose herb with simple, serrate, petiolate leaves and an indumentum of simple eglandular and glandular hairs. The inflorescence is unbranched consisting of 6-10-flowered, distant verticils. The calyx is campanulate, c. 10 mm, 13-14-nerved, with a sparse indumentum of small glandular and eglandular hairs and sessile oil glands; the upper lip is prominently 3-toothed, the lower prominently 2-toothed, c. 5 mm long; the calyx expands slightly after anthesis and is open at the throat. The corolla is large, dark violet-blue, up to 25 cm; the tube is curved, sparsely pilose outside and in, annulate at the base; the upper lip is bifid, the lower 3-lobed. The stamens are four, the anterior pair long-exserted and the posterior pair included; the thecae are unilocular (by fusion), cohering (fig. 1Ed). The ovules are borne on an inconspicuous disc. The style is bifid at the apex with equal lobes. The nutlets are broad, obovate, c. 2×1.8 mm, rounded at the apex, somewhat triquetrous, not mucilaginous on wetting.

H. pyrenaicum is fairly widely distributed on limestone in the high ranges of Europe from the Pyrenees to the Tyrol up to 2400 m.

ANATOMICAL CHARACTERS

Material and method. This account is based on a study of herbarium material, except for *Horminum pyrenaicum* of which herbarium and fresh material was studied. The techniques used for preparing leaf and stem material and for removing epidermis were broadly the same as those described for *Limonium* (Bokhari, 1970), but here a KOH solution of less concentration (2%) was used. In the petiole, the number, position and shape of the vascular bundles vary at different levels and it is essential that sections of strictly comparable portions of the petioles of each genus should be taken. Petioles were sectioned from the middle region and laminae through the midrib.

The following species were examined: *Dorystoechas hastata*, *Meriandra bengalensis*, *M. strobilifera*, *Perovskia abrotanoides*, *P. atriplicifolia*, *P. scrophulariifolia* and *Horminum pyrenaicum*.

In the two non-monotypic genera, *Meriandra* and *Perovskia*, the anatomical features of the species within each genus were essentially the same and unless species are individually mentioned, references below to these genera cover their constituent species.

Leaf.

Lamina and epidermis. Leaves are bifacial in *Dorystoechas*, *Horminum* and *Meriandra* (fig. 2e, g, h) but in *Perovskia* are distinctly isobilateral (fig. 2f). Stomata are of caryophyllaceous (diacytic) type (fig. 3e) and occur on both surfaces of the leaf. In *Dorystoechas* and *Meriandra* where the leaf surface has many folds, the stomata are usually confined to the grooves. In *Horminum* and *Perovskia*, the leaf surface is smooth and stomata are \pm uniformly distributed and in equal abundance on both surfaces of the leaf. In all these genera, the epidermal cells are \pm barrel-shaped and covered with a cuticle. The cuticle is much developed and distinctly corrugated in the petiolar and midrib region, except in *Perovskia* where it is \pm smooth.

Mesophyll. Mesophyll is clearly differentiated into palisade and spongy parenchyma tissue. In *Perovskia*, where the leaf is isobilateral, there are two layers of palisade on the upper and lower side of the lamina; the lower palisade continues into the flanks of the midrib. In *Dorystoechas* and *Meriandra*, the palisade is 2-layered and the cells are much elongated (3x their breadth) but in *Horminum*, the palisade is 3-layered and the cells are much shorter (up to $1\frac{1}{2}$ x their breadth).

Midrib. The structure of the midrib follows that of the main vascular strand in the petiole. There is a single vascular bundle in the midrib of *Dorystoechas*, *Horminum* and *Perovskia*. In *Dorystoechas* and *Perovskia* there are distinct groups of sclerenchyma tissue on the lower side of the vascular bundle (fig. 2c, f) but in *Horminum* the vascular bundle has groups of collenchyma tissue on the upper and the lower side (fig. 2g). In *Meriandra*, the midrib, like the petiole, has an abaxial continuous vascular arc and is accompanied by a \pm interrupted strand of vascular tissue with inverse orientation of xylem and phloem on the adaxial side, and there are groups of collenchyma tissue on the upper and lower side of the midrib vascular strand (fig. 2h).

Petiole.

