

Notes on Nesting and Flower Visiting of some Anthidiine Bees (Hymenoptera: Megachilidae: Megachilinae: Anthidiini) in Southern Africa

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Abstract.—For Anthidiini occurring in southern Africa, descriptive notes on nests of seven species belonging to three genera, have been published. All are constructed from plant fibres and, depending upon the species, are situated aurally on plants or in pre-existing cavities. To these are added first descriptions of nests of three further species representing three genera. *Serapista rufipes* (Friese), like the only other species of *Serapista*, *S. denticulata* (Smith), for which nesting is known, was found to construct nests from plant fibres, however, although similarly found aurally on plant stems, a nest with its builder was discovered in a burrow in the ground. *Afranthidium* (*Nigranthidium*) *concolor* (Friese) was found nesting in a burrow in the ground, like other species of *Afranthidium*, using plant fibres. *Plesianthidium*, represented by *P. (Spinanthidiellum) volkmanni* (Friese), was found constructing groups of separate resinous, spouted, pot-like cells, similar to those constructed by some extraterritorial species of *Anthidiellum*. Additional nest records are given for *Afranthidium* (*Immanthidium*) *repetitum* and *Afranthidium* (*Afranthidium*) *ablusum*. A first record (that of Alan Weaving) of a host, *Megachile* (*Gronocerus*) *feline* Gerstaecker, of *Euaspis abdominalis* (Fabricius) is reported. Anthidiini in southern Africa are relatively polyphagous. In the present analysis inter-generic and intra-generic similarities, differences, and preferences in flower families visited are indicated.

Anthidiini are worldwide in distribution. Michener (2000) recognizes 37 genera of which 18 are represented in Africa south of the Sahara - 15 in southern Africa. Anthidiine bees are generally divisible into two groups on the basis of the materials used for nest construction. One group uses plant hairs or plant fibres and the other resin, often together with pebbles (Michener 1968, Pasteels 1977, Michener 2000). However, *Pachyanthidium bicolor* (Lepeletier) is exceptional as it uses a mixture of plant down and resin (Michener 1968, 2000).

Surprisingly little has been published on the nesting of anthidiine bees in southern Africa. Nesting records are available for seven species from three genera, all using plant fibres: *Afranthidium* (*Immanthidium*)

junodi (Friese) (as *Anthidium junodi* Friese - Skaife 1950, Taylor 1962, Michener 1968 and as *Immanthidium junodi* (Friese) - Gess 1981); *Afranthidium* (*Immanthidium*) *repetitum* (Schulz) (as *Anthidium repetitum* Schulz - Michener 1968); *Afranthidium* (*Branthidium*) *micrurum* (Cockerell) (as *Anthidium micrurum* Cockerell - Michener 1968); *Afranthidium* (*Branthidium*) *braunsi* (Friese) (as *Branthidium braunsi* - Gess 1981); *Afranthidium* (*Afranthidium*) *ablusum* (Cockerell) (as *Afranthidium* (*Oranthidium*) probably *odonturum* (Cockerell) (Gess and Gess 1999); *Pseudoanthidium* (*Micranthidium*) *truncatum* (Smith) (as *Micranthidium truncatum* Smith - Friese 1902, Michener 1968); *Serapista denticulata* (Smith) (Stadelmann 1898, quoted by Friese 1905, 1909, 1916, Michener 1968).

To these published records are added first descriptions of the nests of *Plesianthidium* (*Spinanthidiellum*) *volkmanni* (Fries), a resin user, and of *Serapista rufipes* (Fries) and *Afranthidium* (*Nigranthidium*) *concolor* (Fries), plant fibre users, additional records for *Afranthidium* (*Immanthidium*) *repetitum* and *Afranthidium* (*Afranthidium*) *ablusum*, and a first record (that of Alan Weaving) of a host of *Euaspis abdominalis* (Fabricius).

Although provision from the nests was not investigated, flowers visited are discussed based on the records assembled for 13 of the 15 genera known from southern Africa. The two genera not represented are parasitic in the nests of other bees and therefore visit flowers only for adult nourishment and egg production. In a comparative overview of flower visiting by non-*Apis* bees in the semi-arid to arid areas of southern Africa (Gess and Gess 2004) the authors compared diversity of choice between and within bee families, in the case of Megachilidae to the level of sub-tribe, but no comparisons were made within sub-tribes. The present contribution, restricted to Anthidiini, examines flower visiting at inter- and intra-generic levels.

METHODS

Nests of anthidiines have been rarely encountered by the authors and no full nesting studies were conducted by them. The notes on nesting are limited to a small number of opportunistic observations and collections. Voucher specimens of the bees and of their nests have been deposited in the insect collection of the Albany Museum.

Field research by the authors, spanning 35 years, has been concentrated principally within the Karoo Biome and associated dry savanna, dry fynbos and desert. Apart from in the area around Grahamstown in the Eastern Cape where the authors reside it has not been possible to work in the field throughout the year. In the southeast and south peaks of rainfall are in September

and March and the summer is rarely excessively hot and dry. Thus, in these areas, sampling has been principally from late October through to March. In the winter rainfall region of the southwest, north to Lüderitz and Aus in southwestern Namibia, sampling has been from August, when temperatures start to rise, through to December, when most flowering is over and the land as a general rule becomes parched. North of the Orange River in the southern Kalahari, southeastern Namibia and in western Namibia to the north of the winter rainfall area, sampling has been in March and April, which is when rains are expected and excessive heat is past.

Insects visiting flowers were collected using a hand net. All plants in flower at the study site were observed for visitors and, when possible, were sampled throughout the day. In effect anthidiine bees in an area all had the choice of visiting all those plants that were in flower. Records encompass both types of visit, for collecting nectar and for collecting pollen, indiscriminately.

The records used in the present analysis are listed in the Appendix. Except where indicated, they are condensed from the authors' collection labels. Many of the specimens were collected after the catalogue (Gess and Gess 2003) and the electronic bee database were closed in March 2002. Full locality data, including co-ordinates, and exact dates of all specimens are available from label data and of those for specimens processed before March 2002 in addition from the electronic, relational database.

The great majority of records relate to specimens in the terrestrial insect collection of the Albany Museum, Grahamstown. Voucher specimens for many but not all plants have been deposited in the Schönland Herbarium, Albany Museum, Grahamstown. Duplicates of specimens from Namibia are in the National Herbarium of Namibia, Windhoek. A few additional records have been added from literature

and from specimens collected by V. Whitehead, determined by C.D. Michener and deposited in the collection of the South African Museum, Cape Town (see Appendix). The records listed in Struck (1994) have not been included because it is not clear whether "the flower visiting records .. compiled from direct field observations" are supported by voucher specimens.

The value of including single records of visits to a particular plant family by a particular species of bee have been questioned. Taken singly such records are of little value but taken together with records for other species they are of value in indicating plant families visited by bees at higher taxonomic levels.

Specific flower visitors show varying degrees of diversity of choice, i.e. of oligophagy and polyphagy. In order to make comparisons between groups of flower visitors constituted of unequal numbers of species Gess (1992, unpublished) developed an Index of Diversity of Choice at the specific level, using the formula:

$$D = a-b/b \times 100$$

where a = the sum of the number of species recorded visiting each of the flower families and b = the number of species of flower visitors (published in Gess 1996 page 47). This is an index by which to compare the degree of oligophagy or polyphagy exhibited by taxa of differing numbers of species. 'D' would equal 0 if each species only visited one species of plant; the higher the value of 'D' the greater the degree of polyphagy.

NEW NEST RECORDS

Plesianthidium Cameron

Plesianthidium consists of four sub-genera, *Carinanthidium* Pasteels, *Plesianthidium* Cameron, *Spinanthidiellum* Pasteels, and *Spinanthidium* Mavromoustakis known from South Africa only, principally from the west (Michener 2000).

Plesianthidium (*Spinanthidiellum*) *volkmanni* (Fries) was found nesting abundantly in electricity boxes placed 1.25 m above the ground, provided for campers in the Clanwilliam Dam Resort, Olifants River Valley (Figs 1, 2). Sixty-nine electricity boxes were inspected. Of these 24 had been used for nesting by *P. (S.) volkmanni*.

Within these pre-existing cavities clusters of up to seven separate spouted, pot-like cells with resinous walls had been constructed. The cells were attached horizontally to a wall of the cavity or horizontally on the floor of the cavity (Fig. 3). All of the cells within a cavity were orientated in the same direction but there was no constancy between cavities. In no cases was there more than one cell under construction, suggesting that each cluster had been constructed by a single female.

Construction of a cell was in all cases preceded by the construction of a small "pad or saucer", noticeably different in texture from the cell walls, and attached to the substrate. The cell was then constructed on this base. When a cell had been only partially constructed, at the close of day, the female slept head down within the cell with her gaster curved over within the cell so that only the arched terga were exposed (Fig. 4).

