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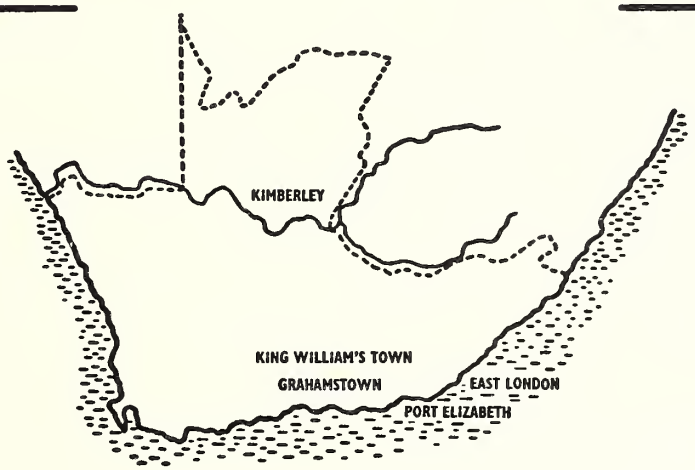

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Ethological notes on Holotachysphex turneri (Arnold) (Hymenoptera: Sphecidae: Larrinae) in the Eastern Cape Province of South Africa

by

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INTRODUCTION

The genus *Holotachysphex* de Beaumont, 1940 (= *Phytosphex* Arnold, 1951 and *Haplognatha* Gussakovskij, 1952) consists of six species found in Africa, Madagascar, the eastern Mediterranean area, southwestern USSR, and the Oriental Region. Most of these species were originally included in the genus *Tachysphex* Kohl. According to Bohart and Menke (1976: 282) *Tachysphex* and *Holotachysphex* are similar in general facies but the presence of a number of basic differences warrants their separation.

The only hitherto published observations on the nesting of *Holotachysphex* are those by Brauns concerning *H. turneri* (Arnold) at Willowmore in the Cape Province of South Africa. According to Arnold (1923: 166), reporting upon Brauns' observations, this species "nests in hollow stems of *Aloe*, *Datura*, etc., lying on the ground; the partitions between the cells being formed of earth and little pebbles". The prey was not recorded. The statement that the stems were lying on the ground indicates that they were dried out. In the case of the *Aloe* the hollow stem is most likely that of an old inflorescence.

In view of the paucity of biological information on the genus it is considered justified to publish the present notes on the nesting of *H. turneri* (Arnold).

THE NESTING OF HOLOTACHYSPHEX TURNERI (ARNOLD)

Information on the nesting of *H. turneri* (Arnold) was obtained as a result of the utilization for nesting purposes by this wasp of five trap-nests of the types described by Krombein (1967 and 1970). All the trap-nests concerned were in the field 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. Hilton is about 270 kilometres E. of Willowmore, the site of Brauns' observations. An account of the climate and vegetation of Hilton has previously been given (Gess and Gess, 1974: 191–192).

All five trap-nests utilized by *H. turneri* were 165 mm long and had a bore of 6,4 mm. All were suspended horizontally from living branches of small trees, one from *Salix mucronata* at a height of 2 metres above the ground and the other four from *Acacia karroo* at a height of a little above 1 metre. Trap-nest A (that on *Salix*) was taken in from the field on 11.i.1974, trap-nests B, C, D and E on 9.xii.1975, 29.xii.1976, 3.i.1977 and 4.ii.1977 respectively, each trap-nest having been utilized by the wasp within the preceding three or four days.

