

A GYNANDROMORPHIC *SCHIZOCOSA* (ARANEAE, LYCOSIDAE)

Individuals in which both sexes are discretely combined are termed gynandromorphs, whereas intersexuality is a condition in which portions of a body are intermediate between the sexes and are not clearly one sex or the other (White 1973; Roberts & Parker 1973). The earliest reference to a spider gynandromorph is given by Blackwall 1867 (cited in Bonnet 1945). Bonnet lists numerous other early citations of gynandromorphs. Roberts & Parker (1973) provide a classification of 14 types of gynandromorphs, which are combinations of lateral and transverse gynandromorphs, although they admit that several of these could never be externally recognized.

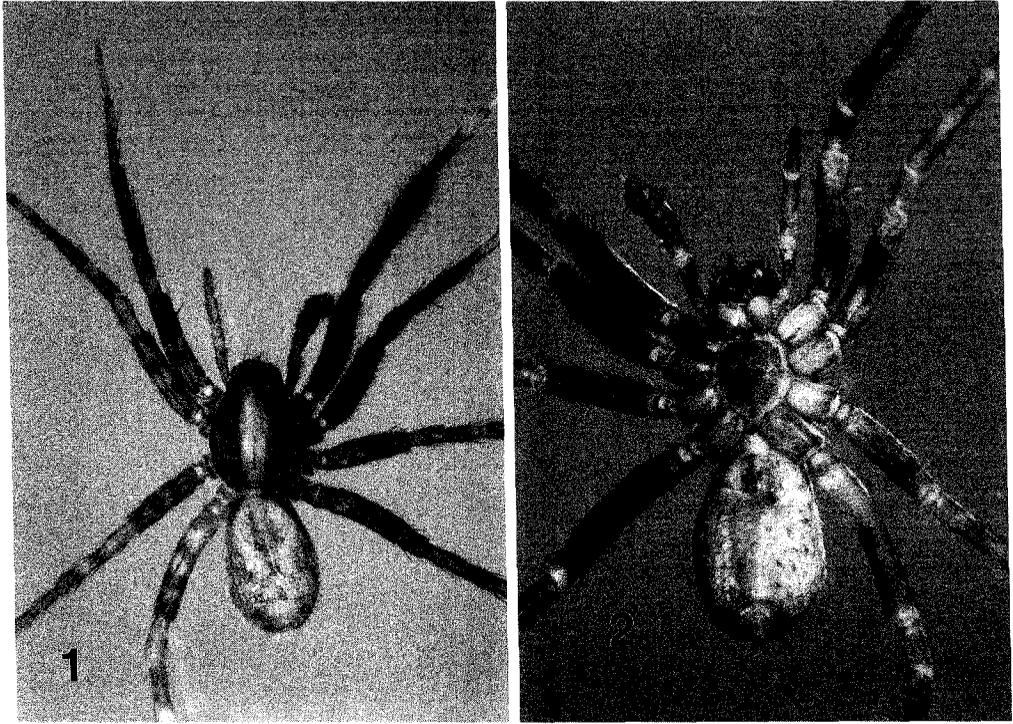
Gynandromorphs probably occur in most taxa of animals including birds (Patten 1993), as well as in many insects and arachnids (Hannah-Alava 1960; Cokendolpher & Francke 1983; Brust 1966). They have been studied extensively in *Drosophila* (Wilkins 1993) and as early as the 1920's, gynanders were used as a means of fate mapping cells. Several mutations in *Drosophila* are particularly prone to being gynandromorphic (White 1973). Only slightly more than 50 cases of gynandromorphy and intersexuality have been reported for spiders (Hull 1918; Bonnet 1934; Kaston 1961; Roberts & Parker 1973). It occurs but is perhaps equally rare in scorpions, solpugids and ticks, although reduced sexual dimorphism may make detection more difficult (Cokendolpher & Sissom 1988). Clarke & Rechav (1992) note that gynandromorphs are "widespread" in the Ixodidae, but they do not offer any estimates on the frequency of occurrence.

Kaston (1961), in his summary of the spider gynandromorphs known to that point, suggested that gynandromorphy in spiders is "exceedingly rare." Palmgren (1979) calculated a rough estimate of the frequency of gynandromorphism based on 69,970 adult spiders from his own collection and from the Zoological Museum of the Helsinki University Collection. He described four gynandromorphs and suggested that the phenomenon occurs about once per 17,000 normal spiders. One of the specimens described by Palmgren was from the genus *Oedothorax*. Holm (1941) noted that a disproportionate number of gynandromorphic specimens are in this genus.