Measurements were taken from a sample of 13 cells (deposited in the collection of the Albany Museum). The average total length is 14.9 mm including the spout. The cell without the spout is 11 mm in length and 7.7 mm in diameter. The walls of the cells are circa 0.5 mm in thickness and the diameter of the opening of the spout at the tip circa 0.5 – 1 mm. The channel within the spout is filled with very short lengths of fine plant material, not fibres or "fluff". The resinous walls are yellow ochre in colour, initially smooth and pliable. When under construction the walls of the wide portion of the cell are made higher than the final height of the cell-proper. The edges are then crimped to

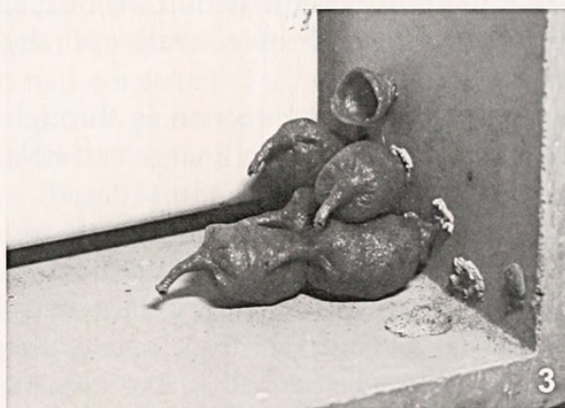


Fig. 1. Vegetation on the eastern side of the Clanwilliam Dam, Olifants River Valley, Western Cape.

Fig. 2. Electricity box in the caravan park on the eastern side of the Clanwilliam Dam.

Fig. 3. Cells of *Plesianthidium* (*Spinanthidiellum*) *volkmanni* (Fries) constructed inside an electricity box. Note: initial "pad or saucer" on which a cell is constructed, partially constructed cell and five completed cells, three attached to the vertical wall and one to the floor. Average actual length of cells 14.9 mm including spout.

Fig. 4. Two cells of *Plesianthidium* (*Spinanthidiellum*) *volkmanni* (Fries) constructed inside an electricity box. Note nest builder sleeping in the incomplete cell.

form the top of the cell-proper but not reaching the centre, construction then continues with a gentle narrowing of the tube of the spout.

Provisioning takes place before crimping and spout construction. Provision taken from a cell (Fig. 5) appeared to be of mixed provenance with an admixture of bright yellow oil. Pollen from the flowers of *Aspalathus spinescens*, the only flowers from which these bees were collected in the vicinity of the nests, is represented mixed with bright yellow oil. The completed provision filled circa 2/3 of the cell-proper.

The resinous walls are probably impervious to air. The function of the spout is most probably for ventilation.

The cocoon is attached to the inner surface of the wall of the cell-proper with the papilla within the base of the spout. Silken threads are visible within the brittle, highly varnished, brown walls of the cocoon.

Emergence from the cocoon is through the side of the cell-proper, a large exit hole being cut by the emerging adult (Fig. 6).

There was a high level of success, *P. (S.) volkmanni* having emerged from most of the circa 20 cells collected. However, a meloid larva emerged from one of the cells and pupated attached to the outside of the cell (Fig. 7).

Serapista Cockerell

The Afrotropical genus *Serapista* Cockerell consists of four species, two of which are represented in southern Africa – the widespread *S. denticulata* (Smith) recorded from central, eastern and southern Africa and the more restricted *S. rufipes* (Fries) recorded only from southern Africa (Passeels, 1984).

Published data concerning the nests of *Serapista* all appear to apply to *S. denticulata* Smith (Stadelmann, 1898, quoted by Fries, 1905 and 1909, Fries 1916, Michener 1968, with republication of his Figs 27-28 by Roubik 1989, Michener, 2000). Michener (1968) illustrated and gave a full descrip-

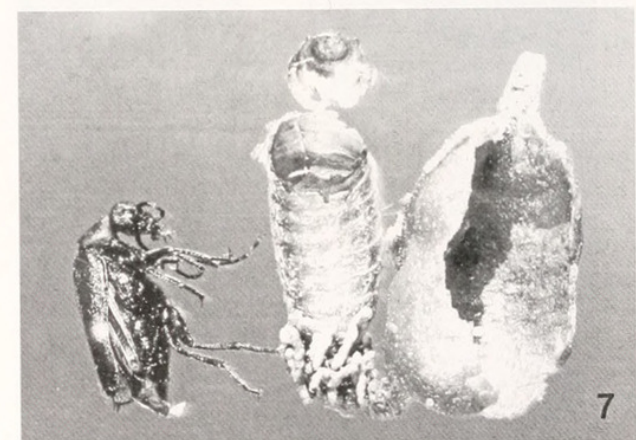
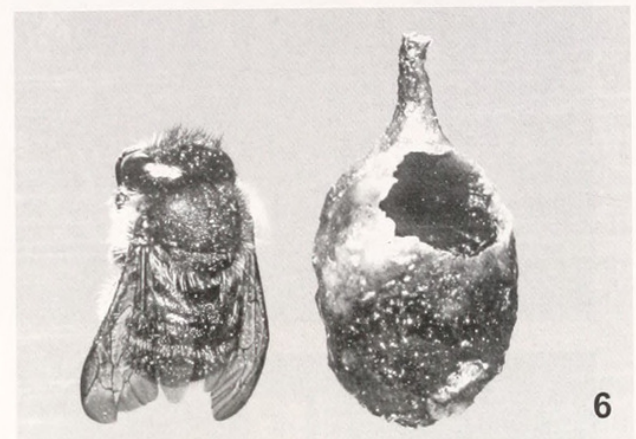
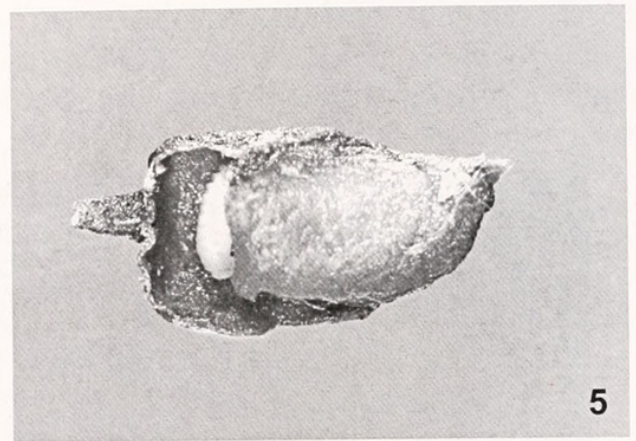


Fig. 5. Cell of *Plesianthidium (Spinanthidiellum) volkmanni* (Fries) cut through longitudinally to show provision and young larva.

Fig. 6. Cell of *Plesianthidium (Spinanthidiellum) volkmanni* (Fries) showing emergence hole and imago.

Fig. 7. Cell of *Plesianthidium (Spinanthidiellum) volkmanni* (Fries) from which a meloid beetle emerged, showing pupal skin of and adult of the beetle.

tion of a nest from Malawi, commented on further nests in the British Museum from Natal, and summarized the accounts of the earlier authors. However, the assumption has been made that the form of the nest of *S. denticulata* and its aerial situation holds

good also for the other species of the genus. Thus it is stated by Michener (1968) that "bees of this genus make exposed nests of down" and by Michener (2000), with regard to the genus, that "nests, masses of plant down often inter-mixed with animal hairs or even feathers and placed on plant stems have been described by several authors..."

In the Albany Museum, collected by the present authors in the vicinity of Grahamstown, Eastern Cape (Fig. 8), are two nests of *S. denticulata* (Figs 9, 10), identified as such from, in one instance, the capture of the builder and, in both from the bees reared from them (a female and a male from one and eight females and three males from the other). Additional identified typical nests of this species are two in a public display in the Albany Museum and others held in the collection of the South African Museum (Margie Cochran pers. com.). Typical nests are roughly oval in shape with a short entrance tube at the higher end.

The four Grahamstown nests like those described in literature are aerial nests built on shrubs, the recorded height above ground of one being circa 50 cm. Two consist entirely of plant down, the other two in patches incorporate fine gray mammalian fur. The nests illustrated are 76 mm and 70 mm in height and 29 mm and 50 mm in diameter respectively. They were constructed on stems of *Elytropappus* (Asteraceae) and *Rhus* (Anacardiaceae). From a third nest, similar in construction and placement, collected by W.A. Clarke from *Lebeckia* (Fabaceae: Papilionoideae) near Twee Rivieren, Gemsbok National Park in 1966 (Figs 11, 12), were reared four female and three male *Serapista rufipes* Friese (nest and bees in the collection of the Albany Museum), supporting the belief that *Serapista* constructs only aerial nests. This nest was similar in size, 72 mm in height and 43 mm in diameter.

