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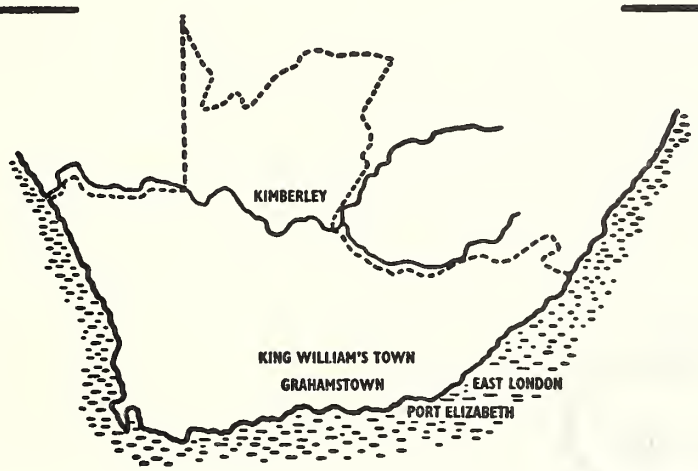

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Some aspects of the ethology of Dasyproctus westermanni (Dahlbom) (Hymenoptera: Sphecidae: Crabroninae) in the Eastern Cape Province of South Africa

by

F. W. GESS

(Albany Museum, Grahamstown)

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ABSTRACT

Some aspects of the ethology of *Dasyproctus westermanni* (Dahlbom) are described. Of particular note is the orientation of the pupae which appears to be governed by gravity rather than the position of the nest entrance. Foraging records are given for *D. bipunctatus* Lep. & Brullé, *D. dubiosus* (Arnold), *D. immitis* (Saussure), *D. ruficaudis* (Arnold) and *D. westermanni* (Dahlbom). The ethology of the genus *Dasyproctus* is reviewed and discussed.

INTRODUCTION

Sixty-seven species of the genus *Dasyproctus* Lepeletier and Brullé (Sphecidae: Crabroninae) are listed by Bohart and Menke (1976:419) of which just over half occur in the Afrotropical Region. The remainder are known from the Oriental and Australasian Regions. Published biological accounts varying from fragmentary to fairly extensive pertain to six species:

D. agilis (F. Smith) and *D. buddha* (Cameron) from the Oriental Region and *D. barkeri* (Arnold), *D. bipunctatus* Lep. & Brullé, *D. kibonotensis* Cameron and *D. stevensoni* (Arnold) from the Afrotropical Region.

The present paper is an account of some aspects of the ethology of a seventh species, *D. westermanni* (Dahlbom) and is the ninth in a series of publications dealing with the ethology of certain solitary wasps occurring at Hilton, a farm situated 18 kilometres WNW. of Grahamstown (33° 19′S., 26° 32′E.) in the Albany Division of the Eastern Cape Province of South Africa.

In all, five species of *Dasyproctus* have been recorded from Hilton. These are: *D. bipunctatus* Lep. & Brullé, *D. dubiosus* (Arnold), *D. immitis* (Saussure), *D. ruficaudis* (Arnold) and *D. westermanni* (Dahlbom). With respect to *D. bipunctatus* three colour forms are present which by some authors (e.g. Leclercq, 1958) are accorded subspecific rank: *D. b. bipunctatus* Lep. & Brullé, *D. b. lugubris* (Arnold) and *D. b. simillimus* (Smith). *D. b. simillimus* (Smith) is listed as a good species by Bohart and Menke (1976). Foraging records are given for all five species.

DESCRIPTION OF NESTING SITES

Of the five species only *D. westermanni* was observed engaged in nesting activities. Nests were situated up off the ground within galleries hollowed out by the wasp in green subvertical pithy inflorescence stems of *Urginea altissima* (Liliaceae) growing on rising clayey ground immediately to the east of the New Year's River in dwarf karroo scrub characterised by *Pentzia incana* (Compositae) (Fig. 1).

