Male scent-organ chemicals of the vine moth, *Phalaenoides glycinae* Lew. (Agaristidae)

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Summary. Extracts of the male brush-organs of the vine moth, *Phalaenoides glycinae* Lew., have been found to contain 2-phenylethanol and 2-phenyl-2-phenylethanolacetate.

It is well known that male moths of a number of species of the family Noctuidae possess a pair of abdominal brushes attached by sclerotized levers to the base of sternite two[2-4]. Less well known is the fact that male moths of a closely related family, the Agaristidae, possess homologous brushes[5]. Our attention was first drawn to an example of the latter while examining a male vine moth (*Phalaenoides glycinae* Lew.) which displayed its brushes (figure) and, in doing so, released a distinctive perfume. Subsequent examination of museum specimens has confirmed that similar brushes are a common feature of many species of Agaristidae (table 1).

Birch[3,4] has drawn attention to the taxonomic value of the noctuid's brushes and the chemicals they secrete, with regard to the classification of British noctuids. The male brush-organs of the Agaristidae, and the nature of the chemicals they secrete are therefore also likely to be of taxonomic and phylogenetic interest and in the case of the vine moth, an indigenous Australian species which attacks grape vines[5,6], of potential economic importance. We report here the identification of the brush-organ chemicals of the vine moth.

Male brush-organ of *Phalaenoides glycinae*.

Methanol extracts of the brushes of 5 male vine moths, captured in the field, were examined individually by combined gas chromatography-mass spectrometry[7]. 4 of the 5 contained 2 volatile components. These were readily identified, on the basis of their gas chromatographic retention times and mass spectra, as 2-phenylethanol and its acetyl derivative (table 2). The former chemical is a floral fragrance which is used widely in perfumery and as an antibacterial agent. It has previously been identified on the homologous anterior brushes of 6 noctuid species[8-12] and on the genital brushes of the male cabbage looper moth, *Trichoplusia ni* (Hübner)[13]. This is, however, the first report of 2-phenylethanolacetate as a male brush-organ chemical.

While the ratio of the 2 components in the brush extracts was relatively constant, a considerable and possibly significant variation in the amount was observed (table 2). In the Noctuidae the glands supplying the brushes with scent chemicals discharge only once, soon after the adults emerge, and then remain inactive[2]. This may also be the case with male vine moths and the variation in the amount of scent on the brushes probably reflects the extent to which they had been used prior to the insects' capture.

The use of male brush-organ chemicals to control pest species has been suggested by Hendricks and Shaver[14] based on their finding that a male pheromone released by the noctuid *Heliothis virescens* (F.) stops the release of the female's male-attracting pheromone. Application of synthetic male brush-organ chemicals to areas of host crops

Table 1. Male agaristids found to possess anterior brush-organs*

Agarista agricola (Donovan)	*Hecatesia exultans* (Walker)
Apina callisto (Walker)	*Hecatesia fenestrata* (Boisduval)
Argyrolepida coeruleotincta (Lucas)	*Hecatesia thyridion* (Feisthamel)
Argyrolepida fracta (Rothschild)	*Idalima aethrias* (Turner)
Burgena varia (Walker)	*Idalima affinis* (Boisduval)
Coenotoca subaspersa (Walker)	*Idalima leonora* (Doubleday)
Comocrus behri (Angas)	*Idalima metasticta* (Hampson)
Cruria darwinensis (Butler)	*Idalima tetrapleura* (Meyrick)
Cruria donowani (Boisduval)	*Ipanica cornigera* (Butler)
Cruria epicharita (Turner)	*Periopta ardescens* (Butler)
Cruria kochii (Macleay)	*Periopta diversa* (Walker)
Cruria platyxantha (Meyrick)	*Periscepta polysticta* (Butler)
Cruria sthenozona (Turner)	*Phalaenoides glycinae* (Lewin)
Cruria synopla (Turner)	*Phalaenoides tristifica* (Hübner)
Eutrichopidia latina (Donovan)	*Radinocera placodes* (Lower)
	Radinocera vagata (Walker)

* Compiled, with the help of Dr I.F.B. Common, after examination of specimens in the National Museum of Victoria, Melbourne, and the Australian National Insect Collection, Canberra.