The authors sampled bees visiting flowers throughout the semi-arid to arid areas

of southern Africa (Gess and Gess 2004). Although *Serapista rufipes* was commonly encountered and observed throughout the south-western areas of South Africa and widely in Namibia, no further nests were found, nor were nests found in the collections of the South African Museum (Margie Cochran pers. com.) nor in the National Collection, PPRI, Pretoria (Connal Eardley pers. com.), both collections with bees as one of their specializations. The authors had frequently observed these bees flying low over the ground but had been unable to observe what they were doing. It was only in October 2005, when the authors were sampling flower visitors on the banks of the lagoon at Lamberts Bay (Fig. 13) that the second author noticed a *Serapista rufipes* bee disappearing into the ground. On closer examination it was found that it had entered a plant down tube projecting from the ground. Excavation showed that it had constructed a five-celled, down nest within a, presumably pre-existing, burrow in the sandy soil (Fig. 14). The total length of this nest was 90 mm of which 42 mm was of an entrance tube, 10 mm in diameter. The lower part of the nest containing the cells was 20 mm across at its widest point, at which two cells had been constructed side by side. One cell, from which no emergence had taken place, was opened in June 2006. In it was uneaten provision. Some of this, examined microscopically, was found to contain pollen of mixed provenance, two pollen types being present. Most of the pollen in the sample was spherical and thin-smooth-walled. It was possible that it was from *Conicosia* sp. (Aizoaceae: Mesembryanthema), several large plants of which were growing in close proximity to the nest. A small percentage of the pollen grains, also relatively thin, smooth-walled, were about twice the size, elongate-oval and considerably longer than broad.

In late summer two adults emerged, each making its way out through the side of its cell (Fig. 15).

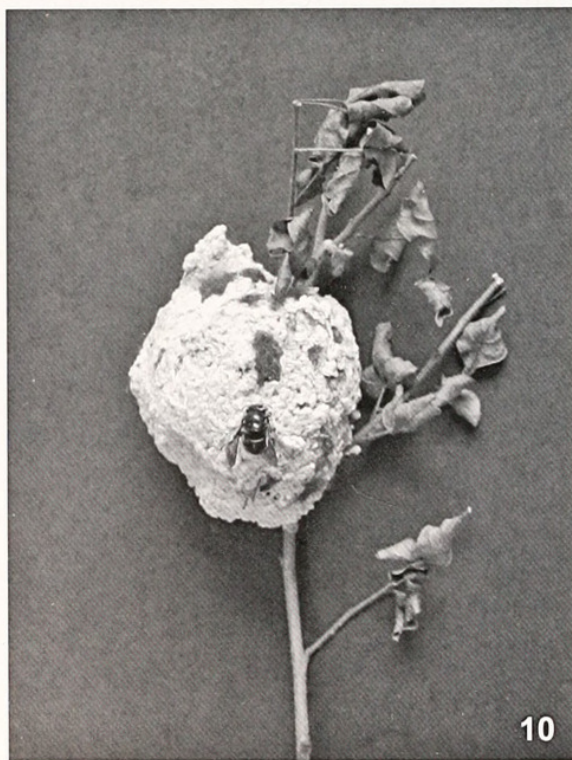
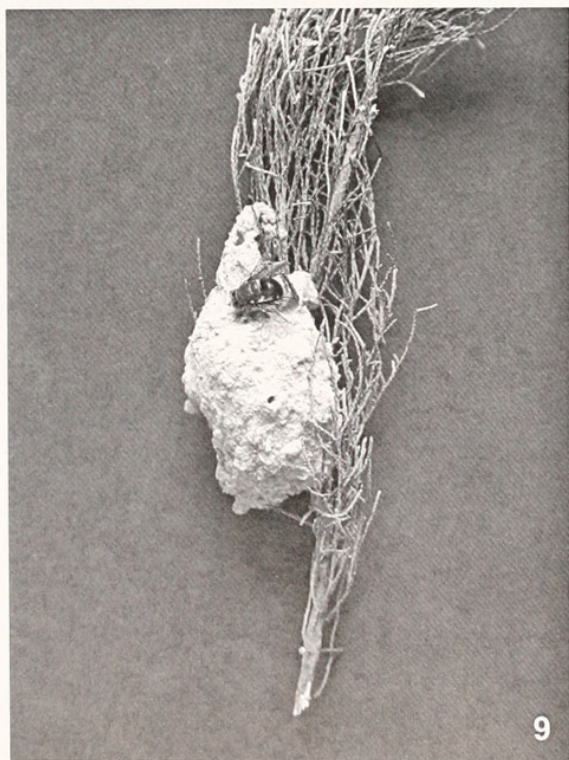


Fig. 8. Strowan Farm, northwest of Grahamstown, Eastern Cape, the area in which nests of *Serapista denticulata* Smith were collected.

Fig. 9. Nest of *Serapista denticulata* Smith constructed on a shrub, *Elytropappus rhinocerotis* (Asteraceae), at Strowan Farm.

Fig. 10. Nest of *Serapista denticulata* Smith constructed on a shrub, *Rhus* sp. (Anacardiaceae) at Goodwin's Kloof, neighbouring Strowan Farm.

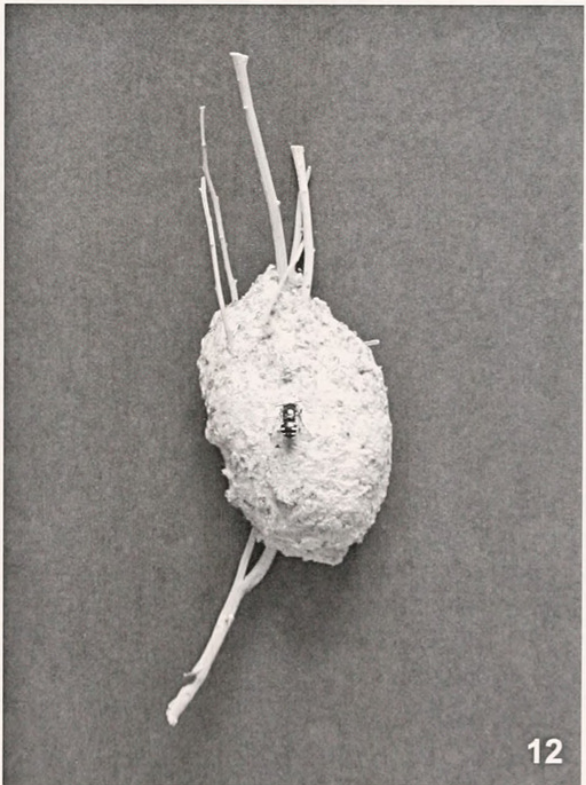


Fig. 11. Southern Kalahari, near Twee Rivieren, Northern Cape, the area in which a nest of *Serapista rufipes* Friese constructed on a shrub, *Lebeckia linearifolia* (Fabaceae: Papilionoideae), as seen in the foreground, was collected.

Fig. 12. Nest of *Serapista rufipes* Friese constructed on a stem of a shrub, *Lebeckia linearifolia* (Fabaceae: Papilionoideae), in the southern Kalahari near Twee Rivieren.

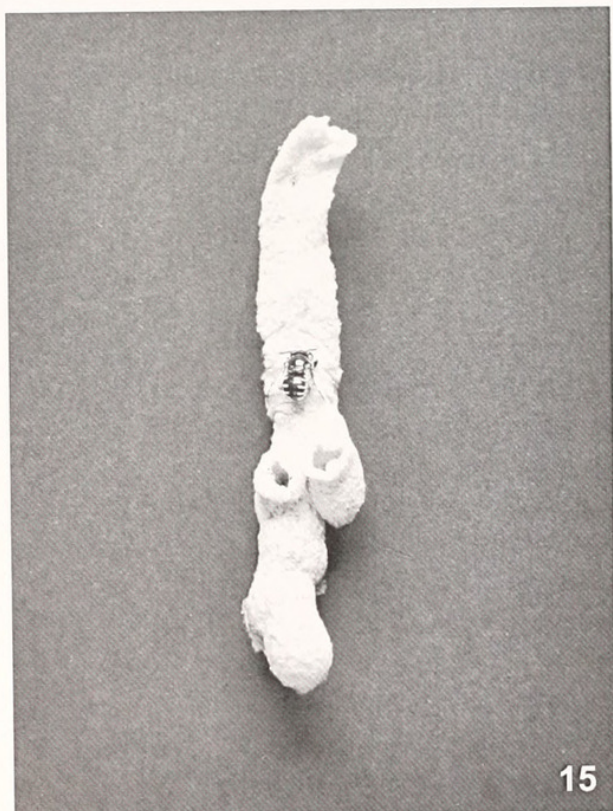


Fig. 13. Southern bank of the lagoon at Lamberts Bay, Western Cape, the area in which a nest of *Serapista rufipes* Friese constructed in a cavity in the ground was found. The clip board on the ground is midway between the site of the nest and a large plant of *Conicosia* (Aizoaceae) beyond the nest.

Fig. 14. Sand cleared away to show nest of *Serapista rufipes* at Lamberts Bay.

Fig. 15. Nest of *Serapista rufipes* Friese from Lamberts Bay showing emergence holes and an imago.

Clearly, *S. rufipes* is remarkable in that it may either construct an aerial nest or may construct its nest within a pre-existing cavity in the ground. The fact that the authors have on several occasions and at several sites observed bees of this species flying low over the ground suggests that the latter strategy may not be unusual.