Transverse sections of the petiole in the middle region exhibit considerable range of vascular structure which are distinctive of each genus (fig. 2 a-d). In *Dorystoechas* and *Meriandra* the petiole has large wings, but in *Horminum* and *Perovskia* the wings are less distinct. In *Meriandra* and *Perovskia* there is a well-developed chlorenchymatous tissue at the flanks of the petiole, but this tissue is lacking from the petioles of *Dorystoechas* and *Horminum*. The petiole of *Dorystoechas* has a crescentic, continuous arc of vascular tissue with groups of sclerenchyma tissue on the lower side (fig. 2a). In *Perovskia*, in addition to the median crescentic arc of vascular tissue, there are two small vascular bundles on its lateral side and groups of sclerenchyma are present below the vascular strand (fig. 2b). In *Horminum*, there is a moderately deep arc of 5 distinctly separate vascular bundles in which the two lateral ones are smaller than the three in the middle. Each bundle has a well-defined group of collenchyma on the upper and lower side (fig. 2c). In *Meriandra* the vasculature of the petiole is distinctly different from the other 3 genera. Its petiole has a \pm crescentic, continuous arc of vascular tissue on the abaxial side and is invariably accompanied by \pm interrupted

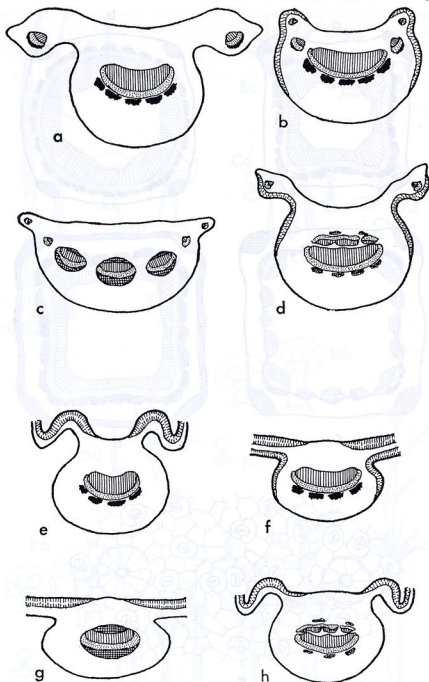


FIG. 2. a-d. Diagrammatic transverse sections of petioles. a. *Dorystoechas hastata*; b. *Perovskia scrophulariifolia*; c. *Horminum pyrenaicum*; d. *Meriandra bengalensis* (all $\times 25$). e-h, diagrammatic T.S. of part of laminas through midrib. e. *Dorystoechas hastata*; f. *Perovskia scrophulariifolia*; g. *Horminum pyrenaicum*; h. *Meriandra bengalensis* (all $\times 25$). Sclerenchyma solid black; collenchyma cross-hatched; chlorenchyma (palisade etc.) ticked; xylem hatched; phloem dotted.

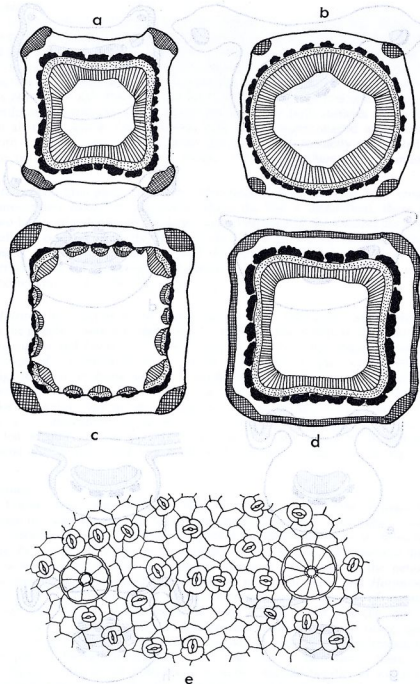


FIG. 3. a-d. Diagrammatic transverse sections of stems. a. *Dorystoechas hastata*; b. *Perovskia scrophulariifolia*; c. *Horminum pyrenaicum*; d. *Meriandra bengalensis* (all $\times 25$). e. a portion of epidermis of *Perovskia atriplicifolia* ($\times 100$). Sclerenchyma solid black; collenchyma cross-hatched; chlorenchyma (palisade etc.) ticked; xylem hatched; phloem dotted.

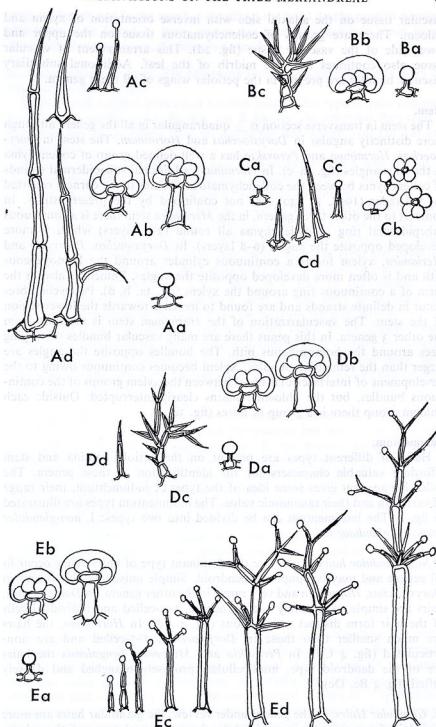


FIG. 4. Types of indumentum. Aa-Ad: *Dorystoechas hastata*; Ba-Bc: *Perovskia scrophulariifolia*; Ca-Cd: *Horminum pyrenaicum*; Da-Dd: *Meriandra bengalensis*; Ea-Ed: *Meriandra strobilifera* (all $\times 100$).

