Nesting and flower visiting of some southern African Anthophorini (Hymenoptera: Apoidea: Apidae: Apinae)

by

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ABSTRACT

Accounts are given of nesting in horizontal or gently sloping ground by two species of *Amegilla* Friese, *A. (Micramegilla) atrocincta* (Lepeletier) and *A. (Zebramegilla) punctifrons* (Walker). The burrow of *A. (M.) atrocincta* is excavated using water and the entrance is surmounted by a turret. Each shaft, of which there may be more than one per nest, is terminated by a single cell. Water is not used in excavation by *A. (Z.) punctifrons*. Soil particles are extracted using the mandibles and are raked out of the burrow. Each shaft, of which there may be more than one per nest, is terminated by several cells in linear series. Notes are given on the nesting in vertical earthen banks by two species of *Anthophora* Latreille, *A. (Heliophila) praecox* Friese and *A. (Paramegilla) epichariformis* Gribodo neither of which constructs an entrance turret.

Evidence is given for possible associations between *Thyreus alfkeni* Brauns and *Thyreus delumbatus* (Vachal) and *A. (Z.) punctifrons*, and between *Thyreus calceatus* (Vachal) and *A. (H.) praecox*.

Flower visiting records, totalling 502, are given for 16 species of *Amegilla* and 10 species of *Anthophora*. Analysis of these records shows that the differences in flower choice between genera and also between subgenera (despite the lack of distinction between pollen and nectar collection) indicate that the Anthophorini do not as a rule practise indiscriminate broad polylecty.

INTRODUCTION

Remarkably little has been published on the biology of the southern African species of *Anthophora* Latreille and *Amegilla* Friese (Apoidea: Apidae: Apinae: Anthophorini). Brauns (1913) and Rozen (1969) gave life history notes on two species of *Anthophora*. Although some observations were made by the present authors from time to time over the past twenty years the difficulty experienced in determining the voucher specimens discouraged more intensive investigation. With the recent taxonomic revisions of the southern African species of these genera (Eardley and Brooks 1989, Eardley 1994) the identification of these bees has been greatly facilitated. It seems useful to present and discuss the available nesting observations and flower visiting records despite the fact that on the whole they are of a somewhat fragmentary nature. This may lay the foundation and provide the stimulus for further investigations.

NESTING

Amegilla (Micramegilla) atrocincta (Lepeletier)

Geographic distribution

Amegilla (Micramegilla) atrocincta occurs throughout southern Africa, with the noticeable exception of the region incorporating southern Namibia, and the northern, central and western Cape Province (Eardley 1994).

Nesting areas, nesting sites and nesting density

Two nesting areas have been located on the farms Hilton (27.15S, 32.21E) and Clifton (27.11S, 32.24E), respectively 18 and 19 kilometres WNW Grahamstown in the southeastern extension of the Nama Karoo. The vegetation of Clifton, the more easterly farm, differs from that of Hilton in having a higher succulent element. The nesting sites were in bare areas of non-friable clayey soil in low scrub, all in close proximity to water. The surface of the ground chosen for nesting was in all instances horizontal to subhorizontal.

During the eight years from 1973 to 1981 during which the authors were working intensively on the farm Hilton *Amegilla atrocincta* was very rarely sighted. Only two single nests were found, one in 1973 and one in 1978.

In some years *Amegilla atrocincta* has been relatively commonly encountered on forage plants at Clifton; however, the nests have proved difficult to locate. No aggregations of nests were found, only single widely scattered nests. During the summer 1985/1986, when a deliberate effort was made to locate nests, only five nests were found.

Brauns (1913) commented that, at Willowmore, he found *A. atrocincta* (as *Anthophora plumipes*) nesting in areas of hard level ground, the nest entrance generally covered by a stone. No nests so sited have been found by the authors.

Flight period

Collecting dates (collected records from Eardley 1994, additional records from label data Albany Museum) throughout the range of *A. atrocincta* suggest that this bee is most commonly in flight from mid- to late-summer, December to March in the Cape Province. Certainly in the vicinity of Grahamstown, where the Gesses have collected throughout the year, this bee is most commonly encountered in January and February. To the north in the Transvaal, Zimbabwe and Namibia the flight period is more extended there being scattered records from September through to May.

Flower visiting

All plants in flower on Hilton and Clifton were sampled for flower visitors at intervals throughout the summer. It was found that males and females of *Amegilla atrocincta* commonly visited the white flowers of *Blepharis capensis* (L.f.) Pers. (Acanthaceae) at Clifton during January and February. An additional two males were taken on flowers of *B. capensis* at Waterford (33.07S, 25.01E). Though not sampled *A. atrocincta* was observed visiting the yellow flowers of *Cotyledon campanulata* Marloth (Crassulaceae) in addition to those of *B. capensis* during January 1986 when the nesting behaviour of the bees was being investigated on Clifton. No forage plants of these bees were located at Hilton. The only other flower visiting records available are of two females taken on the yellow flowers of *Berkheya heterophylla* (Th.) O.Hoffm. (Asteraceae) between Lynton and Vlakwater (27.09S, 32.18E). Voucher specimens are listed in Appendix 1 under Grahamstown and Waterford.

Provision

The provision is in the form of a syrup on which the egg or larva floats. Pollen from the cells of two nests at Clifton was examined microscopically. Though mixed, the bulk of the pollen from both nests matched that of *C. campanulata*. No pollen matching that of *B. capensis* was found suggesting that this plant was principally visited for nectar. However, provision from a third nest, investigated

when the flowers of *C. campanulata* were almost over, contained an appreciable proportion of pollen matching that from *B. capensis* and *Peristrophe cernua* Nees (Acanthaceae) but very little pollen matching that from *C. campanulata.*

The cells when opened gave off a marked odour which could be described as "meady" or "cheesy". It was probably a combination of odours derived from the provision and the waxy Dufour's gland secretion.

Male behaviour

At Clifton, in addition to feeding at the flowers of *B. capensis* males were frequently observed patrolling a patch of this plant growing in close proximity to nest sites. None was observed in the vicinity of nests.

Sheltering and sleeping

A nesting female was observed by the present authors sheltering head downwards in her nest. Males and un-mated, and therefore nestless, females were observed by Brauns (1913) spending the night on low plants, up to 10 bees in a row on a single twig, holding on firmly with their mandibles, and in smaller numbers under stones.

Description of nest

The nest consists of a subterranean burrow surmounted by a cylindrical erect or inclined turret constructed from mud and having an inner diameter of 9 mm and reaching lengths of up to 80 mm (Fig. 1). Individual applications of mud are visible on the outside of the turret but the inside is smoothed.

The burrows of six of the seven nests investigated consisted of a single subvertical shaft, 8-9 mm in diameter. Four terminated in a single cell and two had not reached the stage of cell construction. The burrow of the sixth nest bifurcated just below the surface of the ground (Fig. 2). One shaft, apparently the first excavated, led directly downwards whereas the other at first sloped gently before continuing downwards parallel with the first shaft. Each shaft terminated in a single cell at an average depth of 172.4 mm (sample of five, range 130-208 mm). The sides of the cells were parallel and the base was rounded. The diameter of the cells was the same or marginally greater than that of the shafts. The lengths of the two cells measured were 20 and 23 mm. The walls were smooth and lined with white wax. Each cell was closed with a mud and wax plug which was somewhat smoothed above but not below and which was slightly concave above and was either flat or somewhat concave below as the plug was sometimes deeper around its circumference than at its centre. Above each cell plug was a capping of mud. Above this a portion of shaft, slightly shorter than a cell, with smoothed walls formed a chamber. This chamber was full of mud pellets, and was sealed with a mud plate. The shaft above this chamber was full of loose earth and there was an additional mud plate at a variable height along its length. In one nest a mud plate sealed the shaft at ground level within the turret.

Method of construction

Water is required for the excavation of the burrow, construction of the turret, smoothing of the cell walls and construction of the mud seals. Water is collected by the female from a nearby pool. Whilst taking in water she stands on the mud at the water's edge.

Fig. 1. Nest entrance turret of *Amegilla (Micramegilla) atrocincta* (Lepeletier) on the farm Hilton (27.15S, 32.21E). Actual height of turret 45 mm.