Afranthidium Michener

The genus *Afranthidium*, divided into eleven sub-genera, is principally sub-Saharan with one sub-genus in the Palaearctic and at least two other species occurring in this region (Michener 2000).

A nest of *A. (Nigranthidium) concolor* (Friese) was found in a bare sandy area on a slope at SorsSors in the Kamiesberg, Namaqualand. It was in an early stage of construction. Projecting from the mouth of a vertical burrow, 6 mm in diameter and 41 mm deep, apparently pre-existing, was a short entrance tube constructed from plant fluff and at the base of the burrow was an open, as yet un-provisioned cell, similarly constructed from plant fluff. Examination of the fluff showed it to have been obtained from the seeds of *Eriocephalus* (Asteraceae) growing nearby.

Afranthidium (Afranthidium) ablusum (Cockerell) was found nesting and sheltering (females and males) in empty shells of desert snails, *Trigonephrus* (Mollusca: Gastropoda: Dorcasiidae), in sparsely vegetated, desertic areas north and south of the Orange River, east of Oranjemund and Alexander Bay (Gess and Gess 1999). The cells were embedded in a mass of white, closely packed, cotton-wool like plant fibres. Further nests in *Trigonephrus* shells were found at eight additional sites by the present authors during the course of more extensive sampling and investigation of desert snail shells in 2002, 2003 and 2005. One site, the most southerly, was east of Port Nolloth, Namaqualand, and the other seven were in the Sperrgebiet, Diamond Area no. 1, in the winter rainfall area of Namibia, in the south from the plains in

the vicinity of the Obib Mountains and Boegoeberg northwards to the Klinghardt Mountains and the north/south road west of Grillental.

All the recorded nests of *A. (Immanthidium) junodi* were constructed in pre-existing tubular cavities, which necessitated the construction of the cells in a single linear series, one female nest builder per cavity. Similar nests have been obtained by the present authors from the vicinity of Grahamstown, Eastern Cape. By contrast the nests of *A. (I.) repetitum* are constructed in relatively large cavities. The record published by Michener (1968) is based on part (estimated at one fifth) of a nest removed from an electricity meter box in Estcourt Natal and housed in the Natal Museum. This part of the nest, constructed from plant down, contained an estimated 350 cells or cocoons resulting in the estimation of the total number of cells in the nest having been 1,750 and the conclusion that the nest had been constructed by a considerable group of females.

The remains of a much smaller nest and an associated adult bee of *A. (I.) repetitum* were submitted to the second author for identification. They came from a Cape Town householder who had noticed a bee entering a heavy-duty vice on a workbench in his garage. He had later extracted this nest from a cavity in the vice, in which it had been constructed, and a single cell from an electrical double adapter in the same garage. Regrettably the remains of the nests received were so mangled that no further information could be derived from them. Clearly, the size of the cavity used for nesting will dictate the number of bees which can nest in the cavity and the number of cells which can be constructed.

Subsequently, in June 2000, J. Cardale of CSIRO, Canberra, Australia wrote that this bee had become established in southern Queensland, Australia. Being a nester in pre-existing cavities, the species is an ideal stowaway candidate, making its accidental

transfer with household goods an easy matter.

The origin of the "wool" used by *A. (I.) repetitum* has not been established, however, Taylor (1962) recorded that Jacot Guilarmod had seen *A. (I.) junodi* removing fibres from the stems of *Helichrysum* (Asteraceae) in Lesotho (as Basutoland).

Euaspis Gerstaecker

Euaspis is widespread in Africa, from Nigeria to Kenya and south to South Africa, and in southern and eastern Asia (Michener 2000). Of the 12 described species two only are African. *Euaspis* has been recorded as parasitizing other Megachilidae (*Lithurge* and chalicodomiform *Megachile*) (Michener 2000). Iwata (1976: page 420) states of "*Parevaspis* = *Euaspis*" that, "while it is reported to parasitize *Lithurge* (Lieftinck, 1939), observations show that the Japanese *P. basalis* is a cleptoparasite of *Chalicodoma sculpturalis* only (Iwata, 1933). This species does not parasitize any species other than those which make nests with resin. In Southeast Asia, it is reported to live in the nest of *Ch. disjuncta* or other allied species and even in Japan, it probably lives on *Ch. disjunctiformis*". He goes on to give a detailed account of the activities of this bee in converting its host's nest to its own.

Three *Euaspis abdominalis* (Fabricius) were reared from nests of *Megachile (Gronocerus) felina* Gerstaecker from northern Natal by A.J.S. Weaving in 1992 (specimens in the Albany Museum collection). Of these one, a male, is from a nest constructed in an old *Synagris* (Eumeninae) mud nest from Umlalazi Nature Reserve and two, a female and a male, are from a nest constructed within a length of reed put out as a trap-nest in the Lake St Lucia Game Reserve.

Some further support for a possible predilection for parasitizing chalicodomiform *Megachile* is given by two observations in the vicinity of Grahamstown. A female *E. abdominalis* was found by R.W. Gess shel-

tering in an aerial mud-nest, probably of *Megachile (Gronocerus) cincta* (Fabricius), build under the windowsill of a brick building (specimen in collection of the Albany Museum). The same was observed investigating holes in a vertical sandstone bank but it was not established which nests were being parasitized although circumstantial evidence suggested that it may have been associated with the nests of *Megachile (Pseudomegachile) schulthessi* Friese (as *Chalicodoma (Pseudomegachile) schulthessi* (Friese)) (Gess 1981).

DISCUSSION

The discovery that *Serapista rufipes* constructs nests in two very different situations, one exposed above ground and the other within a burrow in the ground, was a surprise. However, nesting by a single species both aerially and in cavities is not unknown in the aculeate hymenoptera, *Celonites michaelsoni* von Schulthess (Vespidae: Masarinae), the cells of which are known to be constructed attached to rocks, albeit in a somewhat sheltered position (as *Celonites gariepensis* Gess – Gess et al 1997), has been found to nest also in pre-existing cavities in the ground (Gess and Gess fieldnotes 1998).

As noted above *Serapista rufipes* has frequently been seen flying low over the ground, suggesting that nesting in the ground may be common. It therefore seems possible that other species of anthidiines which have been found nesting in exposed aerial situations may be found also to nest in cavities, perhaps explaining why so few anthiidine nests have been found.

The construction of spouted pot-shaped resin cells here recorded for *P. (S.) volkmanni* is not unique to *Plesianthidium*. A commonly known example is the European species *Anthidiellum (Anthidiellum) strigatum* Panzer for which there are several published accounts. An account of cell construction, provisioning and closure together with excellent photographic illustrations is to be found in Bellmann (1995,

pages 275–277). Two other examples of spouted pot-shaped resin cells of species of *Anthidiellum* (*Anthidiellum*), *A. notatum* Latreille and *A. perplexum* (Smith), are illustrated by Baker et al. (1985, page 293). The recorded positioning of the cells of *A. (A.) strigatum* and *A. (A.) notatum* differs from that here recorded for *P. (S.) volkmanni*. Instead of being concealed within a cavity they are built in the open. Those of *A. (A.) strigatum* are attached to the sunnyside of tree trunks, plant stems, stones or rocks. The cells of *A. perplexum* illustrated in Baker et al. had been constructed in cavities but, unlike those of *P. (S.) volkmanni*, had been seated in pebbles and separated from each other by cell partitions. Clearly these cells will always be found to be constructed within cavities, however, it should not be assumed that the free-standing cells of *P. (S.) volkmanni* are always constructed within cavities. The fact that *S. rufipes* constructs its nests either on plant stems or in cavities indicates that such an assumption would not be justified. A second but probably constant difference is the orientation of the cells. Whereas the cells of *P. (S.) volkmanni* were all positioned with their long axis sub-horizontal those of *A. (A.) strigatum* and those of *A. notatum* hang down from the substrate so that the ventilation tube points downwards. Closure of the cell is undertaken in a similar manner. Both *P. (S.) volkmanni* and *A. (A.) strigatum*, using their mandibles, crimp the cell wall at the opening in such a way that the edges are drawn inwards leaving only a narrow collar-like opening, much in the way in which a potter draws in the walls of a jug to form the neck. The crimping is not, however, smoothed away but is visible in the completed cells. The spout or ventilation tube is then constructed. Those of *A. (A.) strigatum* and *A. notatum* are slightly flared at the opening whereas that of *P. (S.) volkmanni* is not. Whereas the resin walls of the concealed cells of *P. (S.) volkmanni* are smooth and in colour contrast with the walls of the cavity those of *A. (A.) strigatum*

are camouflaged by the addition of bark fragments to the resin giving the outer surface a flaky finish which furthermore in colour blends with that of the substrate.

