tion of inhibitor apparently occurred with anti-lambda antiserum. Although this is a very small change in antibody titer, it represents a somewhat greater change in residual Factor VIII concentration than can be accounted for by the error of our method. Case Gu was exclusively a kappa immunoglobulin, but insufficient material was available for heavy-chain typing.

Mobility of the inhibitor peaks on starch-block electrophoresis is illustrated in Fig. 1. A typical protein pattern is shown for comparison. Only one inhibitor (Ba) migrates with the bulk of the gamma globulin. The remainder have more rapid mobilities. There is no relationship between the clinical condition in which anti-Factor VIII antibodies arose, or the serum concentration of these antibodies, and their electrophoretic mobility.

On the strength of the additional cases reported here, it seems probable that most acquired inhibitors of Factor VIII are so-called "monotypic" antibodies. Further support for this conclusion is the recent finding of a single heavy-chain subtype (γ_4) in an IgG_κ anti-Factor VIII antibody (*7*). The nature of the stimulus to production of such homogeneous antibody is unknown. It is interesting to speculate on the unusually rapid mobility exhibited by this group of anti-Factor VIII antibodies. Sela and Mozes have demonstrated an inverse relationship between net antibody charge and net electrical charge of the provoking antigen (*10*). One would expect, therefore, a relatively positive electrical charge for the Factor VIII molecule at *p*H 8.6, a prediction not in keeping with its known rapid mobility on electrophoresis at this *p*H (*11*). A second possibility is suggested by the observation that human IgG4 has a much more rapid anodal mobility than the other IgG subclasses (*12*). On the basis of the mobilities exhibited by the inhibitors we have studied, it seems to us possible that many acquired anti-Factor VIII antibodies may be exclusively $IgG4_\kappa$ immunoglobulins.

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Microstigmus comes: Sociality in a Sphecid Wasp

Abstract. *Pendent nests of the wasp* Microstigmus comes *from Costa Rica contained up to 18 adults each. Ovarian dissection indicates that there is reproductive dominance (division of labor) among females from the same nest, without apparent external morphological differences. Evidence for parental care and cooperation in provisioning and defense also identify this as the first social sphecid wasp.*

Sociality in the Hymenoptera has been achieved independently at least ten times (*1*), mostly in the Apoidea, which also exhibit many intermediate stages of social evolution. Full evolution of social behavior in wasps has been demonstrated only in the family Vespidae (*2*), and, among the Sphecidae, only a few presocial species have been reported (*3*). A census of 22 active nests from Costa Rica now gives evidence of the first fully social wasp in the family Sphecidae (*Microstigmus comes* Krombein) (*4*).

Each known species of the Neotropical genus *Microstigmus* constructs a baglike nest (Fig. 1) suspended from the underside of leaves of broad-leaved primary forest plants (*5, 6*). Cells, each mass provisioned with Collembola, are pocketlike cavities in the lower half of the nest, and adults (Fig. 2) reside in the hollow upper portion below the entrance. Among the Sphecidae, only *Microstigmus* has a pendent nest, possibly a significant social pre-adaptation.

Of the 88 *Crysophila guagara* Allen palms in the study plot, 38 were occupied by a total of 74 nests: 16 had one nest; 14 had two nests; seven had three nests; one had four nests; and one had five nests. In the nests (all of which were collected at night when all adults were presumed within) were 56 females and 19 males; half the nests contained two or more females. No significant morphological differences exist between females from the same nest, nor is there dimorphism in either wing length or head width; behavioral or physiological caste differences may, however, be present without morphological correlates, as in some bees (*7*).

Table 1. Ovarian condition ranked in order of decreasing size of largest oocyte of females from eight nests of *Microstigmus comes* with three or more female adults present. There are three ovarioles per ovary, each with no more than one visible oocyte; the mature oocyte occupies nearly two-thirds of the abdomen. In four nests one female has two oocytes that are more developed than those of any of her nest mates. Parentheses indicate number of visible oocytes. NR, not recorded; U, no visible oocyte development; D, destroyed accidentally.

Cells per nest	Oocyte lengths (in mm)							
	Longest two for most mature females	Longest from other females						
4	0.75(4) .23	0.30(2)	0.18(1)					
7	.18(2) NR	.15(2)	.13(1)	0.13(2)				
4	0.38(3) .30	.15(2)	.10(1)	.08(2)				
1	.33(2) NR	.23(3)	.20(1)	.18(1)	0.15(1)			
3	0.27(1)	.20(1)	.10(2)	.10(1)	U			
10	.43(4) .18	.15(2)	.15(2)	.13(1)	0.08(1)			
9	.68(3) .25	.18(2)	.13(2)	.10(1)	U	D		
13	1.00(3) 0.55	.20(3)	.13(2)	.13(1)	0.10(2)	0.10(2)	0.08(2)	3U