Evidence of nesting by *Dasyproctus* was also found in the inflorescence stems of two species of *Gasteria* (Liliaceae) and in the stems of *Berkheya decurrens* (Compositae), all growing on clayey soil in various situations within thorn scrub. As the nests examined in these plants were all old ones from which the wasps had emerged it was not possible to establish the identity of the builders. It is possible, however, that these were the nests of one or more of the other species of *Dasyproctus*.

FLIGHT PERIOD

The flight periods of all five species at Hilton and elsewhere in the vicinity of Grahamstown fall largely between the beginning of October and the end of March though isolated individuals have been found both earlier and later in the summer. *D. westermanni* is known from November to mid March and was found nesting in *Urginea* at Hilton during December and January.

FLOWERS AND YOUNG GROWTH VISITED BY ADULT WASPS

At Hilton two species of *Dasyproctus* were collected on the yellow flowers of *Acacia karroo* (Leguminosae): *D. b. bipunctatus* (6.i.1977, 1 female and 13.i.1977, 1 male) and *D. dubiosus* (29.xii.1976, 2 males and 6.i.1977, 1 male). The young foliage of *A. karroo* was visited by *D. westermanni* (6.xii.1976, 1 female).

At Strowan, a farm lying between Hilton and Grahamstown, the yellow flowers of *Berkheya heterophylla* (Compositae) were visited by *D. b. bipunctatus* (12.x.1972, 4 females, 16.x.1972, 4 females, and 25.x.1972, 7 females) and by *D. b. simillimus* (16.x.1972, 1 female); at Belmont Valley, lying 25 kilometres SE. of Hilton, the yellow flowers of *Foeniculum vulgare* (Umbelliferae) were visited by *D. b. bipunctatus* (26.i.1970, 1 female), by *D. b. simillimus* (26.i.1970, 1 female, 5.ii.1970, 1 female, 28.iv.1970, 1 female), by *D. dubiosus* (20.i.1970, 1 male), by *D. immitis* (25.i.1970, 1 female) and by *D. ruficaudis* (20.i.1970, 1 female); at the Koonap River

Fig. 1. Hilton, 4.i.1978. Inflorescences of *Urgenea altissima* (Liliaceae) in dwarf karroo scrub characterised by *Pentzia incana*.

near Adelaide, 70 kilometres N. of Hilton, the greenish-yellow flowers of *Zizyphus mucronata* (Rhamnaceae) were visited by *D. b. bipunctatus* (1 female) and by *D. immitis* (1 male) (both 20–22.xii.1972).

IDENTIFICATION OF THE PREY

Prey was obtained only from *D. westermanni* and as in all species of *Dasyproctus* consisted of small flies. It appears that *D. westermanni* is an opportunist with respect to the flies it utilizes as prey and may take any suitably sized fly which it finds in its hunting area. All cells in which prey flies were in a condition allowing identification were found to have been provisioned with several species of flies though in some the preponderance of one or other species indicated that the wasp may, upon finding a ready supply of that species, have concentrated upon it or upon its source.

Seven dipterous families were represented amongst the prey found in nests examined during January, 1978. Details are listed below.

Simuliidae		
Simulium sp.	2,0 mm long	13 females, 4 males
Stratiomyidae		
1 sp.	5,2 mm long	10 specimens
Bombyliidae		
Bombylius delicatus Wied.	4,0 mm long	1 female, 1 male
1 sp. of Cyrtosiinae	1,4 mm long	3 specimens
1 sp. other	3-4 mm long	1 female, 1 male
Empididae		
1 sp.	3,0 mm long	1 male
Syrphidae		
1 sp.	3,6 mm long	1 specimen
Otitidae		
species A	2,2 mm long	3 females, 10 males
species B	2,4 mm long	1 male
Chamaemyiidae		
1 sp.	3,4 mm long	3 specimens

The presence amongst the prey of flies such as the Simuliidae and Stratiomyidae and possibly also the Otitidae may indicate that the chief hunting area of *D. westermanni* was in fairly close proximity to the nests, namely in the riverine vegetation fringing the New Year's River. Other flies such as the less commonly taken Bombyliidae were probably captured in the tract of open dwarf scrub nearer the nests and between the latter and the riverine vegetation.