FLOWER VISITING

In a study of host plant specialization in western Palaearctic anthidiine bees (Muller 1996), pollen sources of 72 anthidiine species of Europe, North Africa and Asia Minor were investigated by analysis of pollen loads from females. Muller found that 43% of the species studied by him were oligolectic (relatively specialized as to pollen source), 35% were polylectic (visiting up to 17 plant families for pollen), and the remaining 4% insufficiently known. The principal pollen sources throughout were Fabaceae, Lamiaceae, Asteraceae, Dipsacaceae, Campanulaceae, and Zygophyllaceae. Of these all except Dipsacaceae are families included in the list of families visited by southern African anthidiines.

In the comparative overview of flower visiting by non-*Apis* bees in the semi-arid to arid areas of southern Africa (Gess and Gess 2004) the Gesses reported that of the 34 plant families found to be attracting visits to flowers by bees 30 were visited by Megachilidae (Gess and Gess 2004: Table 2) and of these 20 were visited by anthidiines (Gess and Gess 2004: Table 5). Of the plant families Fabaceae (almost exclusively Papilionoideae) received visits from 61% of the 44 species of anthidiines for which records were obtained. The three other families receiving visits from a significant, though appreciably lower, percentage of the species of anthidiines are Asteraceae (32%), Malvaceae (all species of *Hermannia*, formerly Sterculiaceae) (27%) and Lamiaceae (23%).

In the overview (Gess and Gess 2004) flower visiting within the Megachilidae was compared between sub-families and tribes. Values for Diversity of Choice (see Methods, present paper) were calculated at the family level. The values obtained were – Andrenidae 177.77, Apidae 195.93, Col-

Table 1. Numbers of species by genus of Anthidiini (Megachilinae) recorded visiting flowers of the listed plant families. Numbers of species below generic names denote the number of species for which flower visiting records are available. Numbers before asterisks denote the numbers of species for which five or more such records were obtained.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
<i>Afranthidium</i>			5	2	1	2	13			5		2	1	1		3		1	6	1
21 species			1*			1*	6*			2*			1*						2*	
<i>Anthidiellum</i>										1		2								
1 species																				
<i>Anthidioma</i>							1													
1 species																				
<i>Anthidium</i>							1								1	1			1	
3 species																				
<i>Aspidosmia</i>				1			1												1	
2 species							1*												1*	
<i>Cyphanthidium</i>							1					1			1					
2 species															1*					
<i>Eoanthidium</i>							1		1			1			1					
1 species							1*					1*			1*					
<i>Pachyanthidium</i>				1		1	3				1	1							1	
3 species						1*	3*													
<i>Plesianthidium</i>	1	1	4			1	5	2	1	5		2			1	5			2	
6 species						1*	3*			1*		1*			1*					
<i>Pseudoanthidium</i>															1	1			2	
2 species																1*			1*	
<i>Serapista</i>							1			1				1				1	2	
2 species							1*			1*										
<i>Trachusa</i>							1													
1 species							1*													
Total number of	1	1	9	4	1	4	28	2	2	12	1	9	1	2	5	10	2	1	15	1
species (45)		1*	1*			3*	16*			4*		2*	1*	3*	3*	1*			8*	

A = Asphodelaceae; B = Iridaceae; C = Aizoaceae; D = Amaranthaceae; E = Molluginaceae; F = Zygophyllaceae; G = Fabaceae; H = Polygalaceae; I = Brassicaceae; J = Malvaceae; K = Loasaceae; L = Boraginaceae; M = Vahliaceae; N = Apocynaceae; O = Acanthaceae; P = Lamiaceae; Q = Scrophulariaceae; R = Apiaceae; S = Asteraceae; T = Campanulaceae.

letidae 50.00, Halictidae 202.90, Megachili-
dae 130.61, Melittidae 70.00. When the
formula is applied to Table 1 a value of
146.67 is obtained for Anthidiini. This
suggests a relatively high degree of po-
lyphagy for the Anthidiini overall. How-
ever, whereas some of the solitary apids
were recorded from flowers of over twenty
families no anthidiine was recorded from
more than seven families.

In the present contribution flower visit-
ing at the levels of genera and for some
genera sub-genera and species are exam-
ined. In most cases the number of females
is too low for analysis of their pollen loads
to give an accurate evaluation of oligolecty

and polylecty and so this has not been
attempted. However, summation of flower
visiting records for females and males does
give some indication of preferences for and
differences in preferences for flowers of
particular taxa and possibly degree of
oligophagy and polyphagy (diversity of
plants visited to obtain pollen and nectar
combined) within the southern African
anthidiines.

At the generic level nine of the 13
genera of anthidiines included were re-
corded from Fabaceae, however, none was
restricted to Fabaceae, flowers of 1–13
plant families being visited. However, if
numbers of records of visits to Fabaceae

Table 2. Numbers of species by subgenus of *Afranthidium* (Megachilinae: Anthidiini) recorded visiting flowers of the listed plant families. Numbers of species following generic names denote the number of species for which flower visiting records are available. Asterisks denote the numbers of species for which five or more such records were obtained.

	Afranth-5 spp.	Branth-6 spp.	Capanth-1 sp.	Domanth-1 sp.	Immanth-3 spp.	Nigranth-1 sp.	Oranth-3 spp.
Aizoaceae	2	2*				1	
Molluginaceae							1
Amaranthaceae		2					
Zygophyllaceae	1	1					
Fabaceae	5**	4****			1*		3
Malvaceae	1	1		1			2**
Boraginaceae					2		
Vahliaceae		1					
Apocynaceae		1			3		
Lamiaceae					1		
Scrophulariaceae					1		
Asteraceae		2*	1*		1	1	
Campanulaceae		2					

compared with visits to other plant families are considered (Table 1), Fabaceae is the most frequently visited family.

When visiting is considered at sub-generic and specific levels, some possible differences in preferences are apparent. Of the seven sub-genera of *Afranthidium* (Table 2), only four were recorded from Fabaceae. Of these, two of the five species of *A. (Afranthidium)*, four of the six species of *A. (Branthidium)* and one of the three species of *A. (Immanthidium)* were recorded five or more times from Fabaceae but none of the three species of *A. (Oranthidium)* was recorded five or more times. Two species of *Oranthidium* were, however, the only species of the genus *Afranthidium* recorded five or more times from *Hermannia* (Malvaceae). One species of *A. (Branthidium)* and the single species of *A. (Capanthidium)* (not recorded from flowers of any other plant family) were recorded at least five times from Asteraceae.

When flower visiting records for the six species of *A. (Branthidium)* are separated (Table 3), it is seen that *braunsi*, *haplogastrum*, *matjiesfonteinense* and *minutulum* were recorded 29 (14 female and 15 male), 11 (seven female and four male), 7 (one female and six male) and 17 (12 female and five male) times respectively from Fabaceae

suggesting a preference for Fabaceae by at least three of these species. However, *minutulum* was recorded 30 (15 female and 15 male) times from Asteraceae suggesting an equal, if not greater, preference for Asteraceae. This species was furthermore recorded seven times (five female and two male) from Aizoaceae and was also found visiting flowers of four other families suggesting that this species at least is polyphagous.

Of the three sub-genera of *Plesianthidium* (Table 4) all were recorded from Fabaceae and furthermore the single species of *P. (Carinanthidium)*, the single species of *P. (Spinanthidiellum)* and two of the four species of *P. (Spinanthidium)* were recorded five or more times from Fabaceae. In addition, one of the four species of *P. (Spinanthidium)* was recorded five or more times from Boraginaceae and one five or more times from Malvaceae (*Hermannia* only).

When the flower visiting records for the four species of *P. (Spinanthidium)* are separated (Table 5), it is seen that *neli* and *trachusiforme* were recorded from Fabaceae 18 (5 female and 13) and 19 (6 female and 13 male) times respectively suggesting a possible preference by these species for Fabaceae. The records of three female and

Table 3. Numbers of records by species of the subgenus *Branthidium* of the genus *Afranthidium* (Megachilinae: Anthidiini) of visits to flowers of the listed plant families.

	<i>braunsi</i>	<i>guillarmodi</i>	<i>haplogastrum</i>	<i>? jocosum</i>	<i>matjiesfonteinense</i>	<i>minutulum</i>
Aizoaceae			2			7
Amaranthaceae	2		2			
Zygophyllaceae						3
Fabaceae	29		11		7	17
Malvaceae						2
Vahliaceae						4
Apocynaceae						1
Asteraceae	3					30
Campanulaceae		1		1		

two male of *tachusiforme* from Boraginaceae probably indicate a possible secondary preference only. The species for which more than five records were obtained from Malvaceae is *callescens* (5 female and 12 male). Although this may possibly indicate a preference it should be noted that only five of the 17 records are for females and that two females were recorded from Lamiaceae and one female from Asteraceae.

Further sampling of flowers for anthidiines would clearly be rewarding and would make more substantiated conclusions with respect to flower preferences possible.

Table 4. Numbers of species by subgenus of *Plesianthidium* (Megachilinae: Anthidiini) recorded visiting flowers of the listed plant families. Asterisks denote the numbers of species for which five or more such records were obtained.