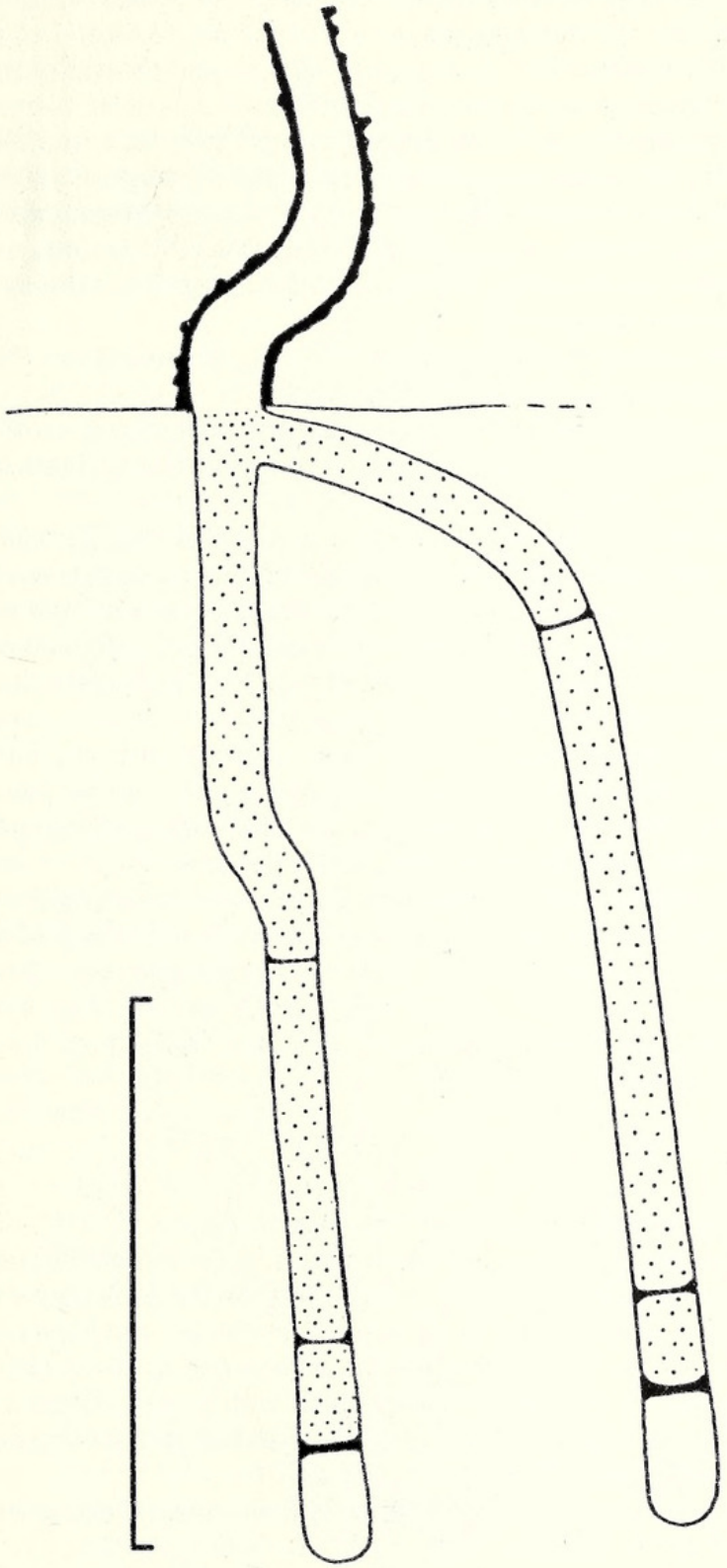

Fig. 2. Vertical plan of one of the nests of *Amegilla (Micramegilla) atrocincta* (Lepeletier) investigated on the farm Clifton (27.11S, 32.24E). Scale bar = 10 cm.

Having selected a suitable nesting site and returned with a load of water the female initiates excavation. She regurgitates the water and mixes it with the soil to form mud which she passes back beneath herself, rotating steadily. The mud is positioned around the rim of the shaft initial to form the base of the turret. Further extracted mud is passed back in the same manner and is positioned by the tip of the abdomen. The lengths of time spent away from the nest collecting water, actually imbibing water and working at the nest excavating mud and working on the construction of the nest were measured for one of the builders. She was found to take 20-34 seconds away from the nest to fetch water, 13-14 seconds to tank up, and for each water load 2-3 minutes excavating, adding two loads of mud to the turret and smoothing it on the inside. On her return flights to the nest she circled above the nest and then flew straight in.

In one instance a shaft passed through a patch of weakly structured soil. The walls of this section of the shaft had been shored up by cementing with mud.

The excavated cell walls were smoothed apparently with the use of water. There was no constructed mud cell within the excavated cell. The wax lining of the cell forms a distinct layer which can be separated from the earthen wall.

The wax coating of the cell wall extends into the mouth of the cell. The mud and wax plug sealing the cell is constructed within the mouth of the cell fitting like a stopper into the neck of a jar. The mud is laid down spirally; however, the spiral is not continuous as each load of mud is added without matching the end of the previous spiral which is little more than a ring with overlapping ends. Five such broken rings could be counted on one of the plugs. The central remaining aperture is crudely plugged with a final load of mud which may project on the lower surface as a rough knob. The manner in which the wax is applied is not clear. As the lower surface of the plug including the knob has a visible white coating it is thought that the wax is probably added with the mud. The upper surface is roughly smoothed and given a light wax coating. An additional mud capping is added above the stopper and this bonds with the walls of the shaft above the cell.

The mud capping added above the cell plug, unlike the plug shows no patterning. It is, apparently, simply a layer of mud spread over the plug and onto the walls at the base of the chamber above the cell. Its function appears to be to completely seal the cell, as the plug is not firmly attached to the cell walls there being a layer of wax between the earthen walls and the plug. No wax is added to this capping or to the walls of the chamber above the cell. The function of the wax appears to be to waterproof the cell, the provision being fluid.

Associated insects

Of the seven nests two were found to have been "parasitised".

One nest had been usurped by a megachilid. This nest contained one *A. atrocincta* cell which had been lined with wax and partly provisioned. The cell and the shaft above it had been filled with gravel to a height of 30 mm above the cell. The megachilid bee had then constructed a petal cell sealed above with a petal disc. The sealing disc was identified as being cut from a white petal of *B. capensis*. The remainder of the shaft had been filled with gravel. Pollen from the provision was examined and found to be of two forms, one of which matched that of *P. cernua* (Acanthaceae) and the other *Pentzia incana* (Thunb.) Kuntze (Asteraceae).

In the other nest eight non-phoretic triungulin larvae of a meloid beetle were found in the single sealed cell.

Amegilla (Zebramegilla) punctifrons (Walker)

Geographic distribution

Amegilla (Zebramegilla) punctifrons is widespread in subsaharan Africa, and apparently occurs throughout the subcontinent, except that it is noticeably absent from the western, southwestern, central and northern Cape Province, and from the southern half of Namibia (Eardley 1994).

Nesting areas, nesting sites and nesting density

Brauns (1913) noted that *A. (Z.) punctifrons* (as *Anthophora circulata*) nests in extensive aggregations in bare level places in the vicinity of Willowmore. The present authors have located two further nesting areas. One in the eastern Nama Karoo on the neighbouring farms of Clifton (27.11S, 32.24E) and Thursford, WNW of Grahamstown, and the other in the southern Great Karoo at the interface between the Succulent Karoo and the Nama Karoo on the farm Tierberg (33.08S, 22.16E), to the east of Prince Albert. The sites of nesting aggregations in these areas are bare patches of horizontal to gently sloping clayey ground in karroid scrub with a strong succulent element. In all instances, although there was an abundance of similar bare areas and although the bare areas selected were extensive, even in small aggregations, the nests were crowded together, new nests being added around the fringes of the aggregations.

Flight period

Collecting dates (collected records from Eardley 1994 and additional records from Albany Museum) suggest that *A. (Z.) punctifrons* is in flight in the southern and eastern Cape from early summer, October, through to late summer, March. To the north in the northern Transvaal and Zimbabwe it is possible that it flies through the winter as it has been collected from June to August.

Flower visiting

On the farm Clifton females and males of *A. (Z.) punctifrons* regularly forage together with *A. (M.) atrocincta* on the white flowers of *Blepharis capensis* (Acanthaceae) in January and February. In addition in October early flying males were taken on the same flowers at Clifton and on yellowish-white flowers of a "mesem" (Mesembryanthemaceae) on Verdun (33.10S, 25.50E) in the Kommadagga District to the north west of Clifton. Voucher specimens are listed under Grahamstown and Kommadagga in Appendix 1.

No forage plants of *A. (Z.) punctifrons* were located on Tierberg.

Provision

Provision from the cells of nests excavated on Tierberg was a very wet mixture of pollen and nectar. Some of the pollen was examined microscopially and was found to be of two types, one relatively large and oval and the other relatively small and spherical, both smooth walled as seen with the light microscope. Though comparisons with pollen from plants in flower were made it was not possible to identify the pollen with any certainty.

Sheltering and sleeping

Sleeping by *A. (Z.) punctifrons* has not been observed by the present authors but has been recorded at Willowmore by Brauns (1913). He found sleeping clusters of males and females mixed, up to 30, on low bushes, the bees being firmly clamped onto the stems by means of their mandibles. More rarely, males were found sheltering together with males of *Amegilla niveata* (Friese) (as *Anthophora niveata*) in hollow stems, lying on the ground, and in dry open seed capsules of *Datura.* Actively nesting females appeared to retire to their nests at night.

