Golden rod galls. 1967

Golden Rod Galls

The University of Wisconsin Arboretum

This field book is dedicated to Mrs. Jean Otto who loved the Arboretum and visited it often.

Mrs. Otto had a deep appreciation and understanding for the natural world and readily transmitted it to those who knew her. For her each season brought its own delights; migrating birds, colors of fall, the stark beauty of bare branches against the winter sky, the tender wild flowers poking through soft earth in spring, and lush green of summer—all were part of the rhythm of her life.

We hope that those who use this booklet will gain a deeper feeling and understanding of the natural world thereby making this a suitable memorial for Jean Wilson Otto.

GOLDENROD GALLS IN THE ARBORETUM

Leach

In late summer and early fall, the goldenrods in the Arboretum have reached maturity, and the extensive vistas of the golden-yellow blossoms on the prairies give a pleasant character to the landscape. If a viewer examines the individual plants closely, it is revealed that the goldenrods support a variety of interesting insect galls. There are three common types of goldenrod galls in the Arboretum: *Figure 1,* a ball gall, a spherical stem swelling about an inch in diameter; *Figure 2,* an elliptical gall, an elongate, spindle-shaped stem swelling; and *Figure 3,* a bunch gall, composed of numerous compact leaves in an apical rosette that replaces the flower head.

The ball gall is caused by the immature stage of a fly, *Eurosta solidaginis* Fitch. The female fly lays her eggs upon the surface of goldenrod stems during early summer. A newly hatched larva, called a maggot, bores into the stem and causes the formation of the pithy gall. By fall, the galls are about the size of a hickory nut, round, and of similar texture to the stems themselves. Cut open the gall and a single maggot will be found in a smooth-walled chamber in the center of the gall. The maggots remain in the galls during the winter, after first cutting a tunnel to the surface of the gall, which serves as an escape hatch for the adult fly following its pupation in the spring. The fly itself may be easily reared in the spring if the galls are gathered and placed in a container, such as a glass jar covered with tissue paper or netting. The fly is a pretty insect with brown-banded wings, and is a member of the fruit fly family, *Tephritidae.*

Ball galls may occur on most of the stems in a good-sized patch of goldenrod. Occasionally two or more galls may be found on the same stem. Most of the galls are at about the same height. They are readily seen in winter and gathered then by fishermen who use the maggot for bait. Birds and mice also open the galls to obtain the maggot inside.

The elliptical gall is caused by the immature stage of a moth, *Gnorimoschema gallaesolidaginis* Riley, a member of the family *Gelechiidae.* In the fall the adult female moth lays eggs on the old plants. The eggs hatch in the spring. The young larva, called a caterpillar, crawls to a new shoot and boring into the stem causes the growth of the gall. The caterpillar becomes full grown about the middle of July. Before changing to a pupa, the caterpillar eats a passageway through the walls of the gall at its upper end, and closes the opening with a plug of silk. This plug is pushed out by the adult moth when it emerges from its brown cocoon in the late summer. The feeding of the caterpillar keeps the interior walls of its shelter smooth and neat, and its castings are packed at the bottom of the cavity.

The bunch gall is produced by a fly in the *Cecidomyiidae,* a family of the smallest midge-like flies. Many species of cecidomyiid midges are responsible for flower, bud and leaf galls. The midge species *Rhopalomyia solidaginis* (Loew) has been reared from bunch galls in the Arboretum (Det. R. Gagne, U. S. National Museum).

The midge lays eggs in the summer that hatch into tiny maggots. These attack the growing tip of the main stem, producing a cluster of deformed leaflets at the apex, instead of leaves being distributed normally along the length of stem. An old bunch gall may have lateral branches produced as a result of the deformity of the terminal bud. One, two or three cells in the center of the globose leafy gall may shelter a stout whitish maggot. The larva of a gall midge may be recognized by the presence of a "breastbone" or chitinized process lying within the thorax and terminating behind the head. The midge completes its development and transforms into a pupa in the fall. This pupa actively moves and leaves the gall from a tiny opening between the tips of the interior leaflets. It emerges as an adult outside the gall. The insect probably overwinters as an adult, as the bunch galls do not contain midges in the late fall.