Table 2. 2-Phenylethanol and 2-phenylethanolacetate on the anterior brush-organs of 5 male vine moths captured in the field

Moth	2-Phenylethanol (μg)	2-Phenylethanolacetate (μg)
1	70	38
2	None	None
3	Traces	Traces
4	8	3
5	24	9

may, under these circumstances, prevent males from locating females and thus reduce the incidence of mating and consequently the density of the pest population. The male brush-organ chemicals of the vine moth may therefore eventually provide an environmentally acceptable means of control once their behavioural significance is established.

1 We thank Dr I.F.B. Common, CSIRO, Division of Entomology, Canberra, for valuable comments on the manuscript.
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Haemoglobin Bohr effect and lactic acid content of the blood of 2 water-snakes with different degrees of aquatic adaptation[1]

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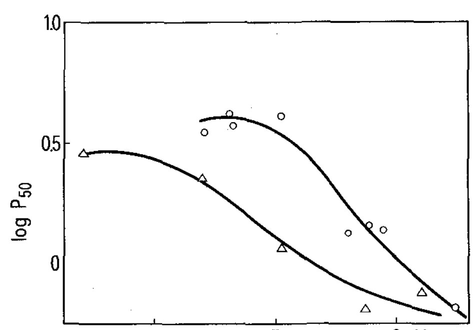
Summary. H. modestus, a water-snake with morphological respiratory adaptation to its habitat, presents haemoglobins with a lower Bohr effect than those of *L. miliaris,* an aquatic snake without such respiratory adaptations. The difference in blood lactic acid content of the 2 snakes submitted to mechanical stimuli appears to be compatible with the properties of their haemoglobins.

Recently, 2 closely related species of water-snake have been studied in this laboratory[2]. *Helicops modestus* is a sluggish water-snake with respiratory morphological adaptations and capable of diving for long periods of time. This snake presents haemoglobins which in the stripped form show a low Bohr effect (−0.07) and high oxygen affinity at pH 7 (P_{50}= 1.0 mm Hg). *Liophis miliaris,* on the other hand, is a semi-aquatic snake without respiratory adaptations, and shows values of −0.3 for the Bohr effect and P_{50} of 1.41 mm Hg. These findings suggested that at low pH, the haemoglobins of *L. miliaris* would more readily unload oxygen to the tissues than those of *H. modestus,* and therefore the semi-aquatic snake would better tolerate acidosis conditions, such as those caused by the increase of the blood lactic acid when subjected to stimuli. To evaluate such a possibility, we submitted both snakes to mechanical stimuli and determined their response and blood lactic acid content. We also analyzed the Bohr effect of the haemoglobins without treatment such as stripping in order to obtain values under conditions which could approach those found in vivo.

Material and methods. Adult forms of both *H. modestus* weighing 40–50 g and *L. miliaris* weighing about 100 g were placed individually in small plastic boxes at 25 °C for 12 h prior to blood collection. Blood samples of 0.1 ml were taken through a small incision in the snake's tail and added to tubes containing 6% perchloric acid. The snakes were then individually stimulated through mechanical aggression. During the stimulation, the snakes underwent an initial period of activity (5–6 min) after which they became completely exhausted and unresponsive to further stimuli. The response intensity of the less aquatic species, *L. miliaris,* was higher than that of *H. modestus.* After



Half-saturation oxygen tensions (P_{50}) of whole haemolysate haemoglobins of *H. modestus* (triangles) and *L. miliaris* (circles) as a function of pH. Buffers: 0.01 M bis-tris-HCl pH 6–7 and 0.01 M tris-HCl pH 7–8; temperature 25 °C; haemoglobin concentration 0.5–0.7 mg/ml.

Haemoglobin-oxygen equilibrium constants (P_{50}) at different pHs, Bohr effect and blood lactic acid concentration in *L. miliaris* and *H. modestus*. The alkaline Bohr effect is expressed as $\Delta \log P_{50}/\Delta pH$ and lactic acid concentration as mg % in the whole blood. 4 snakes of each species were used in the experiments

Determinations	pH	*H. modestus*	*L. miliaris*
log P_{50}	6.5	0.30	0.60
	7.0	0.10	0.56
	7.5	−0.046	0.30
	8.0	−0.161	0.025
Bohr effect	-	−0.25	−0.53
Lactate level			
Undisturbed animals	-	10±5*	40±9
Stimulated animals	-	150±13	230±20

*SDE.