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MEASURING THE STICKINESS OF SPIDER PREY CAPTURE THREADS

Comparative studies of spider orb-web architecture and function make the simplifying assumption that the stickiness of these webs' spiral, prey capture elements is similar. The wide range of spider size, spiral spacing, and web tensions suggests that this may not be true and that capture thread stickiness is an important functional component of web design. Just as the length of capture silk provides an index of material outlay and spiral spacing influences the size of prey captured (Eberhard 1986), silk stickiness determines the web's ability to retain prey until they can be subdued by the spider.

Using a simple balance device, Eisner et al. (1964) compared the retention ability of *Nephila clavipes* (Linn.) viscid thread for naked insect wings with those beset with hairs and scales. However, the stickiness of different species' capture threads have not been compared. To study Uloboridae threads, I designed a simple device for measuring thread stickiness that may be useful to other investigators.

This instrument (Fig. 1) employs a glass needle strain gauge and is similar to the devices used by Craig (1987) for measuring silk tensile strength and Opell (1987) for comparing the web-monitoring forces expressed by spiders. The instrument described here was fabricated from 6 mm thick plexiglass.

Silk samples are collected from a spider's web using a microscope slide, along whose length five 4 mm wide rectangular brass supports are glued at 4 mm intervals. Double-sided tape applied to the top of each support holds the silk under its original tension. This collecting device permits four replicate samples to be taken from each web and the close spacing of its supports minimizes silk extension during the process.

Two clips secure this collecting slide to a sliding platform that permits positioning of each replicate cribellar silk sample under a narrow aluminum contact plate. The latter is glued with epoxy to the tip of a fine glass needle drawn from a hematocrit tube. Thumb screws secure the sliding plate after each sample has been positioned.

The frame holding the calibrated needle can be raised and lowered relative to the microscope slide with a small screw jack. After a small, standard downward force is exerted on the contact plate, the strain gauge is slowly raised until the contact plate attached to the needle's tip pulls free of the capture silk. The position of the needle on the strain gauge's arbitrary scale immediately before the plate pulls free of the thread is noted. When converted to its milligram equivalent using a calibration graph and multiplied by the accelerating force of gravity, this value yields the force in Newtons necessary to overcome the thread's adhesion.

Although the frame is raised by a hand-operated jack, the need to continually observe the glass needle's position on the scale keeps the velocity of silk loading low and fairly constant. In the example given below, scale unit spacing was 632 μm and, in order to record to the nearest half unit the point at which the contact plate pulled free of the silk, the silk was loaded at a velocity of 287-316 μm per second. This velocity is probably less than half that of a struggling prey's appendages. The rate of loading could be more precisely controlled by driving the jack with a small motor, although a greater velocity than that listed above would

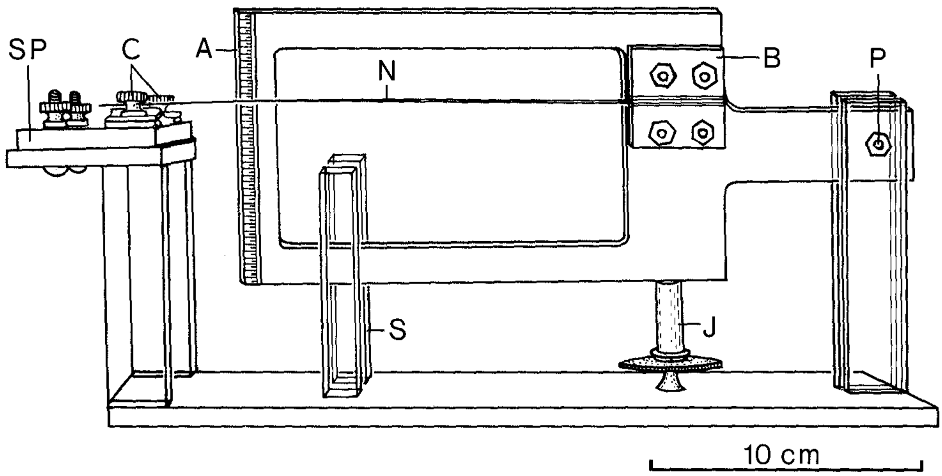

Figure 1.—The instrument used to measure capture silk adhesion. A = arbitrary scale, B = mounting bracket for glass needle, C = clamps for securing microscope slide silk sampler, J = screw jack for raising strain gauge, N = glass needle with contact plate near its free (left) end, P = pivot of strain gauge, S = parallel stabilizing bars to reduce lateral movement of strain gauge, SP = sliding platform for positioning silk samples.

make it difficult to accurately determine visually the point at which the contact plate pulled free of the silk.

To test the reliability of this technique I measured the stickiness of cribellar silk from 21 mature female *Hyptiotes cavatus* (Hentz) webs. All webs were spun in the laboratory and the stickiness of their silk was measured 1-3 days after it was produced. A 2.20 mm wide polished aluminum contact plate was first pressed against each silk sample with a force of 3.03×10^{-5} Newtons. The mean stickiness value of these 84 measurements was 3.251×10^{-5} N / mm of contact (SD = 6.7×10^{-7} N / mm, CV = 2.06). The mean of each web's average stickiness value (N=21) had a SD of 4.4×10^{-7} N / mm and a CV = 1.34. Comparative values for the four replicate measurements of each thread ranged from 0 to 5.76 and had a mean of 1.30.

Although cribellar silk leaves no residue on the aluminum contact plate, viscid threads do and the plate must be cleaned with acetone or other solvent before each measurement. A length of dragline thread serves as both a control and a test for a clean contact plate, as the plate should not stick to it.

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