	<i>Carinanthidium</i> 1 species	<i>Spinanthidiellum</i> 1 species	<i>Spinanthidium</i> 4 species
Asphodelaceae	1		
Iridaceae			1
Aizoaceae		1	3
Zygophyllaceae	1	1	
Fabaceae	1*	1*	3**
Polygalaceae	1	1	
Brassicaceae			1
Malvaceae		1	4*
Boraginaceae			1*
Acanthaceae			
Lamiaceae	1	1	3*
Asteraceae	1		1

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Table 5. Numbers of records by species of the subgenus *Spinanthidium* of the genus *Plesianthidium* (Megachilinae: Anthidiini) of visits to flowers of the listed plant families.

	<i>brunipes</i>	<i>callescens</i>	<i>neli</i>	<i>trachusiforme</i>
Iridaceae			1	
Aizoaceae	1		2	2
Fabaceae	3		18	19
Brassicaceae				
Malvaceae	1	17	3	1
Boraginaceae			1	5
Lamiaceae	2	6		2
Asteraceae		2		

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APPENDIX: FLOWER VISITING
RECORDS FOR ANTHIDIINE BEES
(HYMENOPTERA: MEGACHILIDAE:
MEGACHILINAE: ANTHIDIINI) IN
SOUTHERN AFRICA

The data given below, except where indicated, are condensed from the authors' collection labels. Many of the specimens were collected after the catalogue (Gess and Gess, 2003) and the electronic bee database were closed in March 2002. Full locality data, including co-ordinates, and exact dates of all specimens are available from label data and of those for specimens processed before March 2002 are available from the electronic, relational database.

Afranthidium Michener – eleven sub-genera, 10 found in the Afrotropical Region (Michener 2000).

Afranthidium (*Afranthidium*) Michener - known from the "Cape Province", South Africa, and from Namibia (Michener 2000). Pasteels (1984) includes nine species but Michener (2000) considers that some may belong elsewhere.

Afranthidium (*A.*) *ablusum* (Cockerell): Fabaceae (Papilionoideae), *Aspalathus*, 3♂♂, Clanwilliam in the Olifants River Valley in the Western Cape, early October.

Afranthidium (*A.*) *biangulatum* Pasteels: Fabaceae (Papilionoideae), *Indigofera*, 2♀♀, between Rosh Pinah and Sendelingsdrif, Namibia, mid-October; Aizoaceae (Mesembryanthema), 1♀, between Steinkopf and Vioolsdrif in northern Namaqualand, mid-October.

Afranthidium (*A.*) *hamaticauda* Pasteels: Fabaceae (Papilionoideae), *Indigofera* and *Lebeckia*, 11♀♀ and 11♂♂, six sites from Wallekraal, Northern Cape to Lüderitz, Namibia, late September to early October; Malvaceae (formerly Sterculiaceae), *Hermannia*, 1♂, Wallekraal and 14♀♀, northeast of Aus and at Swakopmund in Namibia, early to mid-September; Zygophyllaceae, *Zygophyllum*, 6♀♀ and 11♂♂, Swakopmund, Namibia, mid-March.

Afranthidium (*A.*) *karooense* (Brauns): Fabaceae (Papilionoideae), *Indigofera*, 4♀♀ and 5♂♂, in the vicinity of Oranjemund and Aus, Nami-

bia, late September and early March; Aizoaceae (Mesembryanthema), 2♀♀ and 1♂, Richtersveld and southeastern Namaqualand, Northern Cape, late September; Zygophyllaceae, 2♀♀ and 1♂, Richtersveld and southeastern Namaqualand, Northern Cape, late September.

Afranthidium (*A.*) *reicherti* Brauns: Fabaceae (Papilionoideae), *Aspalathus* and *Psoralea*, 1♀ and 2♂♂, vicinity of Ceres and of Oudtshoorn, Western Cape, late October and early December.

Afranthidium (*Branthidium*) Pasteels - found from Lesotho to the Western Cape, north to Zaire and Kenya (Michener 2000). Pasteels (1984) recognized 10 species.

Afranthidium (*B.*) *braunsi* (Friesse): Fabaceae (Papilionoideae), *Aspalathus* and *Indigofera*, 15♀♀ and 19♂♂, southwestern Cape, mid-October and late-November, and south and north of the Orange River, western Northern Cape and southwestern Namibia, late-September to mid-October; Amaranthaceae, *Hermbstaedtia*, 2♂♂, Richtersveld, Northern Cape, late-September; Asteraceae, *Tripteris*, 2♀♀, 1♂, north of the Orange River, western Northern Cape, mid-October.

Afranthidium (*B.*) *guillarmodi* (Mavromoustakis): Campanulaceae, *Wahlenbergia*, 1♀, northwest of Grahamstown, Eastern Cape, early-March.

Afranthidium (*B.*) *haplogastrum* (Mavromoustakis): Fabaceae (Papilionoideae), *Indigofera* and *Lessertia*, 12♀♀ and 6♂♂, three localities in Namaqualand and from Aus, Namibia, early-September to mid-October; Aizoaceae (Mesembryanthema), *Prenia*, 2♀♀, Springbok, Namaqualand, early October; Amaranthaceae, *Hermbstaedtia*, 1♀ and 1♂, Richtersveld, late-September.

Afranthidium (*B.*) ? *jocosum* Pasteels: Campanulaceae, *Wahlenbergia*, 1♂, between Okahandja and Karibib, northwestern Namibia, late-March.

Afranthidium (*B.*) *matjesfonteinense* (Mavromoustakis): Fabaceae (Papilionoideae), *Indigofera*, 1♀ and 6♂♂, Richtersveld, Northern Cape, late-September.

Afranthidium (*B.*) *minutulum* (Brauns): Fabaceae (Papilionoideae), mainly *Indigofera*, 6♀♀ and 11♂♂, six sites from the Orange River north to Omaruru in northwestern Namibia, late-February to early-April; Aizoaceae (Mesembryanthema), 5♀♀ and 2♂♂, Augrabies on the

Orange River north to Karibib in northwestern Namibia, late-February, mid-April, mid-October; Asteraceae, *Geigeria* and *Osteospermum* (including *Tripteris*), 17♀♀ and 16♂♂, Orange River north to Usakos in northwestern Namibia, mid-March and mid-October; Aizoaceae (non-Mesembryanthema), 5♀♀, 2♂♂, Augrabies, Orange River, Northern Cape, northwestern Namibia, late-February to early-April; Apocynaceae, *Asclepias*, 1♂, southeastern Namibia, mid-March; Malvaceae, *Hermannia*, 1♀, 1♂, Gibeon, southern Namibia, Büllsport, western central Namibia, late-March, mid-April; Vahliaceae, *Vahlia*, 3♀, 1♂, southeastern Namibia, early-March; Zygophyllaceae, *Zygophyllum*, 2♀, 1♂, Richtersveld and northwestern Namibia, early-October, late March to early April.

Afranthidium (Capanthidium) Pasteels - has a disjunct distribution, southern Africa (Cape Province, South Africa and Namibia) and western Mediterranean (Morocco and Spain) (Michener 2000). Ten species were recognized from southern Africa by Pasteels (1984). There appear to be no records of nesting for this sub-genus.

Afranthidium (C.) capicola (Brauns): Asteraceae, 11♀♀, 8♂♂, Oudtshoorn in the Little Karoo and Karoo Poort near Ceres, Clanwilliam and between Clanwilliam and Klawer in the Olifants River Valley, early December, late October.

Afranthidium (Domanthidium) Pasteels, monospecific, found in Namibia and South Africa, in the "Cape Province", probably also Natal (Michener 2000).

Afranthidium (D.) abdominale: Malvaceae (formerly Sterculiaceae), *Hermannia*, 1♂ between Murraysberg and Hutchinson, central Nama Karoo, South Africa, late-October.

Afranthidium (Immanthidium) Pasteels is widespread in eastern Africa from Sudan to South Africa, Natal west to "Cape Province", and Namibia (Michener 2000).

Afranthidium (I.) immaculatum (Smith): Asteraceae, *Senecio*, 1 specimen, Bastervetpad [near Barkly East], Eastern Cape, South Africa; Scrophulariaceae, *Diascia capsularis* and *Diascia fetacaniensis*, 2 specimens, Mt Kemp and Zuurberg Pass, Eastern Cape (col. V.B. Whitehead, det. C.D. Michener, specimens in South African Museum, Cape Town)

Afranthidium (I.) junodi (Friesse): Fabaceae (Papilionoideae), *Melolobium*, *Aspalathus* and "lu-

cerne", 4♀♀, 1♂♂, northeast Grahamstown, Eastern Cape, Clanwilliam, Olifants River Valley, Western Cape, Augrabies, Orange River, Northern Cape, late September, mid-October, late February; Lamiaceae, *Ballota*, 2♀♀, Kamiesberg, Namaqualand, Northern Cape, early-October; Asteraceae, *Berkheya*, 1♀, Eastern Cape, late-September; Boraginaceae, *Trichodesma*, 1♀, Richtersveld, Northern Cape, late-September.

