

... an object of beauty ... an engineering accomplishment ...
a performance record which can be measured ... a complex
structure consisting of several polypeptides which the animal
synthesizes in its silk glands ...

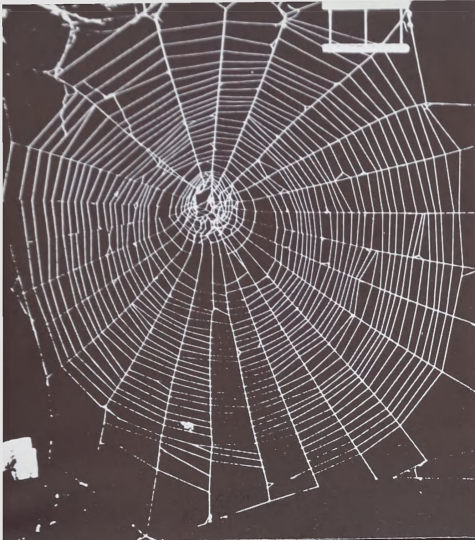
A SPIDER'S WEB

WITT/REED/PEAKALL

PROBLEMS IN REGULATORY BIOLOGY



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*Figure 4. The "normal" web of an adult female *Araneus diadematus* Cl. spider as it is built nearly daily in the early morning hours in the laboratory. Observe asymmetry and irregularities in the geometric pattern.*

A SPIDER'S WEB

PROBLEMS IN REGULATORY BIOLOGY

By PETER N. WITT, M.D., Director of Research, North Carolina Department of Mental Health, Raleigh, N.C.; CHARLES F. REED, Professor of Psychology, Temple University, Philadelphia, Pa., Ph.D. in Psychology, and DAVID B. PEAKALL, Assistant Professor of Pharmacology, State University of New York, Upstate Medical Center, Syracuse, N.Y., Ph.D. in Science, established investigator of the American Heart Association.

with 47 figures. viii, 107 pages. Cloth. \$9.00
Scheduled for publication December 1968.



About 20 years ago it had been discovered that spiders, after receiving drugs, built strangely distorted orb-web patterns. This phenomenon was widely discussed in the popular press during the following years; it also stimulated much research into the sensory motor behavior of spiders during web construction.

A SPIDER'S WEB. Problems in Regulatory Biology. in a multidisciplinary approach, brings all this information together.

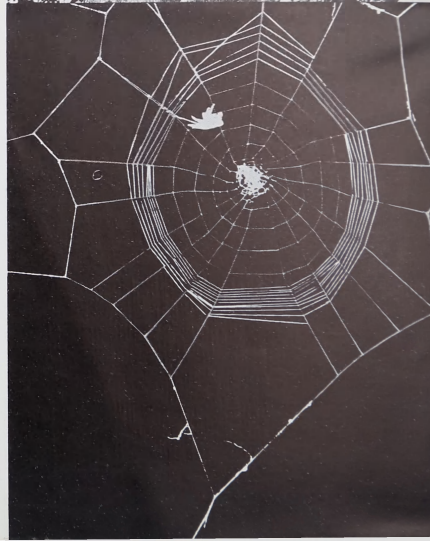
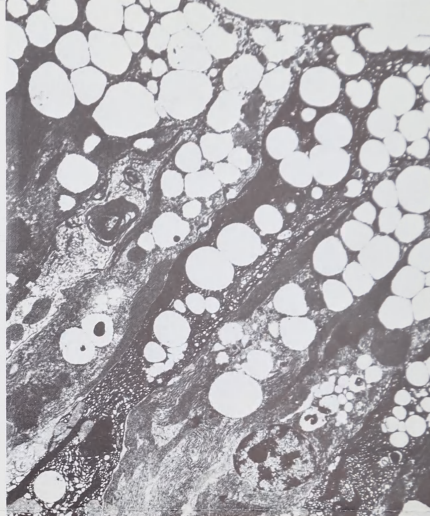
Figure 5. After ingestion of a high dose of caffeine with a drop of sugar water the day before, a spider built this severely distorted web pattern.

Figure 1. Electron micrograph of ampullate gland which produces scaffolding silk. Observe bubbles of silk-polypeptide which empty into gland lumen at upper right.

Production of silk material at the cellular level is explored with biochemical and histological methods, and a regulatory cycle of polypeptide synthesis is discovered. Drugs can interfere with such regulation, and more or less silk becomes available for construction of the web; the amount of detail in the geometric pattern is intimately related to thread material through thread thickness and length. Neural feedback systems from the glands and body surface help in achieving a common end point for material supply and its even distribution in the trap. Adaptive mechanisms aid in reaching the goal—an efficient net to catch flying prey—even if disturbances appear during construction. Methods for raising and keeping spiders in the laboratory, measuring and analyzing the web, and observing the animals in activity are described. A number of strange drug webs and individual variation in patterns can be expressed in size, regularity and shape measures. Statistical comparisons with control webs are performed with the aid of the digital computer. A way is proposed in which all such behavior is coded in the animal's central nervous system.

The book is understandable and of interest to teachers, scientists and students who want to follow the ways in which biophysics and biochemistry join efforts with neurophysiology and pharmacology to help elucidate a complex behavior problem. Everybody can see the beauty and complexity of a spider's orb-web on a sunny morning; but the enjoyment of looking at it and the curiosity about it are much enhanced through reading this book and following the ways by which laboratory research has succeeded in clarifying some of its mysteries.

Figure 3. Web under construction: hub, radii, frame and temporary spiral have been completed, and the sticky permanent spiral has been started at the periphery. Cues for construction can be tested through burning of threads or exchanging spiders from one web to another.



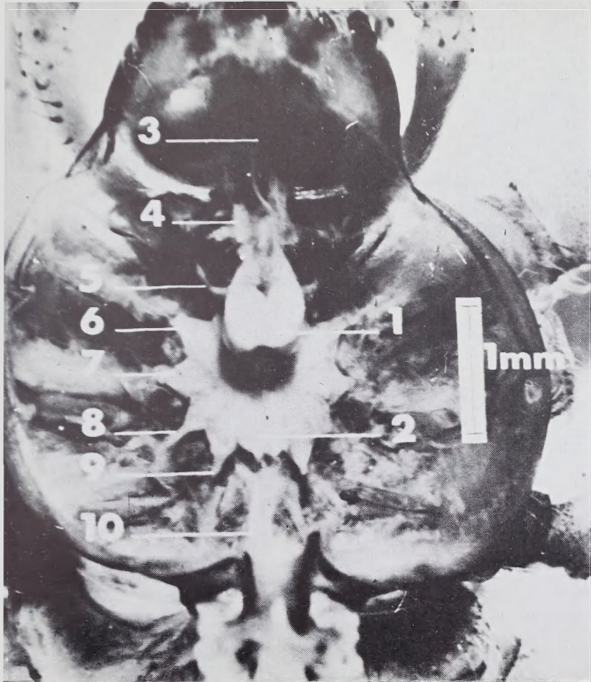


Figure 2. After removal of carapace, the relatively large central nervous system with its (1) supra- and (2) infraesophageal nerve masses can be discerned. The information for the web-pattern is stored here, and its integration with signals from glands and legs is essential for smooth motor execution of the geometric orb.

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Figure 6. 600 mg/kg d-amphetamine caused 12 hours later a characteristic kind of irregularity which can be expressed as a significant change in inter-spiral and central angle measures.

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