13 • *Fibonacci Numbers in Nature*

Fibonacci numbers appear in nature in a number of unexpected ways.

What do you notice about the number of petals (or petal-like parts) in the flowers pictured in Figure 20?

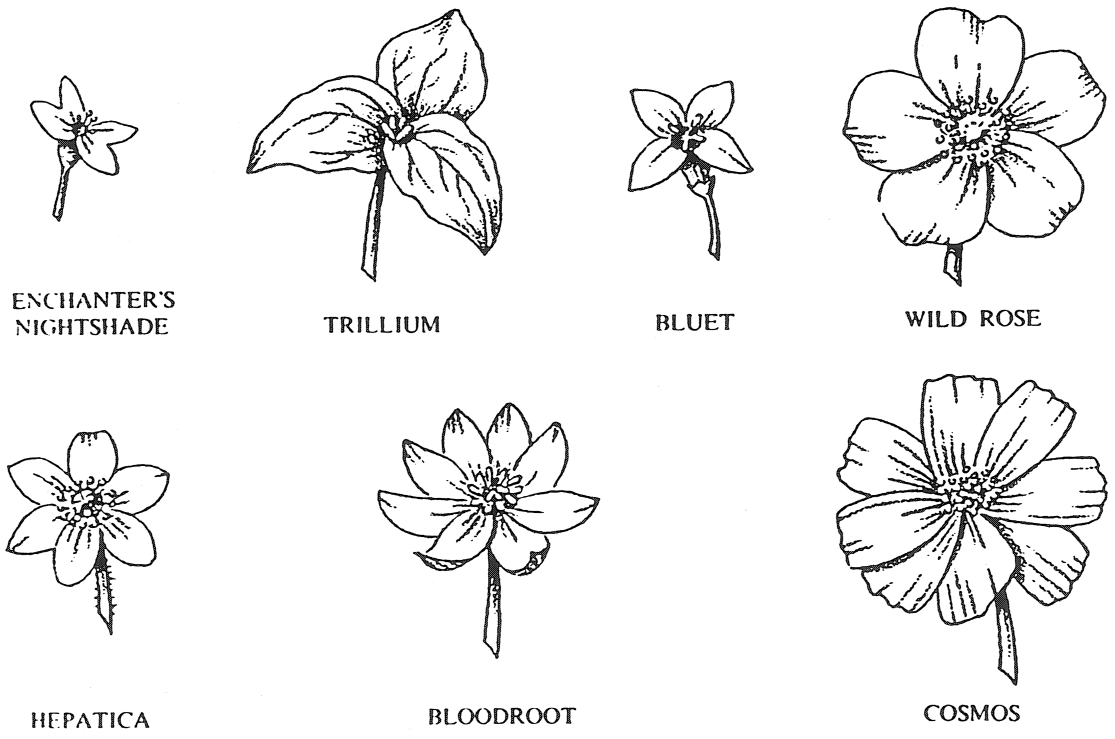


Figure 20

The enchanter's nightshade has 2 petals (even though they are deeply cleft and appear to be four). Thus, the flowers above have 2, 3, 5, or 8 (Fibonacci numbers), or 4 (a Lucas number), or 6 petals or petal-like parts. Others with 5 petals or parts are buttercups and columbine, for example. A day lily blossom has 2 sets of 3 petal-like parts, alternating. An iris blossom has 3 standards (vertical parts) alternating with 3 falls. It is interesting to observe that so many such numbers occurring in nature are Fibonacci numbers.

The numbers of petal-like parts of a flower, such as an aster, cosmos, daisy, or gaillardia, in the composite family is consistently a Fibonacci number or very close to one. A flower of a single variety of gaillardia may have 13 of these parts. Frank Land* reports finding 21, 34, 55, and 89 "petals" on daisies and other members of the composite family.

You can also find Fibonacci numbers in the arrangement of leaves (or twigs) on a stem. Select one leaf as a starting point and then count up the stem until you reach a leaf that is directly above your starting point. The number of leaves is usually a Fibonacci number. Then suppose that a string were wound around the stem following the leaves. The number of turns taken around the stem between the starting point and the leaf directly above it is also usually a Fibonacci number. (The turns may be clockwise or counterclockwise.) The result is often stated as a ratio:

$$\frac{\text{number of turns}}{\text{number of leaves}}$$

Some simplified examples are pictured in Figure 21:

