Formerly Lamiales Newsletter

VITEX

A Newsletter for Lamiaceae & Verbenaceae Research

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ROYAL BOTANIC GARDENS KEW

EDITORIAL

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Welcome to this edition of *Vitex*, a new name for the *Lamiales Newsletter*. As we mentioned in the Editorial of the last edition, the New Ordinal Classification for the Families of Flowering Plants (APG, Ann. Missouri Bot. Gard. 85: 531 - 553), includes many families such as Acanthaceae and Scrophulariaceae within the Lamiales. We wish to concentrate this Newsletter on the study of the Labiatae, and therefore have chosen *Vitex,* one of the basal genera of the family, as its title. Although focusing primarily on the Labiatae, we are still happy to include articles placing the family in a wider context. As many of our readers continue to have an interest in the Verbenaceae (now restricted to tribe *Verbenoideae*), we are happy to include articles on that family, even though it is more distantly related to the Labiatae.

2001 will mark the tenth anniversary of the Advances in Labiate Science Conference held at Kew. This edition of the Newsletter reports on two projects which have benefited enormously from the contacts made at that time: the family treatment for Kubitzki's *Families and Genera of Flowering Plants*; and Frodin and Govaert's *World Checklist and Bibliography of the Labiatae*. We feel that the time is due for another conference to enable discussion on recent work and to identify the priority areas for further research. We would be happy to help publicise a conference if there were anyone willing to devote the necessary time, resources and commitment into running it.

As ever the success of *Vitex* depends on the readers' willingness to send us articles and comments. Please continue to send your valuable contributions and comments on the future of the newsletter to Y.Harvey@rbgkew.org.uk; Tel. +44 20 8332 5238; Fax. +44 20 8332 5278. (Note change of numbers).

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THE FAMILIES AND GENERA OF VASCULAR PLANTS (Ed. KUBITZKI *et al.*)

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The Familes and Genera of Vascular Plants (Ed. K. Kubitzki *et al.*) is a modern treatment of the ferns, fern allies and seed plants at the familial and generic level. This can be seen as a much needed replacement for Engler & Prantl's *Die Natürlichen Pflanzenfamilien*. So far three volumes have been published. The first volume, treating Pteridophytes and Gymnosperms, was published in 1990, one volume of Dicotyledons: Magnoliid, Hamamelid and Caryophyllid families (1993) and two volumes of Monocotyledons (1998). The Asteridae are scheduled to appear in two volumes.

I was originally asked to undertake the writing of the text of Labiatae for the series under the volume editor- ➢

ship of Joachim Kadereit, Mainz University. My response was that there had been very substantial changes in our concept of the family Labiatae with respect to its delimitation from Verbenaceae, and it would be more logical to try to incorporate these changes, even if they were at that time still only sketched out in a preliminary manner. It would therefore make better sense to consider the Lamiales (*sensu stricto*) together. I fully realized at this time, that I might be taking on a very difficult task: to expound in conventional taxonomic terms, and using morphological characters to define taxa which were originally delimited by cladistic analysis. However we were still unaware that the ongoing molecular studies would completely revolutionize our thinking on the "Lamiales". Nevertheless, the preliminary nature of much of this evidence will make it impossible in the short term to arrive at a final consensus. The published treatment will no doubt represent the best compromise at the time, but certainly the groups I am responsible for no longer represent a "natural group", but diverse elements within a larger Lamiales that includes Scrophulariaceae and its allies. The final subfamilial classification of the Labiatae is still not fully decided, although much is now clear. The main group which is problematic is the *Viticoideae*, which consists of various elements which do not cluster to form a clade. The work hopefully will provide a modern treatment which will show where further research is needed.

Fortunately, there have been many specialists willing to contribute to the groups which I offered to coordinate. These include: Sandy Atkins (Verbenaceae), Andrei Budantsev (*Nepetinae*; *Lamioideae* in part), Phil Cantino (Phrymaceae; *Ajugoideae*; *Lamioideae* in part; *Scutellarioideae* in part; *Menthinae* in part), Barry Conn (*Prostantheroideae*), Sebsebe Demissew (Cyclocheilaceae), Ray Harley (*Hyptidinae*, *Menthinae* in part), Tatiana Krestovskaya (*Lamioideae* in part), Ramón Morales (*Salviineae* in part; *Menthinae* in part), Alan Paton (*Scutellarioideae* in part; *Ociminae*; *Plectranthinae*), John Rourke (Stilbaceae, including Retziaceae), Olof Ryding (*Lamioideae* in part), Karen Sidwell (*Salvia*), Tim Upson (*Lavanduleae*). Avicenniaceae is now placed in Acanthaceae according to the latest molecular data. Some groups are still untreated, though deadlines are all but upon us. Some groups are still without an author: some *Mentheae*, *Elscholtzieae*, *Symphorematoideae*, Nesogenaceae for example. Offers would be welcome!

A WORLD CHECKLIST AND BIBLIOGRAPHY OF LAMIALES *sensu stricto*

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There has been a long-standing interest in the drupaceous-fruited Lamiales (the Lamiales of Bentham and Hooker and, with variations, of most subsequent authors until the 1990s) at the Kew Herbarium, starting with Ray Harley and continuing with Alan Paton, Sandy Atkins and others. The Royal Botanic Gardens hosted a successful conference on Labiatae (as one of the two major families in the order as it was then known) in 1991 and this has been followed by the *Lamiales Newsletter*. Several flora accounts along with many revisionary and other studies have appeared over more than three decades, and further research is underway. At present a 'genera of Lamiales' is in preparation, partly as a vehicle for exposition of the new arrangement of genera and families within the order.