Description of the nest

Access to all nests was direct. In no instance was there any form of nest entrance turret. Three nests of a nesting aggregation on Tierberg were excavated. The shaft, 6- 6.5 mm in diameter, in all three nests initially sloped gently downwards before continuing subvertically at a constant diameter to a depth of 95-105 mm below which it ended in one to three subvertical to sloping cells in linear series (Fig. 3). In two of the nests there were secondary shafts in addition to the main shaft, in one a single secondary shaft and in the other two and the initial of a third. The secondary shafts in turn each

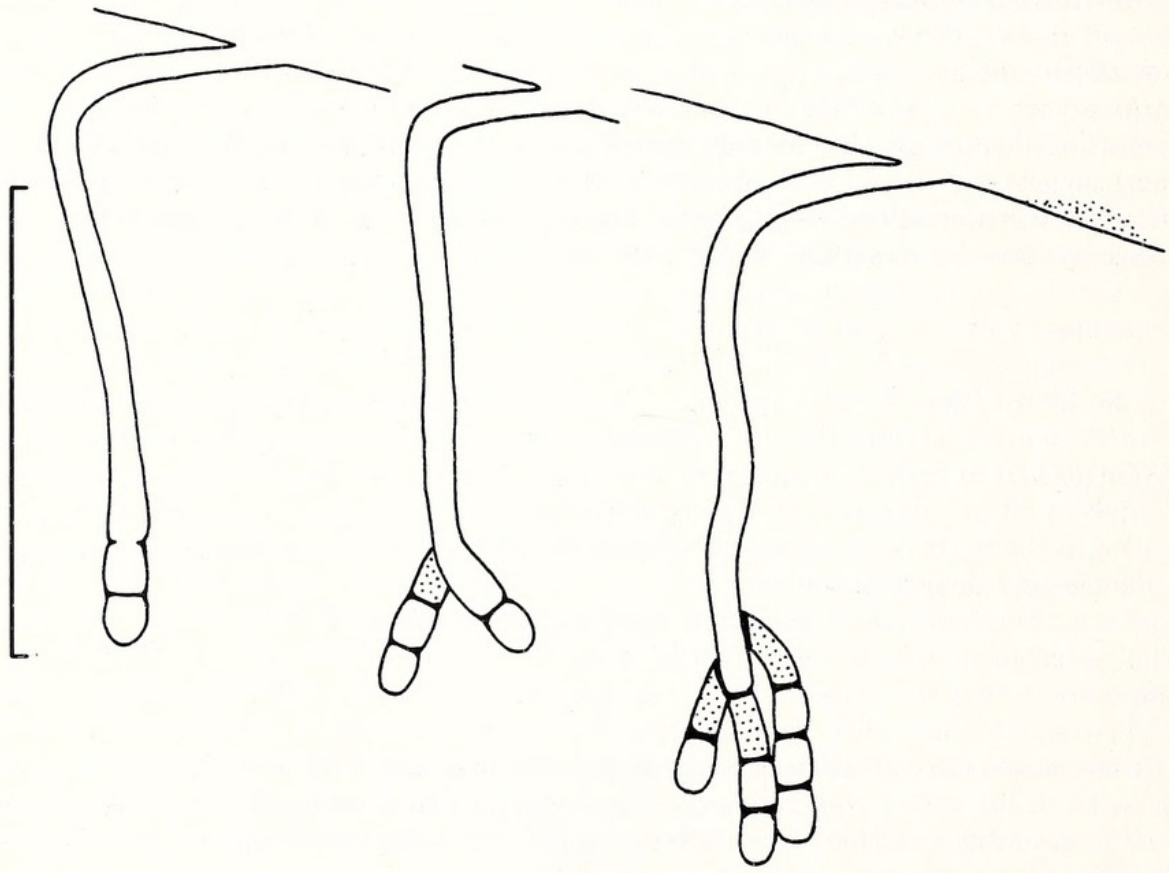

Fig. 3. Vertical plans of the nests of *Amegilla (Zebramegilla) punctifrons* (Walker) investigated on the farm Tierberg (33.08S, 22.16E). Scale bar = 10 cm.

ended in a linear series of cells. Between the last completed cell in each series and the opening to the next excavated shaft the shaft had been filled with earth and sealed off from the main shaft with a mud-plate. Twelve cells in all were obtained. Each was 10 mm long and 7-7.5 mm in diameter at mid-length. The walls were cemented and smoothed, and coated with wax.

Method of construction

Water is not used in nest excavation. A burrow is initiated at a shallow angle to the ground surface. Soil is extracted using the mandibles, the bee continuously turning on its long axis. The spoils of excavation are raked out of the nest and accumulate to one side of the nest. In densely populated nesting aggregations there are no distinct tumuli, the entire surface of the compacted clayey ground becoming covered with destructured soil. An entrance to a well established nest is concealed with loose earth through which the bee digs when entering.

Associated insects

During the nesting season female *Thyreus* have repeatedly been observed in attendance at and digging through closures of nests of *A. (Z.) punctifrons* on the farms Thursford and Clifton strongly suggesting a parasitic association. A sample of eight was constituted of seven *Thyreus alfkeni* (Brauns), three from Thursford and four from Clifton, and one *Thyreus delumbatus* (Vachal) from Clifton. Brauns (1913) recorded that the latter (as *Crocisa braunsiana* Friese) was present in large numbers in association with the nesting aggregations of *A. (Z.) punctifrons* (as *Anthophora circulata*) at Willowmore and, though he gives no further evidence, refers to it as a regular parasite.

It is of interest that *T. delumbatus* was collected in company with its putative host visiting flowers of *B. capensis* on Clifton.

A single female mutillid was observed digging through the loose earth closure of a nest on Thursford suggesting a parasitic association.

Anthophora (Heliophila) praecox Friese

Geographic distribution

Anthophora (Heliophila) praecox Friese has been recorded from the western, southern and eastern Cape Province, from the eastern Orange Free State and Lesotho (Eardley and Brooks 1989, Fig. 108).

Nesting areas, nest sites and density

Two nesting areas of *A.(H.) praecox* have been located, Hilton Farm (27.15S, 32.21E), Grahamstown and Tierberg Farm (33.08S, 22.16E), Prince Albert. Nesting sites in both areas were water cut vertical banks, in the former a river bank and in the latter the bank of an erosion gully. On Tierberg the bee was also found nesting in an artificial vertical bank, the mud wall of a ruined building. Nesting in the walls of buildings was previously noted by Brauns (1913) who observed that *A. (H.) praecox* (as *A. wartmanni var. praecox* Friese) in Willowmore was often found nesting in large numbers close together in walls constructed of unbaked bricks. The nests on Hilton and Tierberg were also similarly crowded together.

Flower visiting and provision

Anthophora (H.) praecox has been collected on the yellow flowers of *Berkheya* species (Asteraceae) from the Olifants River Valley in the west to Hilton Farm, Grahamstown in the east. In addition it has been collected on flowers of *Sphalmanthus* sp. (Mesembryanthemaceae) at Klein Doorn River, 10 km E Lemoenshoek, and on the blue flowers of *Anchusa capensis* Thunberg (Boraginaceae) on Hilton Farm. Voucher specimens are listed in Appendix 1.

This bee was not collected on flowers on Tierberg farm but pollen from provision from nest cells was compared microscopically with that of plants growing in the vicinity of the nests and was found to match that of *Pentzia incana* (Asteraceae).

The cells from the Hilton nests had been provisioned with a very wet but not fluid orange pollen and nectar mixture which filled the cells to within 5 mm of the seal. The surface of the provision was smooth.

Description of the nest

The nest, which is sited in a vertical compacted earthen bank, is a single-celled to multi-celled burrow, in some instances with at least two cells in linear series. Access to the burrow is by a simple entrance hole without any form of entrance turret. The cells are smoothed on the inside, lined with a "varnish" like substance, and closed with a mud seal coated on both surfaces with the same substance as is used for lining the cells.

Method of construction of the nest and oviposition

Nest initiation has not been observed. It was not clear whether the burrows were self-excavated or pre-existing. Those at Hilton were in reddish "sandstone" and the cells had been lined with mud clearly introduced into the nest, suggesting that the burrows might have been pre-existing. No such difference between the substrate and the cell lining was observed in the Tierberg burrows. The burrows in the erosion gulley were crowded together and apparently interlinked sharing more than one entrance and a single entrance being entered by more than one female, suggesting nest sharing.

A single egg was obtained from a horizontally positioned cell from a Hilton nest. It was white, curved, 3.5 mm long and 0.75 mm wide at mid-length and had been laid onto the vertical surface of the provision. It was only attached by the upper end, the rest of the egg hanging free from the provision.

Associated insects

No direct evidence for nest parasitism was obtained; however, *Thyreus calceatus* (Vachal) was commonly in attendance at the nests in the river bank at Hilton.

***Anthophora (Paramegilla) epichariformis* Gribodo**

Geographic distribution

Anthophora (Paramegilla) epichariformis Gribodo has been recorded from the southwestern Cape (Eardley and Brooks 1989). A nesting female and a male collected on the farm Tierberg (33.08S, 22.16E) to the east of Prince Albert in the southern Great Karoo (26.xi.-5.xii.1987, F.W., S.K. and

R.W.Gess) extends the known distribution eastwards.

Nesting area and nest site

One nest of *A. (P.) epichariformis* was located on the farm Tierberg. It was situated near the base of a high, subvertical, south-facing bank of the Tierberg River and sited beneath an overhang. The river bank is constituted of a grey poorly sorted unconsolidated modern alluvium.

Flower visiting and provision

There appear to be no flower visiting records; however, pollen taken from the provision of the three cells obtained from the excavated nest was all of one kind and matched that of a *Pteronia* species (Asteraceae) growing in the vicinity of the nest.

The provision was a moist pollen and nectar mass.

Description of the nest and egg

The single nest obtained consisted of a burrow excavated in the river bank. There was no entrance turret. The shaft penetrated the bank horizontally for 2 cm and then turned at right angles to run subvertically downwards more-or-less parallel to the surface of the bank to a depth of 10 cm terminating in three cells in linear series each sealed with mud. The walls of the cells were cemented and lined with a waxy coating.

The egg, which is laid onto the surface of the provision, is curved, yellow and 4.5 mm long from tip to tip across the arc.

Method of construction of the nest

Water did not appear to have been used for the excavation of the burrow. The nature of the bonding agent used for cementing the walls of the cell and sealing the cells was not identified.