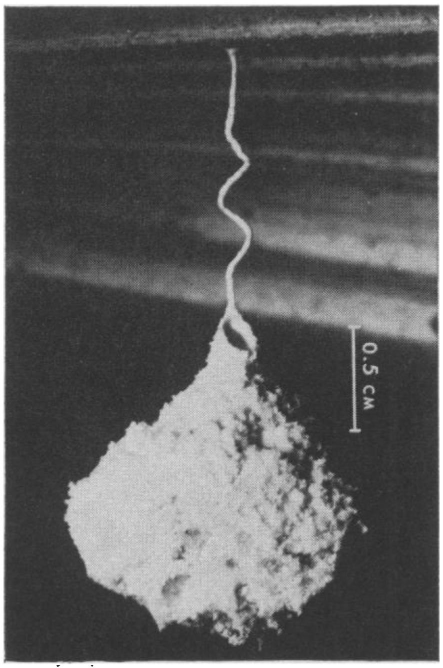

Fig. 1. A *Microstigmus comes* nest attached to the underside of a *Crysophila guagara* Allen palm frond. The nest entrance and doubly coiled pedicel are shown. The nest is constructed entirely from waxy bloom scraped from the undersides of the fronds; nests are found only in association with this plant. As many as 18 adults of both sexes and up to 17 cells occupied a single nest. [Photo by C. W. Rettenmeyer]

Moreover, as a general rule in many social Hymenoptera the degree of morphological difference between the queen and worker castes seems to lag behind specialization as judged by other features.

Females from each nest were preserved in either Bouin's solution or chloral hydrate fixative; subsequently, dissections of the reproductive system were made (*8*). In nearly every case, one female had an oocyte that was much more developed than that of her nest mates (Table 1). This indicates a reproductive division of labor—one female apparently lays most eggs. As was previously noted for *Microstigmus theridii* (*6*), no two cells in a nest are ever at the same stage of development, further substantiating that, regardless of the number of females present, only one mature ovarial egg is available per colony at any time.

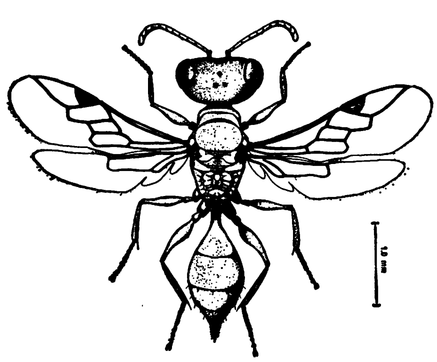

Fig. 2. Female of *Microstigmus comes* Krombein.

Since cells are mass-provisioned, it is significant that no nest, regardless of size or number of females present, had more than one incompletely provisioned cell. In a nest containing two females and a male, both females were observed carrying prey to the nest; the nest was collected late the same day, and only one cell contained prey. Thus, foraging females from each nest apparently cooperate in provisioning one cell at a time. Similarly, in nests of more than one individual, cooperation in nest defense was noted several times. For example, when a small beetle larva was deliberately placed on a nest, the two wasps inside emerged almost simultaneously, encountered the intruder, and attacked it. Wasp parasites were repelled in the same manner. All nests observed with more than one adult always had at least one adult present—a possible division of labor between foragers and those that remained to protect and maintain the nest (*9*). Apparently, parental care also occurs, for larval and pupal cells in active nests have no fecal pellets or meconial remains; however, when nests are kept (without adults) in covered petri dishes, many fecal pellets accumulate in larval cells.

Although many new adults emerged during the study, no nests under construction were found. It therefore seems likely that offspring associate with previously established nests. Parental and offspring adult lives probably overlap, since three of the ten females occupying one of the largest nests found had no visible oocytes, suggesting that they were newly emerged, possibly offspring from that nest. The lack of new nests also suggests a relatively high population viscosity; nest distribution further supports this idea, since 78 percent occurred with at least one other nest. This clumping of nests increases the probability of nest mates being relatives, which in turn may be significant in the evolution of social behavior (*10*).

In regard to its nesting behavior, *Microstigmus comes* shows certain parallels to some species of the vespid genera *Belonogaster* and *Stenogaster* (*2*) and to the halictid bees *Augochloropsis sparsilis* and *Pseudagapostemon divaricatus* (*11*). In each, several morphologically similar females inhabit the nests. Apparently neither *Stenogaster* nor *Pseudagapostemon divaricatus* cooperate in brood care or provisioning, and in both, all females lay eggs; however, *Belonogaster* and *Augochloropsis sparsilis* females cooperate in rearing offspring, and one female lays most of the eggs.

In summary, if social behavior is defined as activity of an individual benefiting the young of another of the same species (*12*), then *Microstigmus comes* Krombein qualifies as the first social wasp of the family Sphecidae, since parental care (provisioning and defense) of brood by more than one adult female has been demonstrated. Even if the definition of sociality includes the more stringent criterion of reproductive dominance (division of labor), the data certainly suggest that this may be the case.

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8. Since the tiny spermathecae were accidentally lost or destroyed in many dissections, we are unable to include this information in the discussion of reproductive dominance.
9. Although the sex of the nest defenders was not determined, it is perhaps significant that in the Sphecidae only males in the genus *Trypargilum* are known to take part in nesting activity; nests generally contain a pair of wasps, the male guarding the entrance while the female is away. See J. T. Medler, *Amer. Midland Natur.* **78**, 344 (1967).
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