The World Checklists and Bibliographies were initiated in 1994 as a collaborative undertaking by David Frodin and Rafaël Govaerts (Global Data Projects) with the initial aim of furnishing synonymised checklists, with selected bibliographies, of families and other groups of particular interest to current research and other activities at Kew. Three Checklists have been published to date and a fourth, on Euphorbiaceae (with Pandaceae), is expected to appear in March 2000. A number of other families are currently in preparation.

Among the projected Checklists is one for Lamiales. Preparation of this began in 1996 with the compilation first of an annotated bibliography (by Frodin) and then of the checklist proper (by Govaerts). Work towards a first draft is now substantially complete and it is expected this will be ready for review by March 2000. It will encompass 305-310 genera and about 8900 species in Lamiaceae, Verbenaceae, and the traditionally associated (and often subsumed) Avicenniaceae, Chloanthaceae, Cyclocheilaceae, Nesogenaceae, Phrymaceae, Stilbaceae and Tetrachondraceae. When published, it will represent the first such account at species level since the mid-nineteenth century.

For such a work we would, not unnaturally, like to invite collaboration from anyone who has at least some specialist knowledge of particular genera or larger taxa and its key literature. If readers are so interested, please let us know and we would be happy to send a copy of the appropriate account. Your comments will be gratefully received and we will credit you with co-authorship. The more informed opinion we are able to obtain, the better the World Checklist will be, and more truly a collective effort.

To conclude, the reader may ask, why cover only the 'classical' Lamiales? It is true that contemporary research in phylogeny and molecular systematics has shown that the traditional distinctions between that order and the Scrophulariales (largely corresponding to the Personatae of Bentham and Hooker) as well as the Plumbaginaceae – notably in vernation and fruit structure – do not hold and that only an expanded Lamiales will satisfy strict phylogenetic criteria. A more detailed scheme of internal relationships has, however, yet to be worked out; furthermore, as one of the more successful groups of modern flowering plants some 21 000 or more species are in all now included. It has therefore seemed to us that maintaining the classical circumscription represents the most practical course from our point of view.

DIVERSITY AND EVOLUTION IN *SALVIA* — PRESENTATION OF A NEW RESEARCH PROJECT

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Salvia (700-900 species) is a worldwide distributed genus comprising woody shrubs, perennial, and annual plants. The most striking character of the genus is the unusual form and function of the two stamens which are modified to act as levers. Morphologically the lever arms are produced by the connective (Troll, 1928), which is usually restricted to the sterile part between the two thecae of an anther, but in *Salvia* is extended in various ways. Usually only the upper arm of each staminal lever bears a fertile theca while the lower part which is highly variable in size, shape and structure is sterile or produces a reduced amount of pollen (Hedge, 1974). The sterile parts narrowing the entrance of the corolla tube are pushed aside by the flower visitors searching for nectar. This way the fertile thecae come down and cause nototribic pollen transfer.

Though the lever mechanism in *Salvia* has been known since the times of Sprengel (1793) only a few papers deal with its evolutionary significance (e.g. Himmelbaur & Stibal, 1931). Current research proceeds from the high structural diversity of the stamens and their significance relative to flower biology. The question has to be answered, how may the structure of the stamens influence the sexual reproduction of the plants concerned? It is assumed that the different sizes, weights, structural details and additional appendages of the connective arms select for specific pollinators and thus influence the process of speciation.

To test this hypothesis a multidisciplinary approach has been initiated which will be continued for several years. It includes aspects of floral and fruit morphology, developmental dynamics, plant architecture, sexual reproduction, biomechanics, taxonomy and systematics (fig. 1).

To start with, the c. 40 European and circum-mediterranean species (Hedge, 1972) have been selected for phenological, reproductive biological and morphological studies. A large number of them are cultivated in the Botanical Garden of Mainz University, but field trips will also be necessary in future. In cooperation with the technical workshop of Freiburg University an instrument to measure the leverage has been developed. It still has to be optimised and tested in detail, but preliminary measures illustrate that forces of 1-20 milliNewtons are needed to move the lever of different *Salvia* species, and that in ornithophilous species a significantly higher force is needed than in melittophilous species.

The research project started only last year. We gratefully use the opportunity to present our project in the Lamiales Newsletter to stimulate further discussion or even cooperation in this subject. If you have any contributions please contact classenb@mail.uni-mainz.de