Afranthidium (I.) repetitum (Schulz): Lamiaceae, 1♂, Richtersveld, Northern Cape, late-September.

Afranthidium (I.) sjoestedti (Friesse): Lamiaceae, *Ballota*, 3♂♂, southeastern Namaqualand and Richtersveld, Northern Cape, late-September; Boraginaceae, *Anchusa*, 1♂, Grahamstown, Eastern Cape, late September.

Afranthidium (Nigranthidium) Pasteels - found in Namibia and in "Cape Province", South Africa (Michener 2000). There are two named species and a third undescribed species (Michener 2000).

Afranthidium (Nigranthidium) concolor (Friesse): Aizoaceae (Mesembryanthema), *Herrea*, 2♀♀, Nieuwoudtville, southeastern Namaqualand, late-September; Asteraceae, *Pentzia*, *Senecio*, 3♀♀, southeastern Namaqualand, northern Namaqualand, Northern Cape, September.

Afranthidium (Oranthidium) Pasteels - represented by five or six species, has been found in Namibia and in South Africa, "Cape Province" east to the "Transvaal" (Michener 2000).

Afranthidium (O.) folliculosum (Buysson): Fabaceae (Papilionoideae), *Indigofera*, 1♀, Kalahari fringe, southeastern Namibia, late-March.

***Afranthidium (O.)* sp. Gess 1**: Fabaceae (Papilionoideae), *Indigofera*, 3♀♀, Kalahari fringe, southeastern Namibia, late March; Malvaceae, *Hermannia*, 4♀♀ and 11♂♂, Kalahari fringe, southeastern Namibia, Northern Cape, early-March, early-April; Apiaceae, *Deverra*, 1♀, 1♂, southern Kalahari, early-March; Molluginaceae, *Limeum*, 2♀♀, southern Kalahari, Northern Cape, early March.

***Afranthidium (O.)* sp. Gess 2**: Fabaceae (Papilionoideae), *Indigofera*, 1♂, east of Oranjemund, northern bank of the Orange River, southwestern Namibia, late-September; Malvaceae, *Hermannia*, 8♀♀, Springbok and Kamiesberg, Namaqualand, Northern Cape, late September, early-October.

Anthidiellum Cockerell - five sub-genera are recognized (Michener 2000). Of these only two, *Chloranthidiellum* Mavromoustakis and *Pycnanthidiellum* Krombein, have been recorded from Africa south of the Sahara.

Anthidiellum near *melanocephalum* (syn. of *apicatum* Smith): Euphorbiaceae, *Dalechampia volubilis* E. Mey. ex Baill., False Bay, northern KwaZulu-Natal (Armbruster and Steiner 1992).

Anthidiellum (*Pycnanthidiellum*) *spilotum* (Cockerell): Malvaceae (formerly Tiliaceae), *Grewia occidentalis* L., 1♂, northeast of Grahamstown, Eastern Cape, early December.

Anthidioma Pasteels - known from Namibia and the Western Cape, South Africa from two species, one undescribed (Michener 2000).

Anthidioma sp.: Fabaceae (Papilionoideae), "yellow legume", one specimen, from Pomona, Sperrgebiet, southwestern Namibia (col. V. Whitehead, det. C.D. Michener, specimen in South African Museum, Cape Town.)

Anthidium Michener - found on all continents except Australia; rather poorly represented in sub-Saharan Africa (Michener 2000).

Anthidium (*Anthidium*) Fabricius - found throughout the range of the genus; represented in Africa by only a few species (Michener 2000).

Anthidium (A.) *pontis* (Cockerell): Acanthaceae, *Blepharis capensis* (L. f.) Pers., 1♀, northeast Grahamstown, Eastern Cape, early January.

Anthidium (*Nivanthidium*) Pasteels - known from only one species; apparently previously recorded only from eastern Africa (Mozambique and Malawi) (Michener 2000).

Anthidium (N.) *niveocinctum* Gerstaecker: Asteraceae, *Geigeria*, 2 ♀♀, Oshivelo, Namibia, early-April (D.W. & G.T. Gess).

Anthidium (*Severanthidium*) Pasteels - known from the Eastern Cape north to Senegal and the Arabian Peninsula (Michener 2000).

Anthidium (*Severanthidium*) *soni* Mavromoustakis: Fabaceae (Papilionoideae), *Crotalaria*, 1♂, Kamanjab, Namibia, late-March.

Aspidosmia Brauns, represented by two species only - known solely from Namibia and the "Cape Province" (Michener 2000).

Aspidosmia *arnoldi* (Brauns): Fabaceae (Papilionoideae), *Lebeckia* and *Wiborgia*, 3♀♀, 3♂♂, four sites from Clanwilliam to Springbok, early-late-September; Lamiaceae, *Stachys*, 1♀, Richtersveld, Northern Cape, late September.

Aspidosmia *volkmanni* (Fries): Asteraceae, *Berkheya*, *Gorteria* and *Osteospermum*, 18♀♀, 33♂♂, four sites from Kamiesberg to north of the Orange River, late-September, early-October; Amaranthaceae, *Hermbstaedtia*, 2♀♀, Richtersveld, Northern Cape, late-September.

Cyphanthidium Pasteels - known from Zimbabwe, Namibia and the "Cape Province" from three species, two described (Michener 2000).

Cyphanthidium *intermedium* Pasteels: Fabaceae (Papilionoideae), *Crotalaria* and *Indigofera*, 1♀, 2♂♂, three sites in western Namibia, Rosh Pinah/Sendelingsdrif (south), Uis/Henties Bay and Khorixas (north), mid-October (south), early April (north).

Cyphanthidium sp.: Acanthaceae, *Blepharis*, 3♀♀, 3♂♂, between Springbok and Kamieskroon in Namaqualand, October.

Eoanthidium Popov - known from Africa, the Middle East, the Indian Peninsula and Asia (Michener 2000); divided into four sub-genera, two of which, *Clistanthidium* Michener and *Griswold* and *Eoanthidium* Popov are represented in Africa south of the Sahara but only the former from southern Africa (Michener 2000).

Eoanthidium. (*Clistanthidium*) *turnericum* (Mavromoustakis): Fabaceae (Papilionoideae), *Indigofera*, "a yellow flowered papilionate shrub", 1♀, 2♂♂, Richtersveld, Northern Cape, between Rosh Pinah and Sendelingsdrif, southwestern Namibia, late-September, mid-October; Acanthaceae, *Monechma* and *Petalidium*, 6♂♂, Richtersveld, Northern Cape, between Uis and Henties Bay, northwestern Namibia, late-September (south), early-April (north); Boraginaceae, *Heliotropium*, 1♀, between Uis and Omaruru, northwestern Namibia, March; Boraginaceae (formerly Hydrophyllaceae), *Codon*, 3♀♀, 3♂♂, Richtersveld, Northern Cape, between Uis and Henties Bay, northwestern Namibia, late September (south), early April (north); Brassicaceae (formerly Capparaceae), *Cleome*, 1♀, 1♂, between Büllsport and Sesriem, westcentral Namibia, mid-April.

Pachyanthidium Fries - known from Africa east to China (Michener 2000); four sub-genera recognized; all present in Africa south of the Sahara; only three recorded from southern Africa (Michener 2000).

Pachyanthidium (*Ausanthidium*) Pasteels, known from a single species found in Namibia.

Pachyanthidium (A.) *ausense* (Mavromoustakis): Fabaceae (Papilionoideae), *Indigofera*, 1♀, 8♂♂, east of Oranjemund, southwestern Namibia, east of Alexander Bay, Richtersveld, Northern Cape, late September; *Amaranthaceae*, *Hermstaedtia*, 2♂♂, Richtersveld, late September; *Boraginaceae*, *Trichodesmia*, 2♂♂, Richtersveld, late September; *Zygophyllaceae*, *Zygophyllum*, 2♀♀, 5♂♂, Richtersveld, between Palm and Khorixas in northwestern Namibia, late-September (south), early-April (north); *Loasaceae*, *Kissenia*, 3♂♂, between Keetmanshoop and Aus in southwestern Namibia, between Uis and Henties Bay, northwestern Namibia, early March (south), early April (north); *Malvaceae* (formerly *Sterculiaceae*), *Hermannia*, 2♂♂, southwest of Aus, southwestern Namibia, September.

Pachyanthidium (*Pachyanthidium*) Fries - widespread in Africa, from Senegal to Ethiopia and south to KwaZulu-Natal and the Cape Province, South Africa; 11 species (Michener 2000).

Pachyanthidium (P.) *cordatum* (Smith): Fabaceae (Papilionoideae), *Psoralea pinnata* L., 1♀, near Grahamstown, Eastern Cape (Jacot Guillarmod label data); *Euphorbiaceae*, *Dalechampia* sp., northern KwaZulu-Natal (Armbruster and Steiner 1992).

Pachyanthidium (*Trichanthidium*) Cockerell - known in Africa from the Ivory Coast to southern Egypt, south to Angola and KwaZulu Natal, South Africa, and in Asia from India to Yunnan Province, China; "at least three species" (Michener 2000).