DISCUSSION OF NESTING BY *AMEGILLA* AND TWO SUBGENERA OF *ANTHOPHORA*, *HELIOPHILA* AND *PARAMEGILLA*

The most detailed description of the nesting of an *Amegilla* is that of Houston (1991) for the Australian *Amegilla (Asaropoda) dawsoni* (Rayment). Further nesting accounts for Australian *Amegilla* species are for *Amegilla (Asaropoda)* sp. 2 (Houston 1991), *Amegilla (Asaropoda)* sp. (*?bombiformis*, Cardale 1968b), *Amegilla (Asaropoda)* sp. (Maynard 1992), *Amegilla (Zonamegilla) pulchra* (Smith) (Michener 1960, as *A. salteri* (Rayment); Cardale 1968a as *Amegilla (Amegilla) pulchra* (Smith)). Fragmentary notes on several Australian species are given in Rayment (1935, 1951) and on a Palaearctic species in Ferton (1920).

Nesting in aggregations as recorded for *A.(Zebr.) punctifrons* seems to be a common feature of *Amegilla.* Single widely scattered nests as recorded for *A. (M.) atrocincta* is less common. However, the nests of *A. (A.) dawsoni* though they do occur singly and widely scattered are also found in aggregations of up to 10 000. This raises the question of whether there are areas where populations of *A. (M.) atrocincta* are large and whether in such areas this species may also nest in aggregations.

Excavation by *Amegilla* may either be with (for example *A. (M.) atrocincta* and *A. (A.) dawsoni*)

or without the use of a wetting agent (for example *A. (Zebr.) punctifrons*). Whereas water collection by *A. (M.) atrocincta* has been regularly observed, Houston states that no Australian solitary bees are known to visit water. He suggests that nectar may be the wetting agent used in excavation and construction by *A. (A.) dawsoni.* Unfortunately he did not test his hypothesis by analysing the mud used in the construction of the turrets.

Turrets are constructed by some but not all Australian *Amegilla.* The turrets of *A. (M.) atrocincta, A. (A.) dawsoni a*nd Maynard's *A. (A.)* sp. at least, apart from the probable difference in the bonding agent, are initially similarly constructed. However, whereas turrets of up to 80 mm appear to be the norm for *A. (M.) atrocincta,* 15-20 mm is usual for *A. (A.) dawsoni* and 10 mm for Maynard's *A. (A.)* sp.. Associated with the turret of *A. (A.) dawsoni* is a pronounced annular tumulus whereas there were no visible deposits of discarded soil in the vicinty of the nests of *A. (M.) atrocincta.* Deposits of discarded soil are, however, characteristic of *A. (Zebr.) punctifrons* which does not construct a turret but keeps the nest entrance closed with loose material excavated from the shaft.

Multicellular burrows seem to be characteristic for *Amegilla* but the arrangement of secondary shafts and cells differs markedly between species. The single-celled burrows of *A. (M.) atrocincta, A. (A.) dawsoni* and Houston's species 2 are similar in that they all terminate in a vertical cell with a double seal above which is a soil filled antechamber. However, burrows with more than one cell are markedly distinct. If the single two-celled nest of *A. (M.) atrocincta* is taken as typical for the species then the secondary shaft in nests of this species diverges from the main shaft immediately within the entrance, extends laterally and then downwards ending in a cell at approximately the same depth as the first cell. However, the main shafts of *A. (A.) dawsoni* and Houston's species 2 remain unbranched until immediately above the antechamber at which point there is a lateral and downward extension leading to a second cell. As each successive cell of *A. (A.) dawsoni* is deeper than that preceeding it the main shaft appears to continue downward in steps. However, succeeding cells of species 2 form a group all at the same depth. Whereas cells in linear series have not been recorded for *A. (M.) atrocincta* and species 2 they seem to be usual for *A. (Zon.) pulchra* and *A. (Zebr.) punctifrons* and occasionally two cells in sequence are constructed by *A. (A.) dawsoni.*

Lining of the cells with wax which is presumed to be derived from the Dufour's gland secretion seems to be general in the Anthophorini. *A. (M.) atrocincta* and *A. (Asaropoda)* species waterproof the cell seal with wax. The way in which this is achieved appears to differ but this may reflect a difference in interpretation. Houston considers the mud seal of *A. (A.) dawsoni* to be constructed spirally and to be waxed on the lower surface just before the central aperture is finally sealed with mud. From the small sample of *A. (M.) atrocincta* seals, all completed, available to the present authors it appears that this species applies the wax together with the mud as the wax on the lower surface extends across the final central application of mud and is also present on the upper surface. Both species construct a second unwaxed seal above the first seal, fill the antechamber with soil and then construct a third seal.

A knowledge of the nesting of more species is required before it will be possible to distinguish between subgeneric and specific differences.

The notes on the nesting of *Anthophora (Heliophila) praecox* and *Anthophora (Paramegilla) epichariformis* presented here though scanty are of interest when considered together with the other published observations for the two subgenera to which they belong.

Nesting in turretless burrows in aggregations in vertical to subvertical earthen banks has, in addition to *Anthophora (H.) praecox,* been recorded for *Anthophora (Heliophila) braunsiana* Friese (Rozen 1969) and *Anthophora (Heliophila) rufolanata* Dours (Rozen 1969 as *Anthophora krebsi* Friese) in the eastern Cape Province, South Africa, and *Anthophora (Heliophila) flexipes* Cresson

(Torchio and Youssef 1968 as *Anthophora (Micranthophora) flexipes* Cresson) and *Anthophora (Heliophila) peritomae* Cockerell (Torchio 1971 as *Anthophora (Micranthophora) peritomae* Cockerell) in Utah, U.S.A. A sixth species of *Anthophora (Heliophila), Anthophora (H.) vestita* Smith, has been recorded nesting in vertical earthen surfaces, walls built of unbaked, sundried clay bricks (Brauns 1913). Unfortunately no details of the nests are given.

Entrance sharing as observed for *A. (H.) praecox,* has been recorded by Torchio (1971) for *A. (H.) peritomae* Cockerell, similarly nesting in a bank honeycombed with burrows.

Instances of at least two cells arranged in linear series have been recorded for all but *A. (H.) rufolanata.* As this practice is variable it is possible that instances may be found to occur for this species in addition.

Little seems to have been recorded on the nesting of *Anthophora (Paramegilla).* Ferton (1902, 1920) gives notes on the nesting of *A. (Paramegilla) balneorum* Lepeletier and *A. (Paramegilla) ferruginea* Lepeletier in France. Both, like *A. (P.) epichariformis* excavate turretless, multicellular nests. *A. (P.) ferruginea* unlike the other two species seemingly nests in horizontal ground rather than in vertical banks. As only a single nest of *A. (P.) epichariformis* is known it could not be established whether or not the linear arrangement of the cells is the rule. In Ferton's nests of *A. (P.) ferruginea* only some of the cells were arranged in linear sequence. It would therefore appear that even within single nests of *A. (Paramegilla)* as in *A. (Heliophila)* this is a variable character. Brooks (1988) mentions that Marikovskaya (1970) has described nests of two Eurasian species of *A. (Paramegilla)* but gives no details.

ANALYSIS AND DISCUSSION OF FLOWER VISITING BY SOUTHERN AFRICAN ANTHOPHORINI

The Anthophorini, that is *Amegilla* and *Anthophora,* are regarded as polylectic [collecting pollen from a wide range of families] as a general rule, narrow oligolecty [collection of pollen from flowers of a single family or even genus] being considered unusual (Brooks 1988). Most collectors when recording flowers visited do not distinguish between pollen and nectar collection. The data for southern African Anthophorini available to the authors in the present discussion should therefore be seen as encompassing both types of visit indiscriminately. They are assembled from label data in the Albany Museum collection (F.W., S.K., D.W., H.W. and R.W.Gess - 339 records, and C.F.Jacot Guillarmod - 54 records) and from label data of other collectors (a total of 109 records) listed by Eardley and Brooks (1989) and Eardley (1994). Records are available for 16 of the 31 species of *Amegilla* and 10 of the 31 species of *Anthophora* represented in southern Africa. Twenty four dicot families and three monocot families in total have been recorded as visited. Tables 1 and 2 indicate the families known to be visited by each of the species. Immediately apparent are some interesting differences between *Amegilla* and *Anthophora,* and between the two subgenera *(Heliophila* and *Pyganthophora)* of *Anthophora* for which records are available.

Taking the 16 species of *Amegilla* together, Acanthaceae appears to be markedly favoured being recorded for 12 (75.00%) of the species as compared with one (10.00%) of the ten species of *Anthophora.* By contrast seven (70.00%) of the ten species of *Anthophora* were recorded from Boraginaceae whereas of the 16 species of *Amegilla* only one (6.25%) was recorded from this plant family. Furthermore five (50.00%) of the ten species of *Anthophora* were recorded from Asteraceae and from Sterculiaceae whereas of the 16 species of *Amegilla* only six (37.50%) and two (12.50%) respectively were recorded from these plant families. However, Asteraceae together with the equally ranked Lamiaceae does come second as being most favoured after Acanthaceae by *Amegilla* as a whole.

TABLE 1. Flower families recorded as visited by 16 *Amegilla* spp. together with the number and percentage of these species visiting each flower family (the species here represented by numbers correspond to the species listed by number in Appendix 1).