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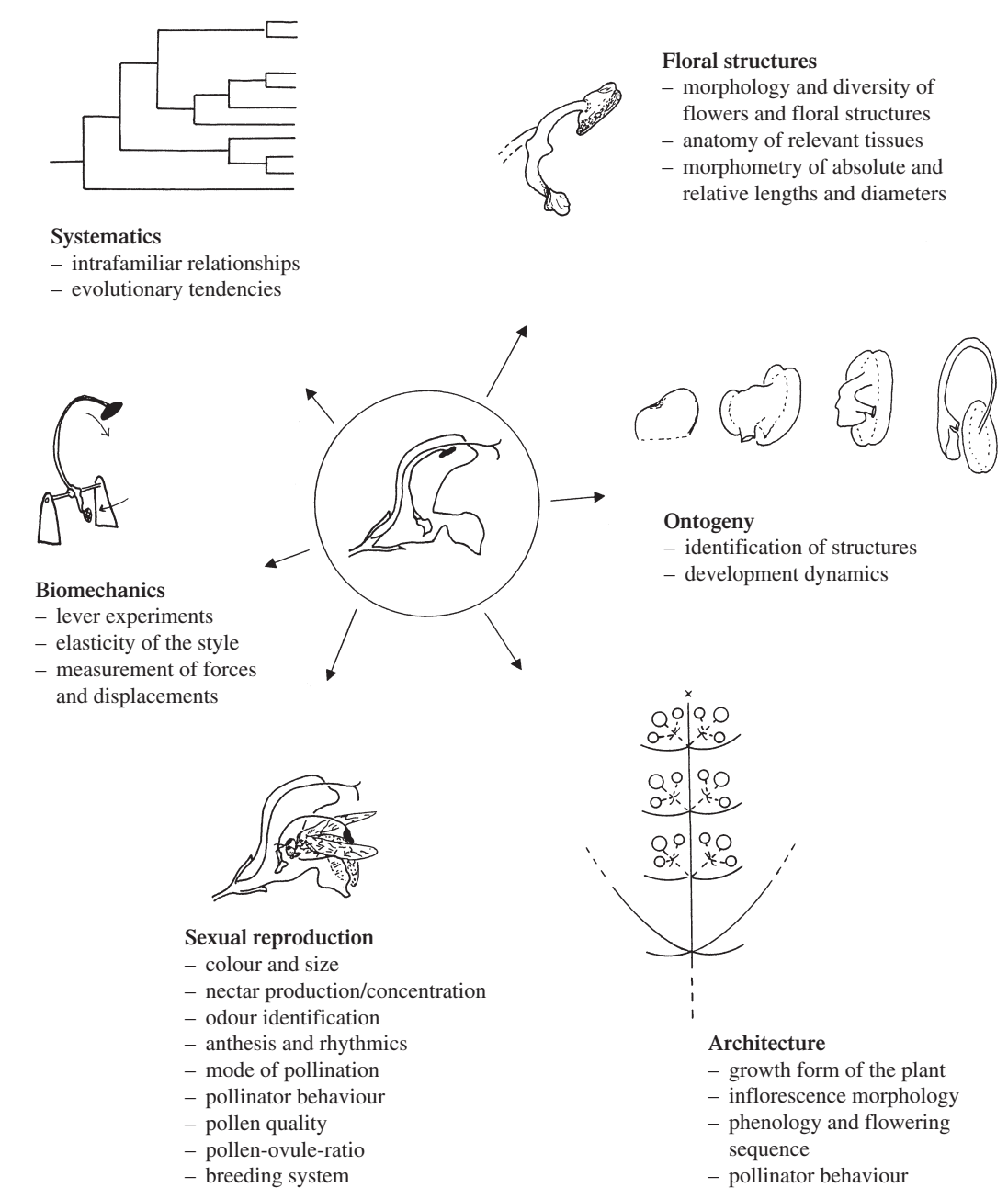

Fig. 1: Diversity and evolution in *Salvia*. Diagrammatic presentation of the different aspects involved in the new research project (Ontogeny after Trapp, 1956).

IN SEARCH OF LABIATAE IN EASTERN BRAZIL

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My own interest in Brazilian Labiatae can be said to stem from August 1968, when, as a newly appointed research botanist at the Royal Botanic Gardens, Kew, I found myself in northern Mato Grosso, Brazil, hot, sweaty and very dusty, watching a very small solitary bee pollinating the savanna labiate *Eriope crassipes* (*Ocimeae*: *Hyptidinae*). It was then that I decided to devote myself to the systematics of Brazilian Labiatae. Little did I realize that this same year would see the death of the doyen of New World Labiatae, Carl Epling. So, in a sense I feel that I picked up his mantle, at least as far as the South American Labiatae are concerned.

Brazil is a very big country, over 4,300 km from North to South and about the same from East to West, having a common border with all the other South American countries, apart from Chile and Ecuador. The country posesses two huge river systems, the Rio Amazonas in the north and the Rio Paraná in the south, but does not contain any part of the great Andean mountain chain extending north to south in western South America. The geological history of much of Brazil relates to the weathering and partial uplift of the Brazilian Shield south of the Amazon and its counterpart, the Guiana Shield, north of the Amazon. These two ancient Pre-Cambrian land masses composed of acidic and often metamorphosed sandstones, were affected by the subsequent uplift of the Andes, which is composed mainly of much younger rocks, often providing soils richer in nutrients. This uplift also helped to give rise to the Amazon basin as we see it today.

As a result of the influence of a series of climatic conditions acting upon this geological diversity, Brazil has a wide range of ecosystems, from semi-desert, savanna and montane through to tropical rainforest, swamp and mangrove as well as temperate grasslands and forest in the extreme south. This is very much reflected in its diverse fauna and flora, and of course its Labiate flora, with something like 27 genera and 512 species to date. This statistic includes those genera which until recently were included in Verbenaceae, but have since been removed, such as *Vitex* (34 spp. recorded from Brazil), *Clerodendrum* (8 spp.) and *Aegiphila* (61 spp. to date). The remainder of the account, however, deals mainly with the traditional Labiatae, with which I am more familiar.