vascular tissue on the adaxial side with inverse orientation of xylem and phloem. There are groups of collenchymatous tissue on the upper and lower side of the vascular tissue (fig. 2d). This arrangement of vascular tissue also continues into the midrib of the leaf. Additional subsidiary vascular bundles are present in the petiolar wings of all these genera.

Stem.

The stem in transverse section is \pm quadrangular in all the genera although more distinctly angular in *Dorystoechas* and *Horminum*. The stem in *Dorystoechas*, *Horminum* and *Perovskia* has a well-defined group of collenchyma in the four angles (fig. 3a-c). In *Horminum*, additional subepidermal strands of collenchyma between the collenchymatous bundles in the corners reported by Solereder (1908, p. 640), are not confirmed by the present study. In contrast to the other three genera, in the *Meriandra* stem there is a continuous subepidermal ring of collenchyma all round (2-3 layers) which is more developed opposite the angles (6-8 layers). In *Dorystoechas*, *Perovskia* and *Meriandra*, xylem forms a continuous cylinder around the homogeneous pith and is often more developed opposite the angles. Phloem is also in the form of a continuous ring around the xylem (fig. 3a, b, d). Pericyclic fibres occur in definite strands and are found to increase towards the lower region of the stem. The vascularization of the *Horminum* stem is different from the other 3 genera. In this genus there are many vascular bundles of varying sizes around the homogeneous pith. The bundles opposite the angles are larger than the remaining bundles. Xylem becomes continuous owing to the development of interfascicular fibres between the xylem groups of the contiguous bundles, but the phloem remains clearly interrupted. Outside each phloem group there is a group of fibres (fig. 3c).

Indumentum.

Hairs of different types are present on the petiole, lamina and stem affording valuable characters for the identification of these genera. The following account gives some idea of the types of indumentum, their range of variation and their taxonomic value. The indumentum types are illustrated in fig. 4. The indumentum can be divided into two types: I, *non-glandular hairs*; II, *glandular hairs*.

I. *Non-glandular hairs*. These are the dominant type of hairs. They occur in all genera and may be simple or dendroid. Simple uniseriate hairs occur in *Dorystoechas*, *Horminum* and very rarely in the other genera. In *Dorystoechas*, hairs are simple (very rarely 1-2 branched), 1-4-celled and individual cells of the hair form distinct articulations (fig. 4 Ad). In *Horminum*, the hairs are much smaller than those in *Dorystoechas*, 1-3-celled and are non-articulated (fig. 4 Cd). In *Perovskia* and *Meriandra bengalensis* the hairs are of the dendroid type, multicellular, profusely branched and densely tufted (fig. 4 Bc, Dc).

II. *Glandular Hairs*. In the genera under review, the glandular hairs are more varied in form than the non-glandular hairs. Several types of these hairs may occur side by side and afford valuable diagnostic characters for differentiating genera or species. Glandular hairs vary in the number of cells in the

stalk, its length and in the number of cells in the head. In the present account, glandular hairs found in these genera are treated under two main types: A, simple glandular hairs; B, branched glandular hairs.

A. *Simple glandular hairs*. The following types of simple glandular hairs are met with in these genera.

i. Hairs with 1-celled stalks and 1-celled heads. This type is quite common in all the genera (fig. 4 Aa, Ba, Ca, Da & Ea). In *Dorystoechas* they tend to be in grooves but in others they are uniformly distributed over the leaf and stem surface.

ii. Hairs with 2-4-celled stalks and 1-celled heads. Such hairs occur in *Dorystoechas*, *Horminum* and *Meriandra strobilifera* (fig. 4 Ac, Cc & Ec), but were not observed in *Perovskia* or *Meriandra bengalensis*.

iii. Hairs with 2-celled stalks and 8-16-celled heads (bladder-like integumental glands). These glands are referred to as bladder-like integumental glands in the literature (Solereder, 1908, p. 638). In these glands the cuticle of the glandular head is raised like a bladder owing to the great accumulation of secretion below the cuticle. Such glands are quite common in *Dorystoechas*, *Perovskia* and *Meriandra* (fig. 4 Ab, Bb, Db & Eb). In *Dorystoechas* and *Meriandra*, these are \pm raised up on a short or long stalk but in *Perovskia* they are commonly sunk in small pits especially on the leaf surface.

iv. Hairs with 1-celled stalk and 2-6-celled head. These glands clearly differ from the bladder-like integumental glands in their smaller size, 1-celled stalk and absence of bladder-like cuticular covering over the head. Such glands were only found on the stem and lower surface of the leaf of *Horminum* (fig. 4 Cb).