Flower families	Amegilla species																no.	% of spp.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
Acanthaceae	+	+	+	+	+	+	+	-	-	+	+	-	-	+	+	+	12	75.00
Asteraceae	-	-	+	-	-	+	+	-	-	+	+	-	-	-	-	+	6	37.50
Boraginaceae	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	1	6.25
Campanulaceae	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	+	2	12.50
Capparaceae	-	-	-	-	-	-	+	+	+	-	-	-	-	-	-	-	3	18.75
Convolvulaceae	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	1	6.25
Elatinaceae	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	1	6.25
Geraniaceae	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	+	3	18.75
Hydrophyllaceae	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	1	6.25
Lamiaceae	-	-	+	+	-	-	+	-	-	-	+	-	+	-	-	+	6	37.50
Malvaceae	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	1	6.25
Melastomataceae	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	1	6.25
Mesembryanthemaceae	-	-	-	-	-	-	+	+	-	-	-	-	-	-	+	+	4	25.00
Mimosaceae	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+	2	12.50
Moringaceae	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	1	6.25
Papilionaceae	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	2	12.50
Pedaliaceae	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-	+	3	18.75
Plumbaginaceae	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	+	3	18.75
Proteaceae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	1	6.25
Rosaceae	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	1	6.25
Scrophulariaceae	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	1	6.25
Selaginaceae	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	+	2	12.50
Solanaceae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	1	6.25
Sterculiaceae	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	2	12.50
Zygophyllaceae	-	-	-	-	-	-	+	-	-	-	-	+	-	-	-	+	3	18.75
Liliaceae	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	2	12.50
no. of flower fams for each bee sp.	1	2	6	2	2	2	15	3	1	2	5	1	4	1	2	14		

The records for the subgenera *Heliophila* and *Pyganthophora* suggest differences in forage flower choice. For example, sampling of flower visitors to Asteraceae has yielded five species of *Heliophila* but no *Pyganthophora*. On the other hand sampling of Zygophyllaceae has yielded four species of *Pyganthophora* but no *Heliophila*. The association with Asteraceae exhibited by these five *Heliophila* species of the Old World Vestita Species Group taken together with the comment of Brooks (1988), reviewing the accounts of Torchio and Youssef (1968) and Torchio (1971), that there is a definite preference by the New World Estebana Species Group for Asteraceae, strengthens an association between the subgenus *Heliophila* and Asteraceae.

TABLE 2. Flower families recorded as visited by 10 *Anthophora* spp., 5 each of the subgenera *Heliophila* and *Pyganthophora*, together with the number and percentage of these species visiting each flower family (the species here represented by numbers correspond to the species listed by number in Appendix 1).

Flower families	*Anthophora* species										no. of spp.			% of spp.
	Heliophila					*Pyganthophora*					*H*	*P*	*H+P*	
	17	18	19	20	21	22	23	24	25	26				
Acanthaceae	-	-	-	+	-	-	-	-	-	-	1	0	1	10.00
Asteraceae	+	+	+	+	+	-	-	-	-	-	5	0	5	50.00
Boraginaceae	-	+	+	+	+	-	-	+	+	+	4	3	7	70.00
Campanulaceae	-	-	-	-	+	-	-	-	-	-	1	0	1	10.00
Lamiaceae	+	-	-	+	-	-	-	-	-	-	2	0	2	20.00
Mesembryanthemaceae	-	-	-	-	-	+	-	+	+	-	0	3	3	30.00
Sterculiaceae	-	-	-	-	+	+	-	+	+	+	1	4	5	50.00
Solanaceae	-	-	-	-	-	-	+	-	-	-	0	1	1	10.00
Zygophyllaceae	-	-	-	-	-	-	+	+	+	+	0	4	4	40.00
Haemodoraceae	-	-	-	-	+	-	-	-	-	-	1	0	1	10.00
Iridaceae	-	-	-	-	+	-	-	-	-	-	1	0	1	10.00
no. of flower fams for each bee sp.	2	2	2	4	6	2	2	4	4	3				

Clearly there are too few records available to draw any firm conclusions. However, the differences in flower choice between genera and also between subgenera (despite the lack of distinction between pollen and nectar collection) indicate that the southern African Anthophorini do not as a rule practise indiscriminate broad polylecty.

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Appendix 1

Catalogue of flower visiting records for the Anthophorini (all records Albany Museum collection except those marked * which are taken from Eardley and Brooks 1989 and Eardley 1994).

abbreviations - colours: B = blue; BV = bluish violet; G = green; O = orange; Pi = pink; PiV = pinkish violet; Pu = purple; PuV = purplish violet; V = violet; W = white; WY = cream; Y = yellow;

sex: F = female; M = male.

areas: CP = Cape Province; Nam. = Namibia; Nat. = Natal; Tvl = Transvaal; Richtersveld N Park = Richtersveld National Park.

Anthophorini

Amegilla Friese					
1. *Amegilla (Ackmonopsis) mimadvena* (Cockerell)					
	Acanthaceae				
	Isoglossa Derst.				
	**I.* sp	-	-	-	? Durban, Nat.; Cockerell, 1930
2. *Amegilla (Aframegilla) nubica* (Lepeletier)					
	Acanthaceae				
	Monechma Hochst.				
	M. mollissimum (Nees) P.G.Mey.	Pi	F	1	Richtersveld N Park, CP; FW,SK&RWGess, 24.ix.95
	Pedaliaceae				
	Sesamum L.				
	**S.* sp.	-	M	1	S Leonardoville, Nam.; VBWhitehead, 11.ii.84
3. *Amegilla (Amegilla) capensis* (Friese)					
	Acanthaceae				
	*-	-	-	-	Wolkberg, Tvl; RHWatmough, -.iv.74
	Asteraceae (Compositae)				
	Othonna L.				
	**O.* sp.				.....; Cockerell, 1908
	Geigeria Griesselich				
	**G.* sp.				.....; Cockerell, 1908
	Convolvulaceae				
	Convolvulus L.				
	**C.* sp.	-	F	1	Angola; Cockerell, 1907
	Lamiaceae				
	Plectranthus L'Herit.				
	**P.* sp.	-	F	2	Katberg Pass, CP; VBWhitehead, 25.xi.85
	*-	-	-	-	Wolkberg, Tvl; RHWatmough, -.iv.74
	Melastomataceae				
	Dissotis Benth.				
	**D.* sp.	-	F	2	Chimanimani Mts, Moz.; RHWatmough, 3.iv.72
	Selaginaceae				
	Walafrida E.Mey.				
	**W.* sp.	-	F	1	N Edenburg, Tvl; MJohannsmeier, -.-.-
4. *Amegilla (Amegilla) natalensis* (Friese)					
	Acanthaceae				
	*-	-	-	-	Wolkberg, Tvl; RHWatmough, -.iv.74
	Lamiaceae				
	*-	-	-	-	Wolkberg, Tvl; RHWatmough, -.iv.74
5. *Amegilla (Megamegilla) acraensis* (Fabricius)					
	Acanthaceae				
	Blepharis Juss.				
	B. capensis (L. *f.*) Pers.	W	F	1	Grahamstown, CP; DWGess, 3.ii.81
	B. capensis (L. *f.*) Pers.	W	M	3	Grahamstown, CP; DWGess, 3.ii.81

	Plumbaginaceae				
	**Limonium* Mill.	-	M	1	Bredasdorp, CP; CDEardley, 15.xi.82
6.	*Amegilla (Micramegilla) atrocincta* (Lepeletier)				
	Acanthaceae				
	Blepharis Juss.				
	B. capensis (L. *f.*) Pers.	W	M	1	Grahamstown, CP; FWGess, 5.i.79
	B. capensis (L. *f.*) Pers.	W	F	6	Grahamstown, CP; FW&DWGess, 7.i.79
	B. capensis (L. *f.*) Pers.	W	M	8	Grahamstown, CP; FW&DWGess, 7.i.79
	B. capensis (L. *f.*) Pers.	W	F	2	Grahamstown, CP; FW&DWGess, 15.i.81
	B. capensis (L. *f.*) Pers.	W	F	4	Grahamstown, CP; FW&DWGess, 3.ii.81
	B. capensis (L. *f.*) Pers.	W	F	5	Grahamstown, CP; FW,DW&RWGess, 8.ii.81
	B. capensis (L. *f.*) Pers.	W	F	2	Waterford, CP; RWGess, 25.xi.87
	Asteraceae (Compositae)				
	Berkheya Ehrh.				
	B. heterophylla (Th.) O.Hoffm.	Y	M	1	Grahamstown, CP; FW&SKGess, 20.xi.90
7.	*Amegilla (Micramegilla) niveata* (Friese)				
	Acanthaceae				
	Blepharis Juss.				
	B. capensis (L.*f.*) Pers.	W	F	1	Waterford, CP; RWGess, 25.xi.87
	Monechma Hochst.				
	M. mollissimum (Nees) P.G.Mey.	Pi	F	5	Richtersveld N Park, CP; FW,SK,&RWGess, 18-24.ix.95
	M. mollissimum (Nees) P.G.Mey.	Pi	M	1	Richtersveld N Park, CP; FW,SK,&RWGess, 18-24.ix.95
	**M.* sp.	-	F	18	Usakos, Nam.; RHWatmough, 5.vii.75
	**M.* sp.	-	M	7	Usakos, Nam.; RHWatmough, 5.vii.75
	Peristophe Nees				
	P. cernua Nees	V	F	1	Grahamstown, CP; FWGess, 3.xii.81
	Petalidium Nees				
	**P.* sp.	-	F	2	Ou Lutzputz, CP; VBWhitehead, 31.vii.84
	"acanth"	W	M	2	Richtersveld N Park, CP; FW,SK,&RWGess, 24.ix.95
	Aizoaceae: Mesembryanthema (Mesembryanthemaceae)				
	Mesembryanthemum L.				
	**M. crystalinum* Hook.f.	W	F	3	SW Kakamas, CP; VBWhitehead, 6.ii.84
	**M.* sp.	-	F	1	Jakkalsputs, CP; VBWhitehead, 21.xi.75
	**M.* sp.	W	F	1	Klinghardtberge, Nam.; RHWatmough, 19.x.74
	**M.* sp.	O	F	2	Aurusberg, Nam.; RHWatmough, 23.x.74
	"mesem"	W	F	3	Montagu/Matroosberg, CP; SK&RWGess, 4.xii.86
	"mesem"	W	F	2	Matroosberg, CP; RWGess, 4.xii.86
	Asteraceae (Compositae)				
	Berkheya Ehrh.				
	B. carlinifolia (DC.) Roessler	Y	M	1	ENE Ceres, CP; HWGess, 29-30.xi.89
	**B. rigida* (Thunb.) H.Bol. & Wolley-Dod ex Adamson & Salter	Y	F	2	SE Hopefield, CP; JGRozen *et al.* , 15.x.72