The Labiatae of Brazil are very different from those found in north temperate regions. The *Ocimeae* (*Nepetoideae*) are particularly characteristic of the tropical region. The *Lamioideae*, so diverse in the north temperate zone, are represented by just a single native species, *Stachys micheliana*, which occurs mainly in temperate South Brazil, and here also is found another large group of *Nepetoideae*: tribe *Mentheae*, although many of the genera centred there are different from those occurring in the northern hemisphere: *Glechon*, *Rhabdocaulon*, *Hoehnea* and *Hesperozygis*.

Tropical extra-Amazonian Brazil is also very different from the Andean region in western South America. Many of the Andean genera, especially *Nepetoideae* tribe *Mentheae*, have a north temperate origin. These include *Salvia*, *Clinopodium*, which now including *Gardoquia* and most New World taxa formerly placed in *Satureja* (see Cantino &Wagstaff 1998, Harley and Granda in press), as well as *Scutellaria* (*Scutellarioideae*) and *Stachys* (*Lamioideae*). Many of these are large-flowered species, often adapted to pollination by hummingbirds, with bright red or orange as well as purple corollas. *Lepechinia*, which has its greatest diversity in the Andes, extends northwards to Mexico, and probably has a southern origin.

South of the Amazon basin, Brazil is dominated by savanna and drier forest formations which favour a rich Labiate flora. Overlying the Brazilian Planalto and occupying a large area of central Brazil, is the *cerrado* with a wide range of *Hyptidinae*, and where *Mentheae* are absent apart from *Rhabdocaulon denudatum*, a slender subshrub with reduced leaves, winged stems, and long, creamy white flowers, and a few Salvia species (especially sect. *Rudes*, with blue or white flowers). This section has been the subject of a recent revision by Elide dos Santos (1994). Cerrado genera of *Ajugoideae* include *Amasonia* (c. 6 spp.) with large, slightly pendent flowers, and *Aegiphila* a large genus of trees and climbers with dense cymes of small, creamy flowers, at least some species of which are dioecious. Another *cerrado* Ajugoid is the remarkable *Clerodendrum ekmanii* from Mato Grosso and Paraguay, a low subshrub with showy long-tubular flowers, no doubt pollinated by some long-tongued hawkmoth. All these genera were formerly included in Verbenaceae

North-east Brazil is generally much drier, with a very pronounced and extended dry season. The state of N. ➢

E. Brazil with the greatest variety of ecosystems is Bahia, and it is in this state that much of Kew's Brazilian fieldwork since 1971 has been carried out. Recently, a large "Flora of Bahia Project" has been started, funded by both Federal and State institutions. This project is based in various centres in the state, including the fine herbarium (CEPEC) at Itabuna, on the coast, and the State University of Feira de Santana, and is in collaboration, among others, with the University of São Paulo, the Royal Botanic Gardens Kew and the New York Botanical Garden. About the size of France, Bahia's ecosystems range from semi-arid thorn forests (*caatinga*) in the lowlands, seasonal savanna (*cerrado*) especially in the western uplands, "*campo rupestre*" - rupestral vegetation in the upper montane zone (900–2000 m) known as the Chapada Diamantina, and a great variety of forests from altitudinal cloud forests, dry deciduous seasonal forests, to wet non-seasonal Atlantic rain-forests on the coast.

I have listed (Harley 1996) a total of 10 genera and 87 species of Labiatae native to Bahia state, of which 35·6% are endemic to the state. Only five of these species (*Salvia*: 2 spp. and *Scutellaria*: 3 spp.) are not members of tribe *Ocimeae*. However the recent discovery of a red-flowered *Salvia* in the dry interior, may represent a new taxon. The *Ocimeae* are well represented by the subtribe *Hyptidinae*: *Hyptis* (50 species), *Eriope* (7), *Hypenia* (5), *Marsypianthes* (2), *Peltodon* (1) and *Rhaphiodon* (1). 17 of these species have been described as new since studies commenced and a number are awaiting publication, so every field trip has the added excitement of finding further novelties.

In the Bahian lowlands, coastal sites have few Labiatae, though one: *Eriope blanchetii* is unique among Brazilian Labiatae in occurring exclusively in coastal dunes. The lowland *caatinga* thorn scrub and woodland, which surrounds the Chapada, provide a few Labiate species not found in the mountains, notably the large, bushy shrub *Hyptis martiusii*, whose pale, perfumed flowers in small heads, are much visited by butterflies, and the shrubby, blue flowered *H. fruticosa*. *H. leucocephala*, which grows in seasonally flooded low areas, is a prostrate sub-shrub with white-tomentose heads of pink flowers. Its strongly aromatic foliage is sometimes collected for medicine. More herbaceous species are annual weeds such as *H. suaveolens* and *H. pectinata*. Another characteristic genus is the related, monotypic *Rhaphiodon* (*R. echinus*), a prostrate herb with aromatic leaves and long-pedunculate spherical heads of bright purple flowers. The calyces are spinose, the head falling as a spiny burr, presumably often distributed by animals. One of the commonest Labiatae, often occurring in secondary areas in the *caatinga*, is the highly perfumed Basil: *Ocimum campechianum*, an annual herb, often used to flavour drinks. Another frequent species, *O. americanum*, usually found with it, is introduced from Africa. However, Verbenaceae, such as *Lantana*, *Lippia*, *Stachytarpheta*, *Bouchea* and *Priva* are more often encountered in these semi-arid areas.