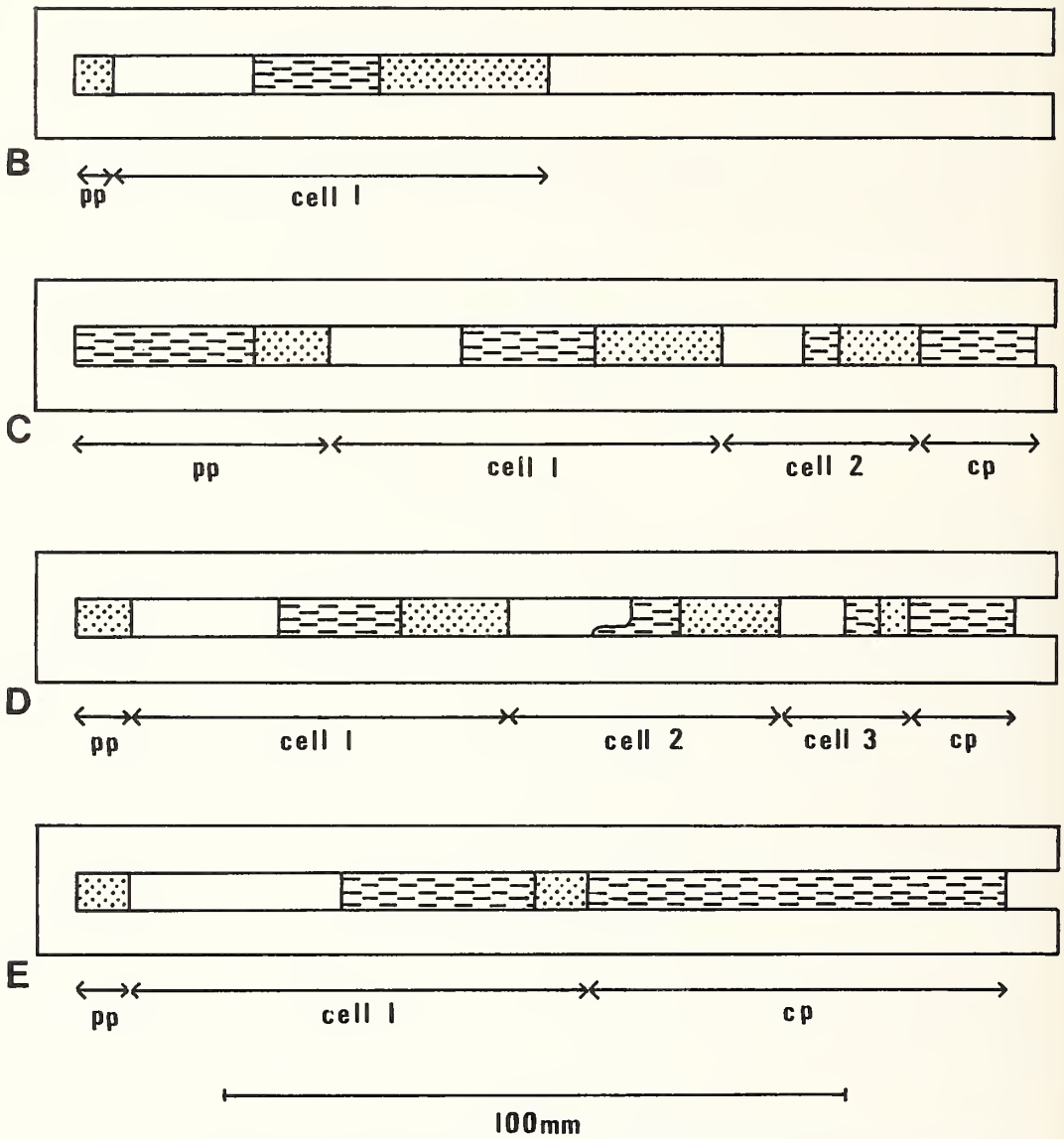

Fig. 1. *Holotachysphex turneri* (Arnold). Plans of nests B–E showing preliminary plugs (pp), cells, and closing plugs (cp) as well as nature of nesting materials: clods of clayey earth (stippled) and coarse detritus (dashed).

Due to the disarrangement of the nesting materials in nest A resulting from a mishap during the splitting open of the trap-nest no accurate measurements were possible and the account of nest architecture is consequently based mainly upon nests B–E (see Fig. 1) all in trap-nests with perspex windows and wooden lids.