B. *Branched glandular hairs*. Branched glandular hairs have been recorded in the *Mimosaceae*, *Orobanchaceae* and *Platanaceae* but not, as far as I have been able to determine, in the *Labiatae*. In the present study, branched glandular hairs were found to form a dense covering on the petiole, lamina and stem surface of *Meriandra strobilifera* and by this type of indumentum it can be easily differentiated from the other species, *M. bengalensis*, where non-glandular dendroid hairs are present. The branched glandular hairs are quite thick-walled; the cells of the main branch form definite articulations, and usually fascicles of glandular branches are produced at the junctions of the main cells. Some of the branches were also noticed to be eglandular (fig. 4 Ed). In fact, there are all transitional stages between 2-celled stalks and profusely branched glandular hairs in this species (fig. 4 Ec, Ed).

POLLEN

There is a considerable amount of information available about the pollen characteristics of the *Labiatae*. Much of this is contained in Wunderlich's paper (1967) in which she attempts a natural classification of the family based on pollen and seed development. Essentially her classification deviates little from that of Briquet (1897) and the amended version of it by Melchior (1964); most of her proposed changes are minor. One of the interesting points that her paper emphasises is the presence of two major groups within the *Labiatae* based on pollen: 1) a 2-celled, 3-colpate group and 2) a 3-celled, 6-colpate group. The former was regarded as primitive, the latter

as advanced. In another paper by Henderson *et al.* (1968), the pollen of a selected range of *Salvia* species was examined together with, among others, the four genera presently under discussion. All the species were 6-colpate. They were arranged in rather arbitrary groups according to size, shape and structure of the pollen in terms of light microscopy. There was little in the way of major observable differences among most of the 50 species of *Salvia* and about 40 of them were placed in Group I—"Salvia" type. But the pollen of our four genera was clearly different. The "*Horminum*" type included *Horminum* and *Meriandra strobilifera*; the "*Dorystoechas*" type included *Dorystoechas* and *Perovskia*.

OTHER CHARACTERS

There is very little cytological information about the genera under discussion and a chromosome count of $2n = 12$ in *Horminum* is apparently the only one available. This number also occurs in *Salvia* but is a relatively uncommon occurrence (Fedorov, 1969).

Wunderlich (1967) had very little data about the Meriandreae with regard to seed-development and embryo characters; that given for the Hormineae was similar to many other subtribes.

The usefulness of pericarp characters has been shown elsewhere (Hedge, 1970) but in our four genera anatomical details of the nutlets have yet to be studied. In this respect, however, it is interesting to note that of the species under consideration here only *Meriandra strobilifera* produced mucilage on soaking whereas over 90% of the *Salvia* species investigated in the paper cited were clearly mucilaginous.

DISCUSSION AND CONCLUSIONS

This study of the four genera showed very clearly that they are all very distinct from each other both in their morphological and anatomical features. All have several distinctive characters not shared by the other genera. To cite only a few examples of them, *Dorystoechas* has an inflorescence consisting of a dense terminal round spike, calyces that much enlarge after anthesis with a closed throat and characteristic apically pointed nutlets; *Meriandra* has either a four-sided terminal spike with prominent floral leaves (*M. strobilifera*) or else the inflorescence consists of many-flowered individually distinct verticils, the corolla is either 4- or 5-lobed and the anthers have or have not a definite connective; in *Perovskia* the inflorescence consists of numerous few-flowered distant verticils and the corolla has an entire lower lip and a four-lobed upper lip; *Horminum* is a scapose herb with large curved corollas and has four stamens with unilocular anthers.

In at least its floral structure, *Horminum* stands clearly apart from the other genera (cf. fig. 1E) and can be left out of the discussion for the present. What then do the other three genera have in common? They have 2-stamens which, in common with most other 2-staminate Labiates*, are the anterior pair. They are all shrubs with rather small flowers. They all have, as fig. 1 shows, fairly similar calyces. But are these similarities significant when the whole

* One exception is provided by the SW Asiatic *Hypogomphia* in which the posterior pair are fertile.

family is considered? My own knowledge of the Labiatae would suggest a negative answer. Furthermore, I would be inclined to consider their floral differences, such as those of corolla structure and androecium form (shown in fig. 1), as more significant than their similarities. When the other non-floral morphological differences are taken into account, it is clear that they share little in common.