It is in the mountains however, that the Labiatae show their greatest diversity, especially in the northern extension of the Serra do Espinhaço, known as the Chapada Diamantina. This region is a prolific centre of plant diversity (Giulietti et al. 1997). The endemic species grow especially in the campo rupestre, where rock outcrops and humid montane grasslands, over coarse acid sands or black humus-rich soils, predominate. Many of the plants are low subshrubs and the ecosystem, with its seasonal climate, is ideal for Labiatae. Certainly for those interested in Labiatae, the flora of these mountains acts like a magnet, as it is here that many new taxa can be expected. Every unexplored mountain is potentially the home of yet another new species. When in the field, my cry "*Eriop*e - espécie nova!" to my companions, became almost a joke, as they looked to the heavens in mock despair - "not another one!' I could hear them say! Genera such as *Hyptis* and *Eriope* show a high level of local speciation and endemism, perhaps due to local edaphic and biotic conditions acting on small isolated populations. It is about 5 hours drive from the university town of Feira de Santana, inland from the capital Salvador, to the nearest point of the Chapada Diamantina. There, one can hope to find new species of *Hyptis* or *Eriope*, as well as of a whole range of other plant groups which seem to have gone "speciation crazy" in the mountains.

Some of my earliest studies involved *Eriope*. Some species exhibit a "greasy pole" syndrome of characters, with elongate, wand-like, fistulose flowering stems, which are glabrous with a pruinose waxy coating below the inflorescences. These, together with the dense bristly hairs at the stem-bases, prevent ants from climbing up to steal the nectar and accidentally trigger the explosive pollination mechanism. The flowers are relatively large, in *E. luetzelburgii* reaching 1.5 mm long on long drooping pedicels.

Hyptis is a huge genus, widespread through the warmer parts of North and South America. Most species occur in the cerrados of Central and Eastern Brazil. *Hyptis* has recently been divided into three, with two new genera: *Hyptidendron* (including a number of savanna trees such as *H. canum* and *H. asperrimum*), and *Hypenia* (Harley 1988). The component species of *Hypenia* show a much closer relationship to *Eriope* than to the rest of *Hyptis*. While the inflorescence of *Hyptis* is usually clearly cymose, though often congested to form a capitulum, the cymes of *Eriope* and often *Hypenia* are reduced to single flowers, the inflorescences thus appearing long and racemose. Ruth Atkinson has recently completed a detailed study of this group and has suggested combining *Hypenia* with *Eriope*. One group of *Hypenia* species, restricted to the cerrado, is remarkable for its long, tubular, red corollas often pollinated by hummingbirds.

Many of the recently discovered species in the Chapada Diamantina of Bahia are of striking appearance. One such is *Hyptis hagei* from the mountains around Lençóis. A bushy shrub with small rigid leaves and long tubular deep pink flowers, its relationships are obscure, though morphologically it shows many characters similar to the Central American *H. asperifolia*. Another group which has a major centre of diversity in the Bahian mountains is section *Polydesmia*, characterized by having congested cymules, associated with usually conspicuous bracts. On the Pico das Almas, a new species: *H. silvinae*, with salmon pink flowers, was discovered in 1977. Twelve years later, to the north, were found populations with bright red flowers, the only known red-flowered species in the genus! Meanwhile, three newly discovered species of sect. *Polydesmia*, all growing within a 20 km radius, are still awaiting publication.

Much work is still needed to be done in the Chapada, especially as it is an ideal area to study plant speciation, phytogeography and vegetational history.

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THREE NEW *NEO*-CLERODANE DITERPENOIDS FROM *AJUGA REPTANS* AND ONE, 14,15-DEHYDROAJUGAREPTANSIN, WITH ANTIFEEDANT ACTIVITY AGAINST LARVAE OF *SPODOPTERA LITTORALIS*.

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Ajuga has proved a rich source of compounds with biological activity to disrupt the development and/or feeding of insect larvae. The interest in *Ajuga* species containing such compounds began with the discovery of phytoecdysteroids in some Japanese species[1]. The potential of phytoecdysteroids to disrupt insect development was quickly recognised from their structural similarity to the insect moulting hormone, ecdysone. A number of compounds of this class have been assayed and have shown activity to disrupt the normal development of insect larvae[2]. The occurrence and biological activity of *Ajuga* sourced phytoecdysteroids has been reviewed[3-6]. Insect antifeedant activity in *Ajuga* species was first discovered in *Ajuga remota* Wall. ex Benth. following a chemical screening of East African plants that had withstood a locust infestation[7]. Three isoperenoid clerodane compounds[8] belonging to the *neo*-clerodane diterpenoid class, were discovered to be responsible for the activity and were named ajugarin I, II and III[9]. *Ajuga* and other Lamiaceae species are a particularly rich source of *neo*-clerodane diterpenoids[10, 11]. However, only a limited number of these compounds possess significant insect antifeedant activity[12,13].