DESCRIPTION OF THE NEST

The completed nest of *D. westermanni* consists of a circular entrance hole of 4 mm diameter bitten through the side of the green inflorescence stem of *Urginea altissima* (Fig. 2) and giving access to an ascending and a descending gallery of 4–4,5 mm bore hollowed out of the pithy centre of the stem. Both galleries are divided serially into a number of cells (Figs 3a, b, c and d).

A total of twenty-two nests of *D. westermanni* within nineteen subvertical stems was examined. Seventeen of the utilized stems each contained a single nest, one stem contained two nests and another contained three nests. The entrance hole to the nest was situated from 500–1 070 mm (average 770 mm) above the ground and in all but one instance was sited below the level of the lowermost elements of the cylindrical raceme which occupies the terminal two-fifths of the inflorescence stem. Heights above the ground of the bottom and the top of the raceme ranged from 820–1 360 mm (average 1 040) and from 1 550–2 100 mm (average 1 800 mm) respectively.

Of the twenty-two nests, twenty had completed ascending galleries and of this latter number nine had in addition completed descending galleries. The ascending galleries ranged in length from 42–114 mm (average 86 mm) and the descending galleries ranged in length from 78–122 mm (average 91 mm).

In length the serially arranged cells including the pithy plug sealing each ranged from 8–14 mm (average of 71: 11,2 mm), the thickness of the plugs or cell partitions being 1,5–2,0 mm. The number of cells in fully utilized ascending galleries ranged from five to eight; the only fully utilized descending gallery found contained seven cells. The maximum number of cells found in any one nest (the only one which had both galleries fully utilized and intact) was fourteen.

Fig. 2. Hilton, 4.i.1978. Portion of inflorescence stem of *Urgenea altissima* (Liliaceae) showing entrance hole of nest of *Dasyproctus westermanni* (x circa 0,5).

Neither gallery is filled with cells right up to the level of the entrance hole, the plug of the outermost cell in each case being some distance removed from it. In the above fourteen-celled completely utilized nest a vestibular space, 16 mm in length, was left between the two outermost cells. The nest entrance opening into this vestibule was not sealed.