Pachyanthidium (T.) *benguelense* (Vachal): Fabaceae (Papilionoideae), *Aspalathus*, 1♀, Graafwater, west of the Olifants River, Western Cape, late September; *Asteraceae*, *Senecio*, 1♂, near Grahamstown, Eastern Cape, late December.

Plesianthidium Cameron, known from South Africa only, principally from the west; consisting of four sub-genera, *Carinanthidium* Pasteels, *Plesianthidium* Cameron, *Spinanthidiellum* Pasteels, and *Spinanthidium* Mavromoustakis (Michener 2000).

Plesianthidium (*Carinanthidium*) Pasteels, represented by a single species found in the Western Cape, but the type specimen was reported to be from the "northern Transvaal" (Michener 2000).

Plesianthidium (C.) *cariniventris* (Fries): Fabaceae (Papilionoideae), *Aspalathus* and *Lebeckia*, 4♀,

19♂♂, Olifants River Valley, Western Cape, Namaqualand, Northern Cape, late-September, early-October; *Polygalaceae*, *Polygala*, 1♀, Namaqualand, late-October; *Asteraceae*, *Pteronia*, 1♀, Namaqualand, early-October; *Lamiaceae*, *Balotta*, 1♀, Namaqualand, early-October; *Zygophyllaceae*, *Zygophyllum*, 3♂♂, Namaqualand, early-October; *Asphodelaceae*, *Albuca*, 1♂, Namaqualand, late September.

Plesianthidium (*Spinanthidiellum*) Pasteels - known from two species from the Western Cape Province of South Africa (Michener 2000).

Plesianthidium (S.) *volkmanni* (Fries): Fabaceae (Papilionoideae), mostly *Aspalathus* and *Lebeckia*, 34♀♀, 68♂♂, Western Cape, Namaqualand, Northern Cape, early-September to late-October; *Malvaceae* (formerly *Sterculiaceae*), *Hermannia*, 1♀, southeastern Namaqualand, late-September; *Zygophyllaceae*, *Zygophyllum*, 1♀, 4♂♂, southeastern Namaqualand, late-September; *Lamiaceae*, *Stachys*, 3♂♂, southeastern Namaqualand, late-September; *Aizoaceae* (*Mesembryanthema*), *Herrea*, 2♂♂, southeastern Namaqualand, late-September; *Polygalaceae*, *Polygala*, 2♂♂, Namaqualand, late-September, late-October.

Plesianthidium (*Spinanthidium*) Mavromoustakis - known from five species all from the "Cape Province", South Africa (Michener 2000).

Plesianthidium (S.) *brunceipes* (Fries): Fabaceae (Papilionoideae), *Lebeckia*, 2♀♀, 1♂, Namaqualand, Northern Cape, early-September; *Aizoaceae* (*Mesembryanthema*), *Herrea*, 1♀, near Springbok, Namaqualand, early-October; *Lamiaceae*, *Ballota* and *Stachys*, 3♂♂, near Springbok, early-October; *Malvaceae* (formerly *Sterculiaceae*), *Hermannia*, 1♂, Kamiesberg, Namaqualand, early-October.

Plesianthidium (S.) *callescens* (Cockerell): *Asteraceae*, *Arctotheca* and *Pteronia*, 1♀, 1♂, Namaqualand, Northern Cape, late-September; *Lamiaceae*, *Ballota*, 2♀, 4♂, southeastern Namaqualand, late-September; *Malvaceae* (formerly *Sterculiaceae*), *Hermannia*, five species, 2♀♀, 15♂♂, Namaqualand, Ratelfontein, Western Cape, late-September, early-October.

Plesianthidium (S.) *neli* (Brauns): Fabaceae (Papilionoideae), *Aspalathus*, *Lebeckia* and *Melolobium*, 5♀, 13♂♂, western Western Cape, Namaqualand, early-September, early-October; *Aizoaceae* (*Mesembryanthema*), *Prenia*,

2♂♂, near Ratelfontein, western Western Cape, early-October; Boraginaceae, *Anchusa*, 1♂, Kamiesberg, Namaqualand, early October; Malvaceae (formerly Sterculiaceae), *Hermannia* 1♀, 2♂♂, Namaqualand, late-September, early-October; Iridaceae, *Homeria*, 1♀, vicinity of Springbok, Namaqualand, early-October.

Plesianthidium (S.) *trachusiforme* (Friese): Fabaceae (Papilionoideae), *Aspalathus*, *Lebeckia*, *Wiborgia*, *Meiobolium* and *Indigofera*, 6♀♀, 13♂♂, Olifants River Valley and westwards, Western Cape, Namaqualand, Northern Cape, early-September to mid-October; Aizoaceae (Mesembryanthema), *Herrea*, 2♀♀, Springbok, Namaqualand, early-September, early-October; Boraginaceae, *Anchusa*, 3♀♀, 2♂♂, Kamiesberg, Namaqualand, early-October; Brassicaceae, *Heliophila*, 1♀, Kamiesberg, early-September; Lamiaceae, *Ballota*, 2♂♂, Kamiesberg, early-October; Malvaceae (formerly Sterculiaceae), *Hermannia*, 1♂, Nieuwoudtville, southeastern Namaqualand, late-September.

Pseudoanthidium (*Tuberanthidium*) Pasteels, four species are recognized – known from Tanzania, Botswana, Namibia, Lesotho, and South Africa, “Cape Province to Natal” (Michener 2000).

Pseudoanthidium (T.) *tuberculiferum* (Brauns): Asteraceae, *Berkheya* and *Pteronia*, 5♀♀, 4♂♂, Nieuwoudtville, southeastern Namaqualand, Springbok, Namaqualand, Northern Cape, northwest of Aus, southwestern Namibia, late-September; Acanthaceae, *Monechma*, 1♂, Richtersveld, Northern Cape; Lamiaceae, *Ballota* and “labiate”, 5♂♂, Nieuwoudtville, Kamiesberg, Richtersveld, Namaqualand, early-late-September, Acanthaceae, *Monechma*, 1♂, Richtersveld, Northern Cape, late September.

Pseudanthidium (T.) *damarensis* (Mavromoustakis): Asteraceae, *Giegeria*, 1♀, 2♂♂, between Oshivelo and Ondongwa, northern Namibia, early-April (D.W. and G.T. Gess).

Serapista Cockerell – known from the Afrotropical Region, two of the four species represented in southern Africa – widespread *S. denticulata* (Smith) recorded from central, eastern and southern Africa and more restricted *S. rufipes* (Friese) recorded only from southern Africa (Pasteels, 1984).

Serapista rufipes: Fabaceae (Papilionoideae), *Crotalaria*, *Indigofera*, *Lebeckia* and *Aspalathus*, 21♀♀, 16♂♂, 14 sites in Namibia, Nababeep, Namaqualand, Northern Cape, four sites in Olifants River Valley and vicinity, Western Cape, early-March to early-April (north), mid-October (south); Malvaceae (formerly Sterculiaceae), *Hermannia*, 9♀♀, 6♂♂, six sites in Namibia, two sites in Namaqualand, early-March to late-April (north), early-September to early-October (south); Acanthaceae, *Monechma*, 1♀, northwest Namibia, late-April; Brassicaceae (formerly Capparaeae), *Cleome*, 1♂, northwest Namibia, late-April; Scrophulariaceae, *Jamesbrittenia*, 1♀, westcentral Namibia, mid-April; Apocynaceae, *Asclepias*, 1♀, 1♂, southern Karoo, Western Cape, late-November.

Trachusa Panzer – known from Africa, Asia, the Mediterranean and North America. The sub-genus *Massanthidium* Pasteels is known from four species - three described by Pasteels, from Kenya and Eritrea and one recorded from a single specimen from Namibia by Michener (2000). In the course of their survey of flowers visited by aculeate wasps and bees in the semi-arid to arid areas of southern Africa the authors encountered an undescribed species in northwestern Namibia, most probably the species known to Michener from a single specimen. Eighteen females and five males were collected.

Trachusa (*Massanthidium*) sp. undescribed: Fabaceae (Papilionoideae), *Crotalaria* and *Indigofera*, 2♀, 2♂, west of Palm in northwestern Namibia, west-northwest of Omatjete in northwestern Namibia, late-March; Fabaceae (Caesalpinoideae), *Adenolobus*, 4♀♀, 1♂, between Palm and Khorixas and a drainage channel between Gaub and Kuiseb passes, northwestern Namibia, mid-late-March; Pedaliaceae, *Sesamum*, 6♀♀, south of Swartbooisdrif, Kunene River, northwestern Namibia, late-March; Brassicaceae (formerly Capparaeae), *Cleome*, south of Swartbooisdrif, late-March; Acanthaceae, *Monechma*, 5♀♀, 1♂, Two Palms, Palmwag, northwestern Namibia, late-March; Lamiaceae, *Hemizygia*, 1♂, south of Palmwag, late-March.



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