Ajuga reptans L. was selected for study[14] due to the high level of insect antifeedant activity associated within ethanol extracts of this plant[15] that could not be accounted for by the *neo*-clerodane diterpenoids already isolated from *A. reptans*[12]. Therefore a chemical analysis was undertaken to elucidate the chemical basis of insect resistance in *A. reptans*. Biological assays were central in this study to first identify the anti-insect activity,

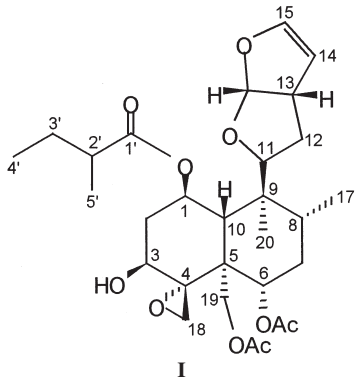
their subsequent use to direct bioactivity led isolation procedures and finally to identify the antifeedant level of each isolated compound.

The principal biological assays employed were based on either incorporating dried, ground plant material into an artificial rearing diet for *Spodoptera littoralis* Boisduval (Egyptian Cotton Leafworm) or an assay designed to assess the antifeedant activity of extracts in solution. The former assay was utilised in the early part of the study to determine if the plant material was biologically active at disrupting larval development. The conclusions of this period in the study showed that leaf material of *A. reptans* was more effective than root material at reducing larval weight gain.

The second assay was based on a glass fibre disc assay (GFDA) that enabled the calculation of an antifeedant index (%) against larvae of *S. littoralis*[13]. The index identifies both phagostimulants (negative values) and antifeedants (positive values). This GFDA was used extensively during the bioactivity led isolation of antifeedant compounds from *A. reptans*. An acetone extract of *A. reptans* cv Catlin's Giant was prepared and fractionated using silica column chromatography (CC). By employing the GFDA, those fractions eluting late with chloroform and chloroform:methanol were identified as having the highest level of activity (index >60%). Therefore, it was these fractions that were pursued to isolate the active components. Repeated CC in elutions of hexane and ethyl acetate yielded semi-purified extracts with very high activity (>85%). However, the fractions proved to be complex mixtures of compounds with similar polarity that were not easily resolved by CC.

Analytical thin-layer chromatography was used to isolate five compounds from active fractions, some fractions weighing as little as 10 mg. The TLC plates were eluted in a mixture of chloroform and ethyl acetate (1:2) and the chromatograms visualised following the application of acidified (H_2SO_4) ethanol, containing ammonium molybdate, and heating. This reagent revealed compounds as dark blue/purple spots on a light blue background. Although the R_f-values of some compounds were similar, there remained enough distance between them to scrape off bands and recover the purified compounds in methanol.

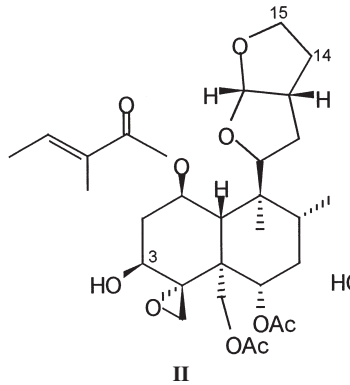
All five compounds were tested for insect antifeedant activity in the GFDA and two were shown to have potent antifeedant activity (97% and 92% - **I**). Unfortunately, only one of these compounds (**I**) was pure enough for investigation by mass spectrometry (MS) and nuclear magnetic resonance (NMR) experiments. The carbon (^{13}C) and proton (^{1}H) results showed signals characteristic



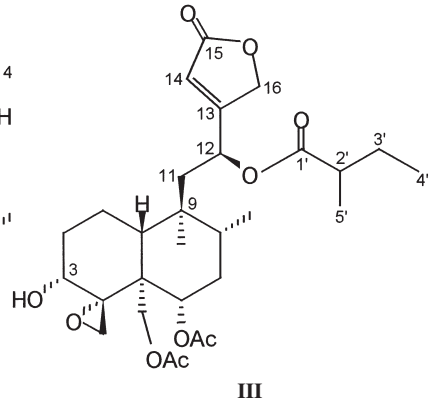
I
14,15-dehydroajugareptansin

of the *neo*-clerodane class and indeed were almost identical to those of ajugareptansin[14, 16, 17], one of three *neo*-clerodane diterpenoids previously isolated from *A. reptans*[18]. The only area of difference in the spectra of **I** was assigned to C-14 and C-15, on the C-9 hexahydrofurofuran side-chain, for the presence of a double bond between C-14/15. Therefore **I** was named as 14,15-dehydroajugareptansin, a new *neo*-clerodane diterpenoid. The antifeedant index results (n=10) for ajugareptansin and 14,15-dehydroajugareptansin at 100 ppm were –41% and 92% ($P<0.05$), respectively. These results clearly showed the structure-function relationship for the enhancement of activity of a *neo*-clerodane diterpenoid possessing C-14/15 unsaturation. This result was in agreement with reports for other antifeedant active *neo*-clerodane diterpenoids, all possessing the same unsaturated hexahydrofurofuran moiety, such as clerodin (74%)[19], jodrellin A (92%)[20] and jodrellin B (100%)[21].