Senecio L.				
S. rosmarinifolius L. *f.*	Y	F	2	Oudtshoorn, CP; FW&RWGess, 7-8.xii.86
Boraginaceae				
Anchusa L.				
A. capensis Thunb.	B	F	1	Kamieskroon, CP; FW&SKGess, 9.x.94
A. capensis Thunb.	B	F	1	Kamieskroon, CP; FW,SK&RWGess, 28.ix.95
Lobostemon Lehm.				
L. sp.	B	F	4	Clanwilliam/Graafwater, CP; FW&SKGess, 4.x.90
Capparaceae				
Cleome L.				
C. paxii (Schinz) Gilg & Ben.	Y	F	1	Richtersveld N Park, CP; FW,SK&RWGess, 16.ix.95
Maerua Forssk.				
M. schinzii Pax	W	M	1	Vioolsdrif, CP; FW&SKGess, 3.x.85
Elatinaceae				
Bergia L.				
B. glomerata L.*f.*	G	F	1	Grahamstown, CP; FW&SKGess, 20.xi.90
Geraniaceae				
Geranium L.				
**G.* sp.	-	F	1	Aussenkehr, Nam.; VBWhitehead, 16.ix.83
**G.* sp.	-	M	1	Aussenkehr, Nam.; VBWhitehead, 16.ix.83
Hydrophyllaceae				
Codon L.				
C. royenii L.	W	F	1	Richtersveld N Park, CP; FW,SK&RWGess, 19.ix.95
Lamiaceae (Labiatae)				
"labiate"	V	F	2	Ouberg Pass, Montagu, CP; FWGess, 3.xii.86
"labiate"	B	F	1	Nieuwoudtville, CP; FW&SKGess, 3-8.x.89
*"labiate"	B	F	1	Aurusberg, Nam.; RHWatmough, 23.x.74
Malvaceae				
*-	-	F	1	Klinghardtberge, Nam.; RHWatmough, 19.x.74
Mimosaceae				
Acacia Mill.				
A. caffra (Thunb.) Willd.	WY	M	1	Oudtshoorn, CP; RWGess, 9-12.xii.86
Moringaceae				
Moringa Adans.				
**M. ovalifolia* Dinter & Berger	-	F	1	Gobabeb, Nam.; MLPenrith&SLouw, 18.ii.-20.iii.83
Pedaliaceae				
Harpagophytum DC. ex Meissn.				
**H. procumbens* (Burch.) DC. ex Meissn.	-	F	1	E Kimberley, CP; VBWhitehead, 19.i.84
Sesamum L.				
**S. triphyllum* Welw. ex Aschers.	-	F	1	Derm, Nam.; VBWhitehead, 10.ii.84

	**S.* sp.	-	F	1	W Boshoff, CP; VBWhitehead, 19.i.84
	**S.* sp.	-	F	1	Harmonie, CP; VBWhitehead, 25.ii.80
Rosaceae					
	Neuradopsis Brem. & Oberm.				
	**N.* sp.	-	F	2	Leonardville, Nam.; VBWhitehead, 15.iv.81
Scrophulariaceae					
	Aptosimum Burch.				
	A. indivisum Burch. ex Benth.	BV	F	1	Springbok, CP; FW&SKGess, 8.x.94
	A. spinescens (Thunb.) Weber	PuV	F	1	Springbok, CP; SKGess, 15-21.x.87
	Peliostomum Benth.				
	P. leucorrhizum E.Mey. ex Benth.	V	F	1	Richtersveld N Park, CP; FW,SK&RWGess, 19.ix.95
Sterculiaceae					
	Hermannia L.				
	H. disermifolia Jacq.	Y	F	1	Nieuwoudtville, CP; FW&SKGess, 29.ix.94
	H. disermifolia Jacq.	Y	F	1	Kamieskroon, CP; FW&SKGess, 10.x.94
Zygophyllaceae					
	Tribulus L.				
	**T.* sp.	Y	F	1	N Kakamas, CP; VBWhitehead, 7.ii.84
	**T.* sp.	Y	M	1	N Kakamas, CP; VBWhitehead, 7.ii.84
	**T.* sp.	Y	M	1	W Mariental, Nam.; RGOberprieler, 22.iii.83
	Zygophyllum L.				
	Z. sp.	Y	F	1	Nieuwoudtville, CP; FW&SKGess, 2.x.89
8. *Amegilla (Micramegilla) velutina* (Friese)					
Aizoaceae: Mesembryanthema (Mesembryanthemaceae)					
	Psilocaulon N.E.Br.				
	**P.* sp.	-	F	1	Noordoewer, Nam.; VBWhitehead, 7.iii.80
	**P.* sp.	-	M	3	Noordoewer, Nam.; VBWhitehead, 7.iii.80
	?*Stoeberia* sp.	W	F	4	Richtersveld N Park, CP; FW,SK&RWGess, 16.ix.95
Capparaceae					
	Cleome L.				
	C. paxii (Schinz) Gilg & Ben.	Y	F	13	Richtersveld N Park, CP; FW,SK&RWGess, 16.ix.95
Geraniaceae					
	Geranium L.				
	**G.* sp.	-	F	1	Aussenkehr, Nam.; VBWhitehead, 16.ix.83
	**G.* sp.	-	M	2	Aussenkehr, Nam.; VBWhitehead, 16.ix.83
9. *Amegilla (Zebramegilla) bechuanensis* (Cockerell)					
Capparaceae					
	Cleome L.				
	**C. angustifolia* Forssk.	-	F	1	nr Vivo, Tvl; CDEardley, 3.ii.84
10. *Amegilla (Zebramegilla) calens* (Lepeletier)					
Acanthaceae					
	Blepharis Juss.				
	B. capensis (L.*f.*) Pers.	W	F	1	Grahamstown, CP; FWGess, 7.i.79

	**B. diversispina* (Nees) C.B.Cl.	-	F	-	Langjan Nat. Res.,Tvl.; CDEardley, 2.ii.84
	Justicia L.				
	**J. flava* (Vahl.) Vahl.	-	F	-	Langjan Nat. Res.,Tvl.; CDEardley, 2.ii.84
	Asteraceae (Compositae)				
	Zinnia L.				
	**Z.* sp.	-	F	1	Lobito Bay, Angola; Cockerell, 1932
11. *Amegilla (Zebramegilla) fallax* (Smith)					
	Acanthaceae				
	"acanth"	Pi	F	1	Morgan Bay, CP; FW&SKGess, 30.iii.-4.iv.89
	*?-	-	-	-	Wolkberg, Tvl; RHWatmough, -.-.-
	Asteraceae (Compositae)				
	Vernonia Schreb.				
	V. fastigiata Oliv. & Hiern	-	M	1	Blyderivierspoort Dam, Tvl; CDEardley, 25-26.x.84
	Campanulaceae				
	Lobelia L.				
	L. sp.	B	M	1	Cape Peninsula, CP; FW,SK&DWGess, 7.iii.93
	Lamiaceae				
	Plectranthus L'Herit.				
	P. sp.	-	F	1	Katberg, CP; VBWhitehead, 25.xi.85
	*?-	B	F	3	nr Loskop Dam, Tvl; RHWatmough, -.-.-
	*?-	B	M	1	nr Loskop Dam, Tvl; RHWatmough, -.-.-
	*?-	-	-	-	Wolkberg, Tvl; RHWatmough, -.-.-
	Plumbaginaceae				
	Limonium Mill.				
	**L.* sp.	-	M	1	Bredasdorp, CP; CDEardley, 15.xi.82
12. *Amegilla (Zebramegilla) langi* (Cockerell)					
	Zygophyllaceae				
	Tribulus L.				
	**T.* sp.	-	F	1	Koopan Suid, CP; VBWhitehead, 13.ii.84
13. *Amegilla (Zebramegilla) obscuriceps* (Friese)					
	Lamiaceae				
	"labiate"	B	F	3	Nieuwoudtville, CP; FW&SKGess, 3-8.x.89
	Liliaceae				
	Trachyandra				
	**T. muricata* (L.*f.*) Kunth	-	F	1	Clanwilliam, CP; VBWhitehead, 23.viii.84
	Papilionaceae				
	Melolobium Ecklon & Zeyher				
	M. sp.	WY	M	1	Grahamstown, CP; FWGess, 12.x.77
	Sterculiaceae				
	Hermannia L.				
	**H.* sp.	-	F	1	Beaufort West, CP; VBWhitehead, 24.xi.85
14. *Amegilla (Zebramegilla) penicula* Eardley					
	Acanthaceae				
	Blepharis Juss.				