The causes of gynandromorphy have been investigated for a variety of groups (but not spiders)

and generally involve the nondisjunction in the X chromosomes early in development (White 1973). For example, in a species of tick studied by Homsher & Yunker (1981), the male tissue had the number of chromosomes typical for males (22 + X) while the chromosomes in the female tissue were consistent with that of a normal female of that species (22 + XX). Presumably the mechanism of formation of gynandromorphs in spiders is the same as in these other groups; however, there have been no published studies of the karyotype of gynandromorphic spiders (White 1973). Kaston (1961) suggested that the phenomenon of gynandromorphy would be less frequent in spiders than insects (particularly *Drosophila*) because of the chromosomal system found in spiders. In many spiders the males are "X1X20" or "X1X2X30," and females "X1X1X2X2" or "X1X1X2X2X3X3" where females have two, three, or more chromosomes than males (White 1973; Hackman 1948; Wise 1983). Kaston suggested that the creation of a gynandromorph from a chromosomal female zygote would involve the loss of 2–3 chromosomes, rather than just one as in *Drosophila* and would thus be quite a bit less frequent in most spiders than in *Drosophila*.

Although some behaviors in a few gynandromorphs have been noted (e. g., *Coelotes atropos* produced an egg sac (Kaston 1961)), the most extensive behavioral description is that of the lycosid *Alopecosa pulverulenta* provided by Gack & von Helversen (1976). These authors described the individual as a "lateral gynandromorph" in which the left side was male and the right side female, except for the right palp which was described as intersexual. The ventral opisthosoma contained male sexual organs. When the gynandromorph was placed with a normal male spider of the same species, the male did not exhibit courtship behavior. This perhaps suggests that the gynander lacked pheromones that are often produced by female lycosids that elicit courtship in males. The gynander never mated with the male. However, the gynandromorph spider built an egg case that contained only a gelatinous fluid and was *not* carried on the spinnerets. When placed with a normal female of the same species, the gynandromorph showed courtship behavior typical of the males of its species, mounted and inserted the male palp in a manner



Figures 1, 2.—Gynandromorphic *Schizocosa ocreata* from Hue, Hocking County, Ohio. 1, Dorsal view of gynandromorphic *Schizocosa ocreata*. Right side of individual shows male palp; left side shows female palp; 2, Ventral view showing differences in coloration of legs, sternum and venter.

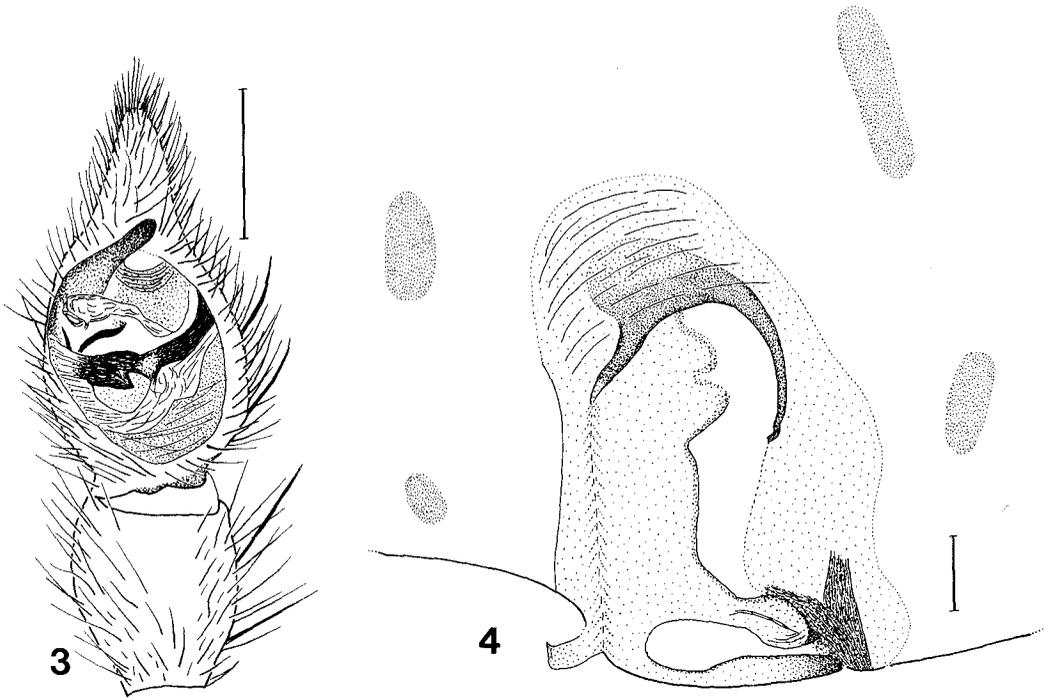
also typical of the species. It made no attempt to insert the other (intersexual) palp. Copulation was short and involved only one insertion. (The species typically shows several insertions). The gynandromorph mated with a second female. The authors do not report if either of the females laid an egg case following this mating.