Two further compounds were also isolated by TLC and characterised from MS and NMR experiments as 3β-hydroxyajugavensin B (**II**) 3α-hydroxyajugamarin F4 (**III**). Both compounds were new 3-hydroxyl derivatives of previously known compounds ajugavensin[22] and ajugamarin F4[23] but neither possessed significant antifeedant activity. **II** only varied in structure from



II
3β-hydroxyajugavensin B



III
3α-hydroxyajugamarin F4

ajugareptansin in the ester group at C-1 on the decalin portion of the molecule, being a tigloyl, rather than a 2-methylbutyroyl group. But the inactivity of the compounds shows that this structural feature appears not to influence the feeding response of the *S. littoralis* larvae. Indeed, the structural features of the *neo*-clerodane diterpenoids that have been shown to be important in activity are maintaining the structural integrity of the parent compound possessing a C-9 hexahydrofurofuran side-chain, C-4/18 epoxide and C-6 and C-19 acetate groups[19].

Ajugamarin F4 was a more unusual finding for a European *Ajuga* species because *neo*-clerodane diterpenoids possessing a C-9 butenolide group are more commonly found in species of the Far East and Africa[10]. In addition this compound also contained the C-3 hydroxyl group, common to many *neo*-clerodane diterpenoids from *Ajuga* but in the opposite α-orientation.

This chemical and biological investigation of insect resistance in *A. reptans* has revealed one new insect antifeedant active *neo*-clerodane diterpenoid and a further two new compounds of the same class. The scope for study within the species is still open to discover new active compounds as demonstrated by at least one in this study that remained unidentified. But perhaps of even greater opportunity is the understudied nature of this genus (ca. 65 species) which, of the few studied are known to be rich in *neo*-clerodane diterpenoids. Recent reports of *neo*-clerodane diterpenoids from *Ajuga* spp. have widened the scope of investigation within the genus[24-26] but only one reported any biological activity[27, 28]. *A. iva* is of particular note in respect of insect antifeedant activity because, from among a number of ethanol extracts prepared from different *Ajuga* species, *A. iva* possessed the most potent activity (100%)[15]. *Neo*-clerodane diterpenoids have been isolated from this species but were shown to be inactive as insect antifeedants[12]. However, the activity of the crude extract has recently been partially explained by the isolation of an antifeedant *neo*-clerodane diterpenoid[29] and perhaps more await discovery.

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Prof. W.M. Blaney and Prof. M.S.J. Simmonds for supervision of the PhD and to the BBSRC (formerly AFRC) for funding the project. The work was carried out in the laboratories of the Zoology Department, Birkbeck College, University of London and Jodrell Laboratory, Royal Botanic Gardens, Kew.

FLORA MESOAMERICANA – LABIATAE

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The first major regional flora ever written in Spanish, Flora Mesoamericana is a collaborative effort of the Missouri Botanical Garden, the Instituto de Biología of the National Autonomous University of Mexico (UNAM), the Natural History Museum, London, and numerous specialists world-wide. In Spanish, the Flora describes, for the first time, all the vascular plants growing in the southeasternmost states of Mexico (including the Yucatán Peninsula) and all the Cenral American republics. The project publishes its results in an Internet version (W3FM), as well as in printed volumes. W3FM first appeared on the Internet in 1994 from the Natural History Museum, London. It is currently being made available from a Missouri Botanical Garden server and was converted to a real-time version during October 1997. Visit our site at http://www.mobot.org/MOBOT/fm/. Dr Karen Sidwell is employed full time on the Flora Mesoamericana project at The Natural History Museum, London and is currently coordinating the treatment of Labiatae for Flora Mesoamericana. Initial estimates, shown in table 1 below, suggest that there are around 27 genera and 150 species to be covered for the Flora. The largest genera are *Hyptis, Salvia* and *Scutellaria* are all being undertaken by Dr Sidwell with supervision and advice from relevant Labiatae experts. Dr Maru García Peña from MEXU is also writing several genera for the Flora. However, many of the smaller Labiate genera have yet to be assigned to particular authors. Botanists who are experts in any of the genera listed and who are able to offer to write a treatment for Flora Mesoamericana or have any comments on the table should contact: Dr Karen Sidwell, email: k.sidwell@nhm.ac.uk.

Table 1: An estimated list of the genera and number of species of Labiatae to be covered by Flora Mesoamericana.

Genus	Author	Total spp.	Estimated no. spp. in Flora	Flora Mesoamericana Author
Asterohyptis	Epling	3	3	
Catoferia	(Benth.)Benth.	4	4	
Chaunostoma	Donn. Sm.	1	1	
Clerodendrum	L.	400	2	
Clinopodium	L.	12	1	
Cunila	Royen ex. L.	15	1 sp. complex	Garcia Pena (MEXU)
Hedeoma	Pers.	38	1	Garcia Pena (MEXU)
Hyptis	Jacq.	300	28	Karen Sidwell (BM)
Leonotis	(Pers.) R.Br.	15	1	Garcia Pena (MEXU)
Leonurus	L.	3	1, introduced	
Lepechinia	Willd.	55	5	
Marsypianthes	Mart. ex Benth.	6	1	
Mentha	L.	25	cultivated	
Monarda	L.	12	? cultivated	
Neoeplingia	Ramam., Hiriart & Medrano	1	1? too far N	
Ocimum	L.	65	3	Garcia Pena (MEXU)
Poliomintha	A.Gray	7	1	Garcia Pena (MEXU)
Plectranthus	L'Hérit	350	c. 1, introduced	
Prunella	L.	4	1, introduced	
Rosmarinus	L.	3	1, cultivated	
Salvia	L.	500-900	50	Karen Sidwell (BM)
Scutellaria	L.	350	15	Karen Sidwell (BM)
Stachys	L.	300	5	Garcia Pena (MEXU)
Teucrium	L.	100	3	Karen Sidwell (BM)
Trichostema	L.	16	? too far N	

REQUESTS

This column has been compiled from the returned database questionaires sent with the last Newsletter mailing. Correspondents are reminded that seed requests must be for scientific study and any commercialisation should be done only with the prior informed consent of the country of origin. Collection of material should comply with the national access laws pertaining to plant genetic resources and permit regulations of the country of origin.