	B. capensis (L.*f.*) Pers.	W	F	8	Grahamstown, CP; FW&DWGess, 7.i.79
	B. capensis (L.*f.*) Pers.	W	M	1	Grahamstown, CP; FW&DWGess, 7.i.79
	B. capensis (L.*f.*) Pers.	W	F	1	Grahamstown, CP; FWGess, 8.ii.81
	B. capensis (L.*f.*) Pers.	W	F	2	Grahamstown, CP; FWGess, 10.ii.86
15. *Amegilla (Zebramegilla) punctifrons* (Walker)					
	Acanthaceae				
	Blepharis Juss.				
	B. capensis (L.*f.*) Pers.	W	M	2	Grahamstown, CP; FW&SKGess, 27.x.72
	B. capensis (L.*f.*) Pers.	W	F	1	Grahamstown, CP; DWGess, 5.i.79
	B. capensis (L.*f.*) Pers.	W	F	1	Grahamstown, CP; FW&DWGess, 7.i.79
	B. capensis (L.*f.*) Pers.	W	M	7	Grahamstown, CP; FW&DWGess, 7.i.79
	B. capensis (L.*f.*) Pers.	W	F	6	Grahamstown, CP; DW&RWGess, 15.i.81
	B. capensis (L.*f.*) Pers.	W	F	5	Grahamstown, CP; DWGess, 3.ii.81
	B. capensis (L.*f.*) Pers.	W	F	3	Grahamstown, CP; FW&SKGess, 8.ii.81
	Aizoaceae: Mesembryanthema (Mesembryanthemaceae)				
	"mesem"	WY	M	1	Kommadagga, CP; FW&SKGess, 23.x.85
16. *Amegilla (Zebramegilla) spilostoma* (Cameron)					
	Acanthaceae				
	Blepharis Juss.				
	B. capensis (L.*f.*) Pers.	W	M	2	Grahamstown, CP; FW&SKGess, 27.x.72
	Aizoaceae: Mesembryanthema (Mesembryanthemaceae)				
	Mesembryanthemum L.				
	**M. crystalinum* Hook.*f.*	W	F	1	Onrusrivier, CP; VBWhitehead, 17.i.76
	Psilocaulon N.E.Br.				
	P. acutisepalum (Berger) N.E.Br.	WPi	F	2	Heerenlogement, CP; FW,SK&RWGess, 8.x.95
	P. cf. subnodosum (Berger) N.E.Br.	Pi	F	1	Graafwater, CP; FW,SK&RWGess, 6.x.95
	"mesem"	W	F	1	Montagu/Matroosberg, CP; FWGess, 4.xii.86
	Asteraceae (Compositae)				
	Senecio L.				
	S. linifolius L.	Y	F	2	Grahamstown, CP; CFJacotGuillarmod, 27.i.75
	S. linifolius L.	Y	M	2	Grahamstown, CP; CFJacotGuillarmod, 27.i.75
	S. linifolius L.	Y	M	3	Grahamstown, CP; CFJacotGuillarmod, 31.i.75
	S. linifolius L.	Y	F	1	Grahamstown, CP; CFJacotGuillarmod, 2.ii.75
	S. linifolius L.	Y	M	3	Grahamstown, CP; CFJacotGuillarmod, 2.ii.75
	Campanulaceae				
	Cyphia Berg.				
	C. sp.	PiV	M	1	Grahamstown, CP; FWGess, 21.iii.78
	Geraniaceae				
	Pelargonium L' Herit				
	P. myrrhifolium Ait.	-	F	1	Oudtshoorn, CP; CFJacotGuillarmod, 10.x.72
	P. myrrhifolium Ait.	-	M	1	Oudtshoorn, CP; CFJacotGuillarmod, 10.x.72
	Lamiaceae (Labiatae)				
	Acrotome Benth.				
	A. inflata Benth.	BV	M	5	Grahamstown, CP; SKGess, 17.iii.78
	A. inflata Benth.	BV	M	1	Grahamstown, CP; FWGess, 21.iii.78

Salvia dentata Ait.	B	F	2	Clanwilliam, CP; FW&SKGess, 4.x.90
**S.* sp.	-	M	1	Queenstown, CP; VBWhitehead, 29.xii.83
Liliaceae				
Aloe sp.	Y	F	1	Grahamstown, CP; FWGess, 6.i.81
Mimosaceae				
Acacia Mill.				
A. caffra (Thunb.) Willd.	WY	F	1	Oudtshoorn, CP; RWGess, 9-12.xii.86
A. karroo Hayne	Y	F	1	Colesberg, CP; DWGess, 19.i.85
Papilionaceae (Fabaceae)				
Aspalathus L.				
A. chortophila Ecklon & Zeyher	Y	F	1	Riebeek East, CP; FW&SKGess, 14.xi.92
Psoralea L.				
P. pinnata L.	B	M	2	Grahamstown, CP; CFJacotGuillarmod, 2.ii.75
P. pinnata L.	B	F	2	Grahamstown, CP; CFJacotGuillarmod, 9.ii.75
P. pinnata L.	B	M	3	Grahamstown, CP; CFJacotGuillarmod, 9.ii.75
Pedaliaceae				
Sesamum L.				
**S.* sp.	-	F	1	W Boshoff, CP; VBWhitehead, 19.iii.84
Plumbaginaceae				
Limonium Mill.				
**L.* sp.	-	F	1	Bredasdorp, CP; CDEardley, 15.xi.82
Proteaceae				
Paranomus Salisb.				
P. bracteolarus Salisb. ex Knight	Pi	F	1	Nieuwoudtville, CP; FW&SKGess, 30.ix.90
Solanaceae				
Lycium L.				
L. sp.	V	M	1	Grahamstown, CP; FW&SKGess, 29.ix.77
*-	-	F	1	Queenstown, CP; VBWhitehead, -.i.64
Zygophyllaceae				
Zygophyllum L.				
Z. sp.	Y	M	3	Nieuwoudtville, CP; FW&SKGess, 28.ix.90

Anthophora Latreille

17. *Anthophora (Heliophila) labrosa* Friese

Asteraceae (Compositae)				
Berkheya Ehrh.				
B. heterophylla (Th.) O.Hoffm.	Y	F	2	Grahamstown, CP; FWGess, 12.x.72
B. heterophylla (Th.) O.Hoffm.	Y	F	1	Grahamstown, CP; FW&DWGess, 16.x.72
B. heterophylla (Th.) O.Hoffm.	Y	M	1	Grahamstown, CP; FW&DWGess, 16.x.72
B. heterophylla (Th.) O.Hoffm.	Y	F	1	Grahamstown, CP; FWGess, 25.x.72
B. heterophylla (Th.) O.Hoffm.	Y	M	2	Grahamstown, CP; FW&SKGess, 15.xi.77
B. heterophylla (Th.) O.Hoffm.	Y	F	2	Riebeek East, CP; FW&SKGess, 22.xi.82
B. heterophylla (Th.) O.Hoffm.	Y	M	1	Riebeek East, CP; FW&SKGess, 22.xi.82
B. heterophylla (Th.) O.Hoffm.	Y	M	1	Riebeek East, CP; FW&SKGess, 16.x.83
B. sp.	Y	F	1	Clanwilliam, CP; FW&SKGess, 9.x.90

Senecio L.				
S. linifolius L.	Y	F	1	Grahamstown, CP; CFJacotGuillarmod, 25.i.75
S. linifolius L.	Y	F	1	Grahamstown, CP; CFJacotGuillarmod, 2.ii.75
Lamiaceae (Labiatae)				
"labiate"	V	M	5	Ouberg Pass, Montagu, CP; FWGess, 3.xii.86

18. *Anthophora (Heliophila) praecox* Friese

Asteraceae (Compositae)				
Berkheya Ehrh.				
B. carlinifolia (DC.) Roessler	Y	M	1	Theronsberg Pass,Ceres, CP; FWGess, 29-30.xi.89
B. heterophylla (Th.) O.Hoffm.	Y	F	1	Grahamstown, CP; FW&SKGess, 15.xi.77
B. heterophylla (Th.) O.Hoffm.	Y	F	4	Riebeek East, CP; FW&SKGess, 22.xi.82
B. heterophylla (Th.) O.Hoffm.	Y	M	1	Riebeek East, CP; FW&SKGess, 16.x.83
B. sp.	Y	F	1	Clanwilliam, CP; FW&SKGess, 9.x.90
Pentzia Thunb.				
P. incana (Thunb.) Kuntze	Y	F	p	Prince Albert, CP; SKGess, 26.xi.-5.xii.87
Boraginaceae				
Anchusa L.				
A. capensis Thunb.	B	F	1	Grahamstown, CP; FWGess, 18.xi.77
A. capensis Thunb.	B	M	2	Grahamstown, CP; FWGess, 18.xi.77
A. capensis Thunb.	B	M	1	Kamieskroon, CP; FW&SKGess, 11.x.94