H. turneri was found to have constructed a preliminary plug at the inner end of all five trap-nests, no empty space being left between this plug and the blind end of the boring. In nests B, D and E the plug consisted of small clods of clayey earth and was 6, 9 and 8 mm in thickness respectively. In nest C the preliminary plug was much more extensive and consisted of an initial 29 mm of coarse detritus (all derived from *Acacia* and consisting of small bits of bark, short lengths of twigs, seeds and leaflets), available to the wasp on the ground beneath the trap-nests, followed by 12 mm of the usual small clods of clayey earth. Four nests were completed of which nests A and E contained one cell each, nest C two cells and nest D three cells. Nest B was incomplete and contained a single cell. Each cell was capped by a partition consisting of two parts, an inner part composed of detritus and an outer part consisting of clods of earth, the whole plug thus being of the same composite nature as the preliminary plug of nest C. The seven capped cells were 21–75 mm long (mean 53 mm). The partitions closing these cells were 10–49 mm thick (mean 32 mm). The thicknesses of the detritus and of the earth in the partitions were 5–31 mm (mean 16 mm) and 5–29 mm (mean 16 mm) respectively. The closing plugs sealing the completed nests were composed of coarse detritus. The closing plugs of nests C, D and E were 19, 17 and 68 mm thick respectively.

The prey in all five nests consisted of nymphs of a single species of short-horned grasshopper belonging to the family Pyrgomorphidae (Acridoidea) and tentatively determined as *Pyrgomorphella* sp. by the author. A sample was submitted to Dr H. D. Brown who replied that the nymphs "are so small that they are almost impossible to determine with certainty, they could, for example, belong to *Pyrgomorphella*, as you suggest, or they could belong to *Pyrgomorpha* itself".

The number of prey stored in each cell was dependent upon size and varied from four individuals (9–10 mm long with a combined mass of 68 mg) in nest E and five individuals (11–12 mm long) in nest A to thirty-two individuals (3,2–6,7 mm long with a mean length of 4,5 mm) in nest B.

The prey were without exception stored facing the blind end of the trap-nest. Although paralysed, slight twitching movements indicated that the prey grasshoppers were alive. *H. turneri* eggs were found attached to prey in cells 2 and 3 of nest D and feeding larvae were found in cell 1 of that nest, in both cells of nest C and in the cells of nests A and B. No egg or larva was found on any of the prey in nest E. In all cases the anterior end of the egg or the mouth of feeding larva was sited just behind the base of the left prothoracic coxa. The length of the egg or later the body of the larva lay transversely across the thoracic sterna and extended beyond the prey on the right. In the five cells of nests C and D the grasshopper bearing the wasp egg or larva was positioned on its back; other prey in the cells by contrast were positioned on their venters or sides. In all five cells the egg- or larva-bearing prey was situated at the inner end of the cell and it appears that oviposition is probably on the first prey to be introduced into the cell.

Developmental data are limited. However, from the dates of the major events in the life-history given in Table I it appears that about three days elapse between oviposition and egg hatching and that the larva grows to maturity within about six to eight days. Available evidence indicates that the species is probably univoltine.

The cocoon is surrounded by fine silken threads attached to the walls of the cell and in places to the cocoon itself and forming a thin net-like envelope or shroud to which in places adhere fragments of prey exoskeleton, clods of earth and other debris from which the cocoon itself is thus kept isolated. The cocoon is oval about 10 mm long by about 4 mm wide, at its widest, and tapers slightly to the rounded ends, the anterior one being more bluntly rounded than the

TABLE I. Developmental dates for *Holotachysphex turneri* (Arnold) in trap-nests from Hilton.

Trap-nest	Cell	Date of oviposition	Date of egg hatch	Date of larval maturity	Date of cocoon spinning	Date of adult emergence and sex
A	1	?	pre 11.i.74	16.i.74	18.i.74	(died)
B	1	on or pre 9.xii.75	12.xii.75	(died)	—	—
C	1	?	on or pre 29.xii.76	4.i.77	5.i.77	7.ii.78 (♀)
	2	?	on or pre 29.xii.76	5.i.77	6.i.77	6.ii.78 (♀)
D	1	?	on or pre 3.i.77	11.i.77	11.i.77	6.ii.78 (♀)
	2	?	4.i.77	11.i.77	11.i.77	(died, cocoon empty)
	3	probably 2 or 3.i.77	5.i.77	11.i.77	12.i.77	(died, cocoon contained fully developed ♂)
E	1	(no egg or larva found in cell)				

posterior. The walls of the cocoon are composed of fine sand grains, silk and an oral secretion to form a hard shell with a granular but glazed surface.