Prof. Dr. E. Wollenweber, Institut für Botanik der TU, Schnittspahnstraße 3, D-64287, Darmstadt, Germany (wollenweber@bio.tu-darmstadt.de) would like Lamiaceae with aromatic scent, in particular from semi-arid regions, for his work on the occurrence and distribution of flavonoid aglycones in lipophilic plant exudates.

Prof. Giovanni Vannacci, Dip. to Coltivazione e Difesa delle Specie Legnose, Sezione Patologia Vegetale, Via del Borghetto 80, I 56124 PISA, Italy (gvann@agr.unipi.it) would like seeds of *Ocimum* species.

Dr. Tim Upson, Cambridge University Botanic Garden, Cory Lodge, Bateman Street, Cambridge, CB2 1JF, UK (tmu20@cam.ac.uk) would like *Lavandula* species especially from NE tropical Africa and the Arabian Peninsula, and *Sabaudia*, especially *Lavandula atriplicifolia* (*Sabaudia atriplicifolia)* from Saudi Arabia and Yemen.

Prof. Kurt Aitzetmuller, Institute for Chemistry and Physics of Lips, Piusallee 76, D - 48147 Munster, Germany (aitzetm@uni-muenster.de) would like seeds of *Panzerina* spp., *Oncinocalyx* spp. & *Spartothamnella* spp. and all the closest phylogenetic relatives of *Lamium, Teucrium, Thymus, Phlomis* & *Panzerina.*

Dr. A. J. Solomon Raju, Assistant Professor, Dept. of Environmental Sciences, Andhra University, Visakhapatnam 530 003, India would like material of *Stachytarpheta* and *Anisochilus.*

Janet Barber, Dept. of Botany, Bio 311, University of Texas, Austin, TX 78713, USA (barberj @uts.cc.utexas.edu) would like seeds and/or leaf material of known provenance from continental species of *Sideritis* (Europe, N. Africa).

Dra Elaine Elisabetsky, Laboratorio de Etnofarmacologia, ICBS, Universidade Federal do Rio Grande do Sul, C.P. 5072, 90041-970 Porto Alegre - RS, Brazil (elisasky@vortex.ufrgs.br.) helped establishing a soap factory at the "Chico Mendes" Extractive Reserve – with women experimenting with their ethnobotanical knowledge to produce medicinal, hygiene and general purpose soaps. She would like to identify socially responsible entrepreneurs interested in marketing/buying/selling these products and wonders if any of the Lamiales Newsletter subscribers could help or know of any such person.

John Covanes, Director of Research, Botresearch, 23410 Harpergate, Spring, Tx 77373, USA (botresearch@hotmail.com or fax: +1 281 355 1857) is currently looking for a source of *Phlomis* seed for the next segment of his studies. Botresearch is a company that does tissue culture via organogenesis to provide either explants or plantlets to other researchers or botanical gardens and arboreta to assure their longevity, in addition to looking at anatomical structures and conducting physiological studies. It is not a commercial tissue facility.

Dr Zoltán Kereszty, Institute of Ecology and Botany of the Hungarian Academy of Sciences, H-2163 Vácrátót, Hungary (Kereszty@botanika.botanika.hu) is currently working on a revision of *Verbena* and would be grateful for any herbarium specimens, papers, seeds (especially species missing in European garden collections), illustrations and photographs of this genus.

Dr David Frodin, Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AE, UK (d.frodin@rbgkew.org.uk) is currently preparing a world checklist and bibliography of Lamiales (with Raphaël Govaerts and collaborators). He is particularly keen to receive literature about this family and its allies.

BIBLIOGRAPHY OF RECENT TAXONOMIC PUBLICATIONS

The following list of publications has been abstracted from the Kew Record of Taxonomic Literature and from the Kew Economic Botany Bibliographic Database (March 1998 – November 1999), and we are, again, extremely grateful to the editors and compilers for their assistance in preparing this bibliography (Ann McNeil and Mark Nesbitt). Regrettably, as in LN6 our selection from the Economic Botany Database is not complete due to space constraints. It should be pointed out that our Economic database compilers record data significantly differently from the Kew Record compilers. There has been a tendency to call authors "anon". To rectify this situation, some of the ANON authored publications listed in previous newsletters will appear here again - this time with their named authors. If you too have been relegated to ANON please inform the eds, and we will endeavour to reinstate you! As was the case for the last newsletter, some authors have sent us notification of publications not listed on the "Kew Record" and these have also been included. Where possible articles are listed under the applicable genus, or occasionally, tribe or family - and are are arranged alphabetically. Where a number of references to different taxa in the Lamiales are made in a single paper they have tended to be listed under the "General" heading. Any title enclosed completely within brackets is the English translation of a title written in a "symbol" font such as Arabic, Chinese, Japanese or Russian. All diacritical marks have been removed to facilitate editing.

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