Perovskia is the most isolated of the genera considered here for several reasons but particularly because of the corolla structure which is quite unlike anything else either amongst other SW Asiatic genera or, as far as I know, in the whole of the Labiatae. There are other genera with a single lobed lower corolla lip (as in the Bentham tribe Ocymoideae) but in these genera the stamens are declinate and the corolla shape is quite different.

Anatomically, the most distinctive single feature of the four genera studied is the vascular structure of their petioles. They exhibit a pattern of diagnostic value and it is quite possible to distinguish them on this character of vascularization alone. But to be more exact in recognising the genera, accessory petiolar characters such as the presence of sclerenchyma or collenchyma accompanying vascular strands, the presence or absence of chlorenchyma at the flanks of the petiole and, externally, the indumentum can be reliably used. Isobilateral leaves are only found in *Perovskia*. Two of the genera have a characteristic stem anatomy: in *Horminum* there is an interrupted phloem around the xylem cylinder and in *Meriandra* there is a characteristic continuous subepidermal ring of collenchyma.

The anatomical evidence therefore shows no evidence of affinity between the genera. However, any overall assessment of the value of this anatomical information would require knowledge of the range of variation throughout the family as a whole. This is not available.

Turning now to the question of possible relationships of the four genera to *Salvia*, has any new evidence come to light during this investigation that suggests inter-relationships? Anatomical data about *Salvia* are not at hand so the question can only be answered on morphological evidence based on personal knowledge acquired over several years. *Salvia* is a vast genus of between 800 and 900 species and although it would not be very difficult to split it up into a few separate genera, it is essentially a homogeneous unit held together by the characteristic separation and differentiation of the thecae. The closest approach to this structure is shown by *Meriandra bengalensis* (fig. 1 Bd) where the thecae are clearly separated but they are not differentiated in size or fertility and there is no articulation, as occurs in *Salvia*, between filament and connective. In the form of the corolla, *M. bengalensis* is quite different from any *Salvia* I know. This is also true of the other species illustrated in fig. 1. Therefore, in general, the floral evidence speaks against any close link between *Salvia* and the genera considered in this paper.

If then the Meriandreae is considered as an artificial assemblage and its constituent members are not considered as allies of *Salvia* can affinities be found for them in another part of the family? My own opinion is that they have no obvious allies elsewhere. They are apparently ancient relict genera whose ancestors and relatives have long since vanished in the course of evolution. And therefore in the absence of a better place to put them they are probably best left where they usually have been placed.

As pointed out at the start of this paper there are some very natural 'groups' throughout the Labiatae. For the most part, these 'groups' are super-genera. Some examples are: "*Satureia*" including e.g. *Satureia*, *Calamintha*, *Clinopodium*, *Micromeria*; "*Nepeta*" including e.g. *Nepeta*, *Dracocephalum*, *Lallemantia*, *Glechoma*, *Hymenocrater*, *Cedronella*, *Lophanthus*; "*Salvia*" including *Salvia*, *Audibertia*, *Salviastrum*. In this context, the only natural 'groups' in the Meriandreae are the individual genera. But if one rises above this level to the inevitably more artificial assemblages of tribes, the very broad groups of Bentham's tribe Monardeae, with *Salvia*, *Rosmarinus*, *Perovskia*, *Meriandra*, *Dorystoechas*, etc. possibly unites genera which although they are not at all closely related may have evolved from a common ancestral stock.

El-Gazzar & Watson (1970) have recently pointed out the defects of the generic groupings in the family as a whole and many of their critical observations are well justified. Their own suggested replacements are however unlikely to be accepted in preference to those currently used although they certainly provide food for thought. As pointed out elsewhere (Burt et al., 1970) with reference to a similar work on *Salvia* by El-Gazzar et al. (1968), the small size of their sample and the exclusion of almost all available corolla characters have resulted in some proposed alliances which most taxonomists would regard with at least surprise if not scepticism. Bentham (1832-36) said, in his introduction to the conspectus of the genera and species of Labiatae, that they were "intended as artificial keys to assist the determination of Labiatae and therefore the most striking characters are given necessarily rather more absolutely than they exist in nature and I fear they may sometimes lead astray". Although a vast number of new species have been described since then and a great amount of additional information is at our disposal, little progress has been made in producing a family classification that is clearly and fundamentally an improvement on that of Bentham.

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