The identification of the nests as those of *H. turneri* was made possible by the capture on 3.i.1977 of a nesting female which was observed carrying small clods of earth into a newly positioned trap-nest. The earth which was being collected on the ground beneath the branch from which the trap-nest was suspended was carried up to the nest in flight and was being used by the wasp in the construction of the preliminary plug. This female is believed to have been the builder of the nests in trap-nests C (taken in on 29.xii.1976) and D (taken in on 3.i.1977) as both these had in their turn occupied the identical position in the same trap-nest bundle as did the trap-nest being worked upon by the female when she was captured. On 3.i.1977 less than an hour had elapsed between the removal of trap-nest D and the initiation of the preliminary plug in its replacement.

DISCUSSION

The genus *Holotachysphex* was described by de Beaumont (1940: 179) as a subgenus of *Tachysphex* Kohl in which genus five of the six species now placed in *Holotachysphex* were

originally included. Bohart and Menke (1976: 282) state that although the two taxa are similar in general facies and are allied with respect to the form of the genitalia, male subgenital plate, and the pair of supra-antennal tubercles, there are a number of basic differences that warrant the recognition of *Holotachysphex* as a genus. Among these differences, according to the above authors, are: the presence in *Holotachysphex* of lateral carinae on terga I and II, the absence of a foretarsal rake, the absence of a pygidial plate, the generally dense punctation of the body, and the velvety sternal patches of the male.

Other than Brauns' observations (Arnold, 1923: 166) that *H. turneri* (Arnold) nests in hollow stems lying on the ground, nothing has hitherto been published regarding the biology of any *Holotachysphex* species. In contrast, a considerable number of papers on the biology of *Tachysphex* species have appeared, important ones being listed by Bohart and Menke (1976: 270). A useful summary of the known biology of the Palaearctic species has been provided by Pulawski (1971: 16–20). The present observations on the nesting of *H. turneri* enable some basic facets of the biology of this species, as a representative of *Holotachysphex*, to be compared with the biology of species of *Tachysphex*.

The most notable differences in the nesting behaviour shown by *H. turneri* and species of *Tachysphex* pertain to the situation and nature of the nest and to the method employed by the wasp in the manipulation of nesting materials. Thus, with the exception of one species which uses abandoned *Philanthus* burrows or ant tunnels for its nest, all *Tachysphex* species as far as is known dig their nests in the soil. In contrast, *H. turneri*, as has been shown, nests in pre-existing cavities—hollow plant stems and old inflorescences lying on the ground (and in trap-nests 1–2 metres above the ground). Directly associated with these ethological differences are two of the basic morphological differences that according to Bohart and Menke warrant the separation of *Holotachysphex* from *Tachysphex*, namely the presence or absence in the female of a foretarsal rake and of a pygidial plate. Excavation of the nest in the soil by *Tachysphex* species is effected by the loosening of the earth by the mandibles followed by the removal of the loosened earth by the well-developed foretarsal rakes which are usually composed of long, fine, close-set, flexible spines. These tarsal rakes are used also in reopening temporarily closed nests and in sealing nests.

The pygidial plate in *Tachysphex* is believed to aid in nest excavation by acting as an earth pusher. *H. turneri* which nests in pre-existing cavities in horizontal or near horizontal plant stems neither excavates earth nor pushes earth and in common with twig-nesters in other genera of the family Sphecidae lacks a foretarsal rake and a pygidial plate in consequence. As far as is known manipulation of the nesting materials (clods of clayey earth and coarse detritus) by *H. turneri* is effected by the mandibles only.