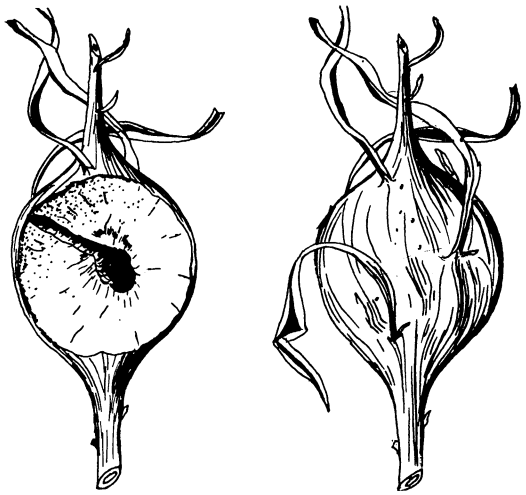

Figure 1. Ball gall.

Figure 2. Elliptical gall.

Figure 3. Bunch gall.

Sketches by Wayne Westphal.

The physiology of gall formation is not completely understood, but appears to be closely related to the growth of the insect larva. Ordinarily a gall does not grow until the egg is hatched—if the egg is removed the gall does not appear. The gall grows along with the insect larva. It appears that the larva exudes some fluid that acts upon certain meristematic cells, such as the cambium and other cells capable of further growth and multiplication, in such a way as to stimulate their increase in size and number. Why the galls of different species of insects have a distinctive, or specific form, is not yet completely known.

The gall is important to its insect maker as a source of special food and as a shelter niche. Empty goldenrod galls also serve as shelter or nesting niches for guest insects or inquilines and transients. For example, the eumerid wasp, *Ancistrocerus tigris* (Saussure), which builds clay-partioned cells and provisions them with caterpillars, was reared from a goldenrod gall in the Arboretum by J. R. Dogger in 1946. Both gall-makers and inquilines are attacked by parasites and predators.

The overall incidence of insect galls on goldenrod is low, and the galls are not of economic importance on the plants except that elliptical and bunch galls usually prevent normal flowering. However, goldenrod galls provide an interesting example of the evolution of a plant-insect relationship. The botanist can find interest in the effect of the insect secretions on abnormal plant growth and anatomy. The entomologist can be concerned with the life histories of the different gall insects and the ecological relations in the gall between parasites, predators, inquilines and transients.

Many other examples of gall insects can be found on *Solidago* throughout its range of occurrence. For example, E. P. Felt (1940, *Plant Galls and Gall-Makers*, 364 pp. Comstock Publ. Co., Ithaca, N. Y.) listed the following insects associated with goldenrod galls:

Flower galls
- 2 genera, 5 species of midges

Bud galls
- 5 genera, 8 species of midges

Apical rosette galls
- 5 genera, 10 species of midges (incl. 2 inquilines, 1 predator)

Leaf galls
- 7 genera, 9 species of midges (incl. 3 prob. inquilines)

Blisterlike leaf galls
- 2 genera, 10 species of midges (incl. 1 predator)

Stem and root galls
- 6 genera, 21 species of midges
- 3 genera, 7 species of flies
- 2 genera, 5 species of caterpillars
- 1 genus, 1 species of gall wasp

The above summary shows that *Solidago* supports 76 species of gall-making insects, of which 63 are the tiny gall midges.

In the Arboretum, the ball and elliptical galls are found on *Solidago altissima* L. The bunch gall is found principally on *S. altissima,* and also on *S. graminifolia* (L.) Salisb. The midge species responsible for the bunch gall on the latter plant was not reared or identified.

—J. T. Medler
1965

NOTES ON THE YELLOW CONEFLOWER IN THE ARBORETUM

(Ratibida pinnata)

The yellow coneflower, *Ratibida pinnata,* is one of the most beautiful of the prairie plants. We are fortunate, therefore, that it has found the Arboretum to its liking and is among the more abundant plants—excluding the grasses—on the Curtis Prairie. The prairie survey of 1966 recorded the coneflower as being present in 233 out of 807 meter-square quadrats studied, or the ninth most frequent plant on the prairie. In general, it tends to be associated with native prairie species, rather than with the European weeds prevalent on parts of the Curtis Prairie. The most significant association values are with rigid sunflower *(Helianthus rigidus),* cut-leaf compass plant *(Silphium laciniatum),* bird's foot violet *(Viola pedatifida),* and blue-eyed grass *(Sisyrinchium campestre).*

Last winter, germination tests of *Ratibida* seed in the laboratory disclosed an interesting fact about this plant. A small percentage of the seedlings were found to be albinos, that is, without the normal green chlorophyll pigment. About four such albinos were observed in 1,500 seeds, so the frequency of this character is rather low. Since such plants cannot manufacture food, they die when very young, so naturally you will not find yellow coneflowers with white leaves on the Curtis Prairie.

Yellow Coneflower
(Ratibida pinnata)

—Paul H. Zedler
1967