The present report provides a description of a gynandromorphic *Schizocosa ocreata* (Hentz) discovered in the summer of 1993 and a rough estimate of the frequency of gynandromorphism in this genus. This is the first report of a gynandromorph in the genus *Schizocosa*, although occurrences have been reported in other lycosids (Exline 1938; Holm 1941; Kaston 1961; Mackie 1969; Gack & von Helversen 1976).

The specimen of *Schizocosa* described here was from Ohio, Hocking County, Hue. It was collected in a house on 25 June 1993 by Lawrence M. King III (a former undergraduate student of Jerome Rovner) who suspected that it was a gynandromorph. The spider was given to J. Rovner, who noted that it walked in a manner typical of male *S. ocreata* by extending and tapping the front legs (pers. comm.).

Description.—By using the classification suggested by Roberts & Parker (1973), I would suspect that this specimen is a regular Type 2 gynandromorph, although like many gynandromorphs, it is not perfectly symmetrical (Figs. 1, 2). The left side of the spider is female, its right side male. The total length is 7.8 mm and is within the range for both males and females of this species (Dondale & Redner 1978 report that the size range for males of *S. ocreata* is 5.65–8.3 mm; for females, 7.3–10.4 mm). The carapace length is 3.64 mm, and the carapace width 2.8 mm. The right (♂) side of the carapace is 1.3 mm from edge to the middle; the left (♀) side is 1.5 mm, resulting in a slightly asymmetrical carapace. Likewise, the chelicera on the left side is slightly larger and the fang on this side also is longer. The spinnerets reflect the same pattern: on the left (♀) side, the spinnerets are larger.

The right side of the animal has a fully developed and apparently normal ♂ palp (Fig. 3). There is a stridulatory organ located on the tibio-tarsal joint of this palp. Leg I on the right side has a brush of bristles along the tibia, as is typical for males of this species (Fig. 1). The brush extends



Figures 3, 4.—Gynandromorphic *Schizocosa ocreata*. 3, Ventral aspect of spider's right palp, scale bar = 0.5 mm; 4, Detail of spider's epigynal area, scale bar = 0.1 mm.

to the basitarsus. The left side has a palp resembling that of normal females, and on the opisthosomal venter there is an epigynum that has a single large excavation (Fig. 4). This half of the epigynum looks normal for this species except that the median septum has an irregular border.

The ventral aspect of the animal exhibits two different colorations (Fig. 2). On the spider's right (♂) side, the sternum is darker, although not in a straight line down the sternum. There is a dark band on the right side of the venter of the abdomen, and the pattern of pigmentation on each side of the venter of the abdomen differs. The right side appears mottled, while the left side has distinct dark spots of pigment.

The ventral surface of all four coxae and femora on the right side is black (Fig. 2). On the left (♀) side, the coxae and femora have patches of dark pigmentation but are overall much lighter. In a manner that is atypical for males of *S. ocreata*, the legs on the male side are uniformly dark. Curiously, the tibia of leg II has a rudimentary brush. Legs II–IV on the spider's right side are more similar to a typical male leg I than they are to typical legs II–IV. From a dorsal view, the legs on the left side are annulated, while the legs on

the right are mostly black with some lighter streaks. In most *S. ocreata*, legs II–IV of the males have annulations but are not uniformly dark.

The venter of the abdomen has numerous spots of sclerotization that are more evident on the male side. The dorsum of the abdomen has a heart-mark and the pigmentation on the abdomen is slightly asymmetrical.

Estimation of frequency of gynandromorphs in *Schizocosa*.—My work for the past three years, including much done in collaboration with Gary L. Miller and Patricia R. Miller, provides a rough estimate as to the frequency of this phenomenon in the genus *Schizocosa*. For each of the summers of 1993 and 1994 we have maintained nearly 1000 specimens of *Schizocosa* and other lycosids in the laboratory for behavioral studies. We have also completed a year-long pitfall study, focusing primarily on the lycosids. Thus, we have identified and/or observed behavior in close to 3000 individuals of Lycosidae (mostly *Schizocosa*), and have never encountered a gynandromorph. In earlier studies done at Ohio, I raised or collected nearly an additional 2000 spiders. Thus, an estimate of the frequency of gynandromorphs in this genus is that one may occur not more fre-

quently than once every several thousand spiders.

The specimen is currently housed in the teaching collection of Jerome Rovner at Ohio University.

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