In marked contrast to the above differences with respect to the nature of the nest and the method employed in the manipulation of nesting materials is the conformity shown by other facets of nesting behaviour, comparison being on a level of gross detail. Thus in both *H. turneri* and *Tachysphex* species the nest is prepared before hunting takes place—that is, in the former a preliminary plug is introduced into the pre-existing nesting cavity and in the latter a burrow is excavated in the ground. In both *H. turneri* and *Tachysphex* species orthopteroid prey is utilized: in the former Pyrgomorphidae (Acridoidea); in the latter, according to the species, Acridoidea, Tettigonioidea, Grylloidea (all Orthoptera), Mantidae and Blattidae (both Dictyoptera). In both, the nests may be single-celled or multicellular and each cell is provisioned with an indefinite number of prey: one to eight are recorded for *Tachysphex* species and four to thirty-two for *H. turneri*. Similarly, in both the prey is incompletely paralysed and twitching movements of the antennae, mouthparts and tarsi take place. Furthermore, the egg is positioned on the prey in the identical manner in *H. turneri* and in those species of *Tachysphex* which like the former utilize Acridoidea, namely, transversely across the underside of the prey's body with the anterior end attached immediately behind the base of one of the fore-legs. Whereas in *H. turneri* oviposition

appears to be on the first prey to be introduced into the cell, in *Tachysphex* the prey oviposited upon appears to vary according to the wasp species. Thus Pulawski (1971: 18) records oviposition to be on the first, second or last prey whereas Bohart and Menke (1976: 271) state that the egg is laid after the last provision is stored and that it is often placed on the largest prey.

Comparison of the overall nesting behaviour of *Holotachysphex* (as exemplified by *H. turneri*) with that of *Tachysphex* species indicates a close relationship between the two taxa which is in accord with that shown by the sum of their morphological characters. At the same time, however, *Holotachysphex* in general appears to be specialized or advanced in comparison with *Tachysphex* with respect to those major characters, both morphological and ethological, in which the two taxa differ.

If *Holotachysphex* species are considered to have developed from a *Tachysphex*-like form, as seems possible, then the major ethological advance would have been marked by the abandonment of the construction of a nest in the ground in favour of the utilization for nesting of a pre-existing cavity in a dry twig, stem or inflorescence. Concomitant with this change to twig-nesting would have been the secondary loss of both the foretarsal rake and the pygidial plate. This view is consistent with the conclusions of Bohart and Menke (1976) who hold that the absence of a foretarsal rake is specialized or advanced when it occurs in the Larrinae and that the absence in *Holotachysphex* of a pygidial plate is secondary. With respect to the presence in *Holotachysphex* of lateral carinae on terga I and II it is considered by the same authors that this character too is specialized or advanced and conversely that the absence of these carinae in *Tachysphex* is unspecialized or primitive.

If *Holotachysphex* is considered to have developed from a *Tachysphex*-like form, it appears to be a matter of opinion whether the species included in *Holotachysphex* are sufficiently distinct to warrant generic separation from *Tachysphex* as is advocated by Bohart and Menke (1976) or whether they should rather be seen as advanced species of *Tachysphex* in which case they could be accorded subgeneric separation as suggested by de Beaumont (1940). Of interest in this connection is the fact that the pygidial plate is weakly defined in a few *Tachysphex* and is totally absent in the aberrant Argentinian *T. mendozanus*. According to Bohart and Menke (1976: 270) this species, of which they saw only the female, could be placed in *Holotachysphex* except that it has a well-developed foretarsal rake and lacks the lateral carina on tergum II. Also of interest is the presence in *Tachysphex* and in *H. turneri* of an externoventral notch in the mandible and its absence in the other species of *Holotachysphex*. It may be hoped that ethological information pertaining to species such as *T. mendozanus* and further species of *Holotachysphex* when available will be of use in clarifying the relationship of the two taxa.

SUMMARY

Some aspects of the ethology of *Holotachysphex turneri* (Arnold) (Hymenoptera: Sphecidae: Larrinae) in the Eastern Cape Province of South Africa are described. In the study which was based upon five nests constructed within wooden trap-nests suspended from small trees particular attention is given to nest architecture and nesting materials, to the identity, number and orientation of the prey in each cell, and to the position of the wasp egg on the prey. The nesting of *Holotachysphex* is compared with that of species of *Tachysphex*, a closely allied genus.

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