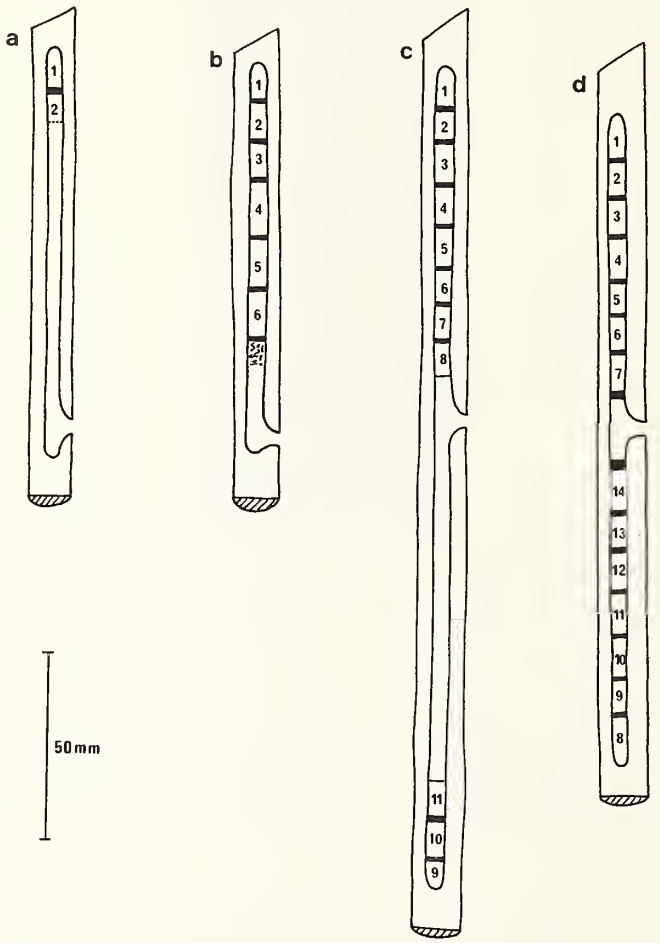
METHOD OF CONSTRUCTION OF THE NEST, OVIPOSITION AND PROVISIONING

A nest entrance hole having been bitten through the wall of the inflorescence stem and the pith centre having been reached, the wasp hollows out its galleries by biting off and removing the pith. Some at least of this pithy material appears, however, to be retained within the nest for the purpose of constructing the cell partitions.

The ascending gallery is invariably the first to be hollowed out and only after the full number of cells destined for this gallery has been constructed within it is a start made with the hollowing out of the descending gallery (Figs 3a, b, c and d).

Each cell is provisioned with a relatively large number of prey which are closely packed and are orientated to face the inner (i.e. blind) end of the cell. The prey is alive but partially paralysed. Two fully provisioned and sealed cells, the contents of which had neither been consumed nor had become mouldy, contained fourteen and twenty-six flies respectively.

It is not clear on which prey, in order of provisioning, oviposition takes place but it appears not to be on the first. A *D. westermanni* egg was found in each of the above two cells—in the first it was attached to a *Bombylius delicatus* Wied. (4 mm long male), one of the first three prey



Figs 3a, b, c, and d. Plans of nests of *Dasyproctus westermanni* in inflorescence stems of *Urginea altissima* in longitudinal section.

to be introduced into the cell; in the second it was attached to an Otitid (2,4 mm long male) situated about in the middle of the cell. Two partially provisioned and still open cells containing three and ten prey respectively were found in which no egg had yet been laid.

The egg of *D. westermanni* is white, very strongly curved and 1,9 mm in length. It is glued to the underside of the prothorax of the fly anterior to the legs—that is more or less in the neck region, the fly's head being pushed forwards to accommodate the anterior end of the egg in the space between the prothorax and the underside of the head. The egg extends laterally or postero-laterally across the ventral surface of the fly to either left or right. The newly hatched larva is orientated in the same way (Fig. 4).

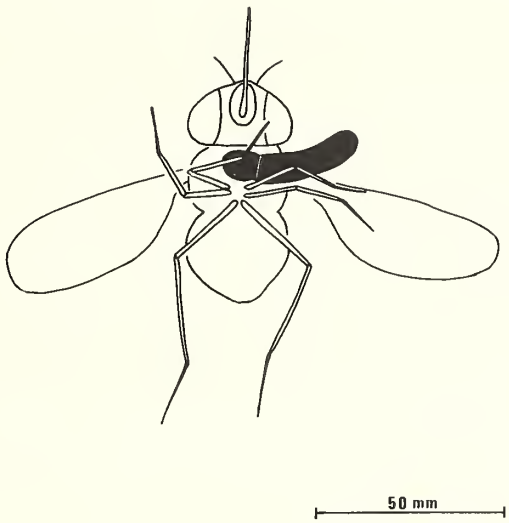


Fig. 4. Diagrammatic representation of bombyliid fly showing position of newly hatched feeding larva of *Dasyproctus westermanni*.

LIFE HISTORY

Due to the fact that in the nests examined all but two of the completed cells contained either provision and wasp young that had gone mouldy or cocoons containing spinning larvae or pupae, little information concerning the life history of the species could be obtained. The two eggs found on prey on 4.i.1978 and 10.i.1978 hatched on 5.i.1978 and 14.i.1978 respectively. Neither larva survived.

All twenty-six male and thirteen female wasps reared from the examined nests emerged during the period 10–27.i.1978. Development from egg to adult appears to be very rapid in the generation reared in *Urginea* stems, probably owing to the short time during which these stems are suitable for the nesting of *Dasyproctus*. It is probable that there is at least one other annual generation of the species but its nesting site has not been identified.