19. *Anthophora (Heliophila) rufolanata* Dours

Asteraceae (Compositae)				
Berkheya Ehrh.				
B. heterophylla (Th.) O.Hoffm.	Y	F	2	Grahamstown, CP; FWGess, 12.x.72
B. heterophylla (Th.) O.Hoffm.	Y	M	4	Grahamstown, CP; FWGess, 12.x.72
B. heterophylla (Th.) O.Hoffm.	Y	F	5	Grahamstown, CP; FW&DWGess, 16.x.72
B. heterophylla (Th.) O.Hoffm.	Y	M	1	Grahamstown, CP; FWGess, 16.x.72
B. heterophylla (Th.) O.Hoffm.	Y	M	3	Grahamstown, CP; FWGess, 25.x.72
B. heterophylla (Th.) O.Hoffm.	Y	F	1	Riebeek East, CP; FW&SKGess, 16.x.83
Pteronia L.				
P. incana (Burm.) DC	Y	F	2	Kamieskroon, CP; FW&SKGess, 17.ix.92
P. incana (Burm.) DC	Y	M	1	Kamieskroon, CP; FW&SKGess, 17.ix.92
Senecio L.				
S. linifolius L.	Y	F	10	Grahamstown, CP; CFJacotGuillarmod, 25.i.75
S. linifolius L.	Y	F	1	Grahamstown, CP; CFJacotGuillarmod, 27.i.75
S. linifolius L.	Y	M	1	Grahamstown, CP; CFJacotGuillarmod, 27.i.75
S. linifolius L.	Y	F	2	Grahamstown, CP; CFJacotGuillarmod, 31.i.75
S. linifolius L.	Y	F	4	Grahamstown, CP; CFJacotGuillarmod, 2.ii.75
Boraginaceae				
Anchusa L.				
A. capensis Thunb.	B	M	1	Grahamstown, CP; FWGess, 18.xi.77
A. capensis Thunb.	B	M	1	Leliefontein, CP; FW,SK&RWGess, 2.x.95

20. *Anthophora (Heliophila) vestita* Smith

Acanthaceae				
Peristrophe Nees				
P. cernua Nees	V	F	1	Grahamstown, CP; FWGess, 3.xii.81
"acanth"	Pi	F	6	Morgan Bay, CP; FW&SKGess, 30.iii.-4.iv.89

Asteraceae (Compositae)					
Berkheya Ehrh.					
B. heterophylla (Th.) O.Hoffm.	Y	F	8	Grahamstown, CP; FWGess, 12.x.72
B. heterophylla (Th.) O.Hoffm.	Y	M	1	Grahamstown, CP; FWGess, 12.x.72
B. heterophylla (Th.) O.Hoffm.	Y	F	3	Grahamstown, CP; FW&DWGess, 16.x.72
B. heterophylla (Th.) O.Hoffm.	Y	F	5	Grahamstown, CP; FWGess, 25.x.72
B. heterophylla (Th.) O.Hoffm.	Y	F	1	Grahamstown, CP; FW&SKGess, 15.xi.77
B. heterophylla (Th.) O.Hoffm.	Y	M	1	Grahamstown, CP; FW&SKGess, 15.xi.77
B. heterophylla (Th.) O.Hoffm.	Y	F	1	Riebeek East, CP; FW,SK&DWGess, 22.xi.82
B. heterophylla (Th.) O.Hoffm.	Y	M	1	Riebeek East, CP; FW,SK&DWGess, 22.xi.82
B. heterophylla (Th.) O.Hoffm.	Y	F	2	Grahamstown, CP; FW&SKGess, 20.ix.90
B. heterophylla (Th.) O.Hoffm.	Y	M	3	Grahamstown, CP; FW&SKGess, 20.ix.90
Cirsium Mill. emend. Scop.				
C. vulgare (Savi) Ten.	Pu	F	1	Grahamstown, CP; SKGess, 9.iii.78
C. vulgare (Savi) Ten.	Pu	M	2	Grahamstown, CP; SKGess, 9.iii.78
Senecio L.				
S. linifolius L.	Y	F	3	Grahamstown, CP; CFJacotGuillarmod, 25.i.75
S. linifolius L.	Y	M	1	Grahamstown, CP; CFJacotGuillarmod, 25.i.75
S. linifolius L.	Y	F	1	Grahamstown, CP; CFJacotGuillarmod, 27.i.75
S. linifolius L.	Y	F	2	Grahamstown, CP; CFJacotGuillarmod, 31.i.75
S. linifolius L.	Y	M	1	Grahamstown, CP; CFJacotGuillarmod, 31.i.75
S. linifolius L.	Y	F	2	Grahamstown, CP; CFJacotGuillarmod, 2.ii.75
S. linifolius L.	Y	M	1	Grahamstown, CP; CFJacotGuillarmod, 2.ii.75
S. sp.	Y	F	1	Grahamstown, CP; FWGess, 28.xii.86
Boraginaceae				
Anchusa L.				
A. capensis Thunb.	B	F	3	Grahamstown, CP; FWGess, 18.xi.77
A. capensis Thunb.	B	M	7	Grahamstown, CP; FWGess, 18.xi.77
Lamiaceae (Labiatae)				
Acrotome Benth.				
A. inflata Benth.	BV	M	1	Grahamstown, CP; FWGess, 3.iii.78
A. inflata Benth.	BV	M	2	Grahamstown, CP; SKGess, 17.iii.78
21. *Anthophora (Heliophila) wartmanni* Friese				
Asteraceae (Compositae)				
Arctotis L.				
A. laevis Thunb.	Y	F	1	Clanwilliam, CP; FW&SKGess, 5.x.90
Berkheya Ehrh.				
B. heterophylla (Th.) O.Hoffm.	Y	M	1	Grahamstown, CP; FWGess, 12.x.72
B. heterophylla (Th.) O.Hoffm.	Y	M	2	Grahamstown, CP; FWGess, 16.x.72
Metalasia R. Br.				
M. muricata (L.) D.Don	Pi	F	1	Nieuwoudtville, CP; FW&SKGess, 29.ix.90
M. muricata (L.) D.Don	Pi	F	1	Nieuwoudtville, CP; FW&SKGess, 25.ix.94
Pteronia L.				
P. sp. B	Y	F	1	Nababeep, CP; FWGess, 12-13.x.89
P. sp. B	Y	M	1	Nababeep, CP; FWGess, 12-13.x.89
Senecio L.				

	S. linifolius L.	Y	M	1	Grahamstown, CP; CFJacotGuillarmod, 25.i.75
	S. linifolius L.	Y	F	1	Grahamstown, CP; CFJacotGuillarmod, 31.i.75
	S. linifolius L.	Y	F	1	Grahamstown, CP; CFJacotGuillarmod, 2.ii.75
Boraginaceae					
	Anchusa L.				
	A. capensis Thunb.	B	M	1	Kamieskroon, CP; FW,SK&RWGess, 28.ix.95
	A. capensis Thunb.	B	M	1	Leliefontein, CP; FW,SK&RWGess, 2.x.95
Campanulaceae					
	Wahlenbergia Schrad. ex Roth				
	W. sp.	V	F	1	Nieuwoudtville, CP; FW&SKGess, 30.ix.90
Haemodoraceae					
	Wachendorfia Burm.				
	W. sp.	Y	F	2	Nieuwoudtville, CP; FW&SKGess, 29.ix.90
Iridaceae					
	Homeria Vent.				
	H. sp.	Y	F	1	Nieuwoudtville, CP; FW&SKGess, 28.ix.90
Scrophulariaceae					
	Oftia Adans.				
	O. africana (L.) Bocq.	W	F	1	Graafwater, CP; FW&SKGess, 21.ix.92
22. *Anthophora (Pyganthophora) abrochia* Eardley & Brooks					
Aizoaceae: Mesembryanthema (Mesembryanthemaceae)					
	Herrea Schwant.				
	H. sp.	Y	F	2	Leliefontein, CP; FW&SKGess, 13.ix.92
	H. sp.	Y	F	1	Springbok, CP; FW&SKGess, 8.x.94
	H. sp.	Y	F	3	Springbok, CP; FW,SK&RWGess, 27.ix.95
Sterculiaceae					
	Hermannia L.				
	H. disermifolia Jacq.	Y	F	2	Springbok, CP; FW&SKGess, 8-10.ix.92
	H. disermifolia Jacq.	Y	F	1	Springbok, CP; FW&SKGess, 3.x.94
	H. disermifolia Jacq.	Y	F	3	Kamieskroon, CP; FW&SKGess, 10-11.x.94
	H. disermifolia Jacq.	Y	F	2	Kamieskroon, CP; FW,SK&RWGess, 28.ix.95
	H. disermifolia Jacq.	Y	F	3	Kamieskroon, CP; FW,SK&RWGess, 3.x.95
23. *Anthophora (Pyganthophora) braunsiana* Friese					
Solanaceae					
	Lycium L.				
	L. sp.	V	M	2	Grahamstown, CP; FWGess, 9.iii.78
Zygophyllaceae					
	Zygophyllum L.				
	Z. divaricatum Ecklon & Zeyher	Y	F	1	Leliefontein, CP; FW&SKGess, 13.ix.92
24. *Anthophora (Pyganthophora) diversipes* Friese					
Aizoaceae: Mesembryanthema (Mesembryanthemaceae)					
	Herrea Schwant.				
	H. sp.	Y	F	4	Leliefontein, CP; FW&SKGess, 13.ix.92
Boraginaceae					
	Anchusa L.				
	A. capensis Thunb.	B	M	1	Leliefontein, CP; FW,SK&RWGess, 2.x.95
	Lobostemon Lehm.				