The silken cocoon of *D. westermanni* is brown and papery, 9 mm long and with a maximum width of 3,4 mm. Its anterior end is rounded whilst the posterior end has incorporated in it the

dark brown meconium voided by the post-spinning larva. Adhering to the meconium at the hind end of the cocoon are the prey remains—wings, legs and other uneaten fragments which the mature larva on cleaning the cell prior to the start of cocoon spinning has concentrated behind it at one end of the cell.

The orientation of the cocoons and of the pupae within them is unusual and of interest in *D. westermanni* in that it appears to be governed by gravity rather than by the position of the nest opening as indicated to the spinning larva by the curvature of the cell partitions. Thus in all cells, whether constructed in ascending or descending galleries, the anterior end of each cocoon is orientated upwards, facing away from the ground. Thus in the first-constructed ascending gallery the anterior end of each cocoon is directed away from the nest entrance and the meconium and prey remains are between each wasp and the outer partition of its cell. In the later-constructed descending gallery, however, the orientation normally practised by wasps nesting serially in tubes is present—the anterior end of each cocoon is directed towards the nest entrance and the meconium and prey remains are between each wasp and the inner or blind end of its cell.

PARASITES AND OTHER ASSOCIATED INSECTS; MOULD

Three distinct categories of associated insects occur in *D. westermanni* nests: a parasitoid of *D. westermanni* itself, a species cleptoparasitic with respect to the stored provision, and at least one species possibly cleptoparasitic with respect to the nest galleries.

A 4,2 mm long dark metallic green and reddish bronze *Perilampus* sp. (Hymenoptera: Chalcidoidea: Perilampidae) was found to be a parasitoid in nine cells distributed over five nests studied during January, 1978. Previously, during the summer of 1974 two specimens of the parasite were reared from the same host. The *D. westermanni* larva is attacked after it has spun its cocoon in the normal manner but before it has changed into a pupa. Each parasitized *D. westermanni* cocoon yields a single perilampid. The emergence of the adult parasitoid from the host cocoon is timed to coincide within a few days with the emergence of adult *D. westermanni* from adjacent cells in the nest.

A 2,6 mm long yellowish-brown species of Phoridae (Diptera) was found to be a cleptoparasite in one nest. When opened on 18.i.1978 it was found that in both the ascending and descending galleries all the cell partitions, bar those sealing the two outermost cells (i.e. those closest to the nest entrance), had been broken down and that the provision stored in the breached cells had been almost completely devoured. In the ascending (older) gallery the cleptoparasites had already pupated, thirteen puparia being cemented in a group to the gallery wall at the end nearer the nest entrance. In the descending (newer) gallery were twenty-four as yet unpupated maggots. These were transferred to a glass vial where they pupated on 20.i.1978. Flies from both galleries emerged from their puparia towards the end of February.

A species of *Trypoxylon* (Sphecidae) which utilizes pre-existing cavities for its nesting was found in three instances to have taken over the galleries excavated by *D. westermanni*. Though it cannot with certainty be stated that actual competition for the excavated galleries took place between *Trypoxylon* sp. and *D. westermanni* it does appear that this may have been the case and that the galleries taken over by the former were ones being used by the builder, not abandoned ones. Thus all three *D. westermanni* galleries (which were ascending ones) were either in the process of being hollowed out or of being provisioned. One of the galleries had not yet reached its final length as evidenced by the fact that its blind end had not yet been rounded off as is the case with completed galleries; the second gallery had been completed but nesting by *D. westermanni* had not yet commenced; the third gallery had had three cells completed by *D. westermanni*, the point of succession being during the provisioning of the fourth cell.

Other insects found in *D. westermanni* galleries were females of *Heriades ?spiniscutis* (Cameron) (Megachilidae) (three instances) and a female of *Allodapula variegata* (Smith) (Anthophoridae) (one instance). The *D. westermanni* galleries used by these bees were clearly

abandoned ones, no recently provisioned cells being present. It is possible that the bees were merely sheltering in the galleries but it cannot be ruled out that they might have commenced nesting had they been left undisturbed. If they had, they would clearly not have been competitors for the galleries as it appears that *Trypoxylon* sp. may have been.

The previously mentioned old nesting galleries of *Dasyproctus* sp. in *Gasteria* inflorescence stems were found to have been utilized for nesting by *Trypoxylon* sp., *Heriades ?spiniscutis* (Cameron) and *Allodapula variegata* (Smith) whereas the galleries in *Berkheya decurrens* stems had been utilized by *Heriades ?spiniscutis* (Cameron) and *Allodape* sp. (*rufogastra* Lep. & Serv. or *exoloma* Strand) (Anthophoridae).

Mould attacking the stored provision is of common occurrence in the cells of *D. westermanni* and effects a larger number of cells than do parasitoids and predators together. Details are given in Table 1 of the nesting success and mortality rate due to various causes in one hundred completed cells examined.

TABLE 1.

Nesting success and mortality rate due to various causes in one hundred completed cells of *D. westermanni* examined.

Total No. of completed cells*	No. of cells attacked by mould	No. of cells attacked by Perilampidae	No. of cells attacked by Phoridae	No. of cells attacked by other insects	No. of cells in which pupae died for unknown reasons	No. of cells from which *D. westermanni* adults emerged
100	30	9	13	1	8	39

*Excluding two cells containing newly hatched larvae which did not survive examination.

REVIEW AND DISCUSSION OF THE ETHOLOGY OF THE GENUS DASYPROCTUS

As already noted, published biological accounts varying from fragmentary to fairly extensive pertain to six species: *D. agilis* (F. Smith) and *D. buddha* (Cameron) from the Oriental Region and *D. barkeri* (Arnold), *D. bipunctatus* Lep. & Brullé, *D. kibonotensis* Cameron and *D. stevensoni* (Arnold) from the Afrotropical Region.

D. agilis and *D. buddha* were both recorded nesting in stems of Gramineae (sorghum and solid dead stems of *Coelorrachis* respectively) in which their cells were provisioned with Otitidae (mainly), Muscidae and Syrphidae and with Chloropidae and Otitidae respectively (see Bohart and Menke, 1976: 419).

Of the African species, *D. bipunctatus* Lep & Brullé (including its colour forms *simillimus* (Smith) and *lichtenburgensis* (Arnold)) is the best known. The species has been found by several observers to be restricted in its nesting to the inflorescence stems of the monocotyledonous families Amaryllidaceae, Iridaeceae and Liliaceae. The most comprehensive account of the nesting of this species (*D. bipunctatus sensu stricto*) is that by Bowden (1964: 425–437) who found it nesting near Kampala (Uganda) in the flowering stems of *Kniphofia* and *Aloe* spp. (Liliaceae), *Gladiolus* sp. (Iridaceae) and *Hippeastrum* (an American genus) (Amaryllidaceae). Six families of Diptera were represented amongst the prey, namely Chloropidae, Lonchaeidae, Muscidae, Simuliidae, Sphaeroceridae and Trypetidae. Most prey were *Atherigona* species (Muscidae: Coenosiinae). On the basis of the prey taken Bowden theorized that *D. bipunctatus* forages primarily over grass. *D. bipunctatus* was also found nesting in gladiolus stems near

Salisbury (Rhodesia, now Zimbabwe) by Cuthbertson (1937: 28–31). That author listed the prey as belonging to the Anthomyiidae, Sarcophagidae, Sapromyzidae, Syrphidae and Tachinidae.

D. bipunctatus simillimus, in the Western Cape Province at least, appears to nest by preference in the green flowering stems of *Watsonia* sp. (Iridaceae). The present author found it nesting commonly in such stems at Kirstenbosch (Cape Peninsula) on 22.xi.1964 and A. J. Hesse of the South African Museum (unpublished notes) recorded its prey found in *Watsonia* stems at an unnamed locality as Otitidae.

It seems that the "watsonia wasp" described by Skaife (1953: 338) is referrable to *D. bipunctatus simillimus* (Smith) and that the name, *Dasyproctus capensis* Skaife, given it in the above publication may be considered a hitherto overlooked and therefore new synonym of the former. In the new (1979) edition of Skaife's book the revisers have come to the same conclusion concerning the identity of the wasp in question and have substituted the name *Dasyproctus bipunctatus* for *Dasyproctus capensis*.

D. bipunctatus lichtenburgensis at Tanga on the East African coast was found to provision its cells in stems (unspecified) almost entirely with Otitidae (= Ortalidae) and to be subject to parasitization by a species of Mutillidae (Carpenter, 1942: 48).

In contrast with the above considered species with respect to the stems utilized for nesting are *D. barkeri, D. kibonotensis* and *D. stevensoni* all of which utilize dicotyledonous plants.

D. barkeri, described from Durban, Umgeni and Malvern in Natal, was recorded by Arnold (1927: 127) as "nesting in dry stems of the Kaffir-boom" (*Erythrina* sp.) (Leguminosae).

D. kibonotensis, studied as was *D. bipunctatus* at Kampala (Uganda), was found by Bowden (1964: 425–437) to be restricted to the stems of *Rubus sp.* (Rosaceae) for the excavation of its nests. The prey encompassed five families, namely Lonchaeidae, Muscidae, Platystomidae, Tachinidae and Trypetidae. Most prey were *Trirhithrum coffeae* Bezzi (Trypetidae), a dominant of the dipterous fauna of robusta coffee. On the basis of the prey taken Bowden theorized that this species forages in understory shrubs. Recorded parasites were Miltogramminae.

D. stevensoni in West Cameroon was found nesting in a stem of *Conyza bonariensis* (Compositae) in which the cells were provisioned with Milichiidae (Michener, 1971: 407).

As far as can be established from a consideration of so relatively few species, the nesting of *Dasyproctus* appears to present great uniformity in its basic features and the nesting of *D. westermanni* at Hilton here described appears, with the possible exception of pupa orientation to be dealt with below, to be very similar to the general pattern.

All the species nest up off the ground in galleries which they themselves excavate in the pith of usually live green plant stems. The serially arranged cells are separated by pith partitions and are provisioned with numerous small adult Diptera.

In *D. bipunctatus, D. kibonotensis* and *D. westermanni* the nest entrance is on the side of the stem and the nest galleries proceed in both directions through the stem, the gallery directed towards the stem apex (that is the ascending gallery) being completed first in all three species. Details of the nest plans of the two Oriental species and of *D. barkeri* are not available. With respect to *D. stevensoni* it is stated that the only nest examined was damaged in its collection but that apparently the entrance was at the broken end of the stem, rather than in the side of the stem. Confirmation of this apparently unusual nest form is required.

It is in the orientation, within the galleries, of the cocoons and of the pupae within them that *D. westermanni* differs from the other two species for which the orientation has been recorded. Thus Bowden (1964: 429 and 430) recorded both *D. bipunctatus* and *D. kibonotensis* larvae as pupating with their heads towards the entrance hole of the nest. In *D. westermanni*, as already described, all pupae are orientated with their heads away from the ground and towards the apex of the flower stalk, so that only those larvae in the descending gallery have their heads towards the nest entrance.

Using the trends shown by the reviewed species some speculation is possible concerning the

identity of the builders of the old *Dasyproctus* nests found at Hilton in the inflorescence stems of *Gasteria* spp. (Liliaceae) and in the stems of *Berkheya decurrens* (Compositae). All the nests concerned had side entrances and both ascending and descending galleries. In the case of the nests in *Gasteria* it is not impossible that these were the work of *D. westermanni* but the fact that these plants were in a vegetation type different from that in which occurred the *Urginea* frequently utilized by *D. westermanni* may indicate the involvement of a different species. The nature of the inflorescence stalk utilized may indicate that *D. bipunctatus* might have been the species concerned. In the case of the nests in *Berkheya decurrens* it is probably correct to consider that they were the work of neither *D. westermanni* nor *D. bipunctatus* as all records indicate that these two species are restricted to monocotyledonous inflorescence stalks and that no species nests in both monocotyledonous and dicotyledonous plants. The nests in *Berkheya* are thus probably those of one of the other three *Dasyproctus* species recorded from Hilton, namely *D. dubiosus, D. immitis* and *D. ruficaudis*.

It is clearly of survival value to all species of *Dasyproctus* if the herbaceous plant stems in which they make their nests are protected in some manner or other from being eaten by large herbivores. With respect to those plants found to be utilized by *Dasyproctus* at Hilton it can be shown that all are so protected at least from the herbivores now common there, namely cattle, sheep and goats. Thus *Urginea altissima,* which grows freely exposed in the dwarf karroo scrub and which is very conspicuous when flowering on account of the long inflorescence stalks, is avoided by the above animals. This is undoubtedly due to the plant's toxicity to stock resulting from the presence in all parts of the plant of a glucoside having a digitalis action (see Watt & Breyer-Brandwijk, 1962: 717–718). It has furthermore been observed by the author that *Urginea altissima* is also left untouched under the more natural conditions of the Addo National Elephant Park where the herbivores in the portion of the park examined are buffalo, eland, hartebeest and a variety of smaller buck.

The *Gasteria* spp. at Hilton appear to be innocuous to herbivores, no indication to the contrary being found in Watt & Breyer-Brandwijk. However, these plants are found at Hilton only in the shelter of thorny shrubs such as *Acacia karroo* where they are thus physically protected from stock. *Berkheya decurrens* on the other hand grows in the open, often on disturbed ground, but is well protected from herbivores by the spinose projections of the leaves and involucral bracts.

Stems utilized elsewhere by *Dasyproctus* species may at least in some instances also be shown to be immune from destruction by herbivores. Thus the trailing stems of *Rubus* sp. (used by *D. kibonotensis*) are undoubtedly protected by the sharp prickles with which they are armed. With respect to *Watsonia* spp. (used by *D. bipunctatus*) it has been observed near Grahamstown that buck readily eat the actual flowers but not the inflorescence stalks (Jacot-Guillarmod, *pers. com.*).

It is apparent therefore that there is no consistency in the nature of the protection offered by the plants in which *Dasyproctus* nests as it may be due to their physiological or morphological nature or to their protected habitat.

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REFERENCES

Arnold, G. 1927. The Sphegidae of South Africa. Part 8. *Ann. Transv. Mus.* **12** (2): 55–131.
Bohart, R. M. and Menke, A. S. 1976. *Sphecid wasps of the world: a generic revision*. Berkeley: University of California Press.
Bowden, J. 1964. Notes on the biology of two species of *Dasyproctus* Lep. and Br. in Uganda (Hymenoptera: Sphegidae). *J. ent. Soc. sth. Afr.* **26** (2): 425–435.
Carpenter, G. D. H. 1942. Note on the bionomics of the sphegid wasp *Dasyproctus bipunctatus* Lepeletier (Hym.). *Proc. R. ent. Soc. Lond.* (A) **17** (4–6): 48.
Cuthbertson, A. 1937. Biological notes on some diptera in Southern Rhodesia. *Proc. Trans. Rhod. scient. Ass.* **35** (1): 16–34.
Leclercq, J. 1958. Hymenoptera Sphecoidea (Sphecidae II. Subfam. Crabroninae). *Explor. Parc. natn. Upemba Miss. G. F. de Witte* Fascicule **45:** 1–114.
Michener, C. D. 1971. Notes on crabronine wasp nests. *J. Kans. ent. Soc.* **44** (3): 405–407.
Skaife, S. H. 1953. *African insect life*. Cape Town: Longmans Green & Co.
Skaife, S. H. 1979. *African insect life*. (2nd ed. revised by J. Ledger and A. Bannister.) Cape Town: Struik.
Watt, J. M. and Breyer-Brandwijk, M. G. 1962. *The medicinal and poisonous plants of southern and eastern Africa*. Edinburgh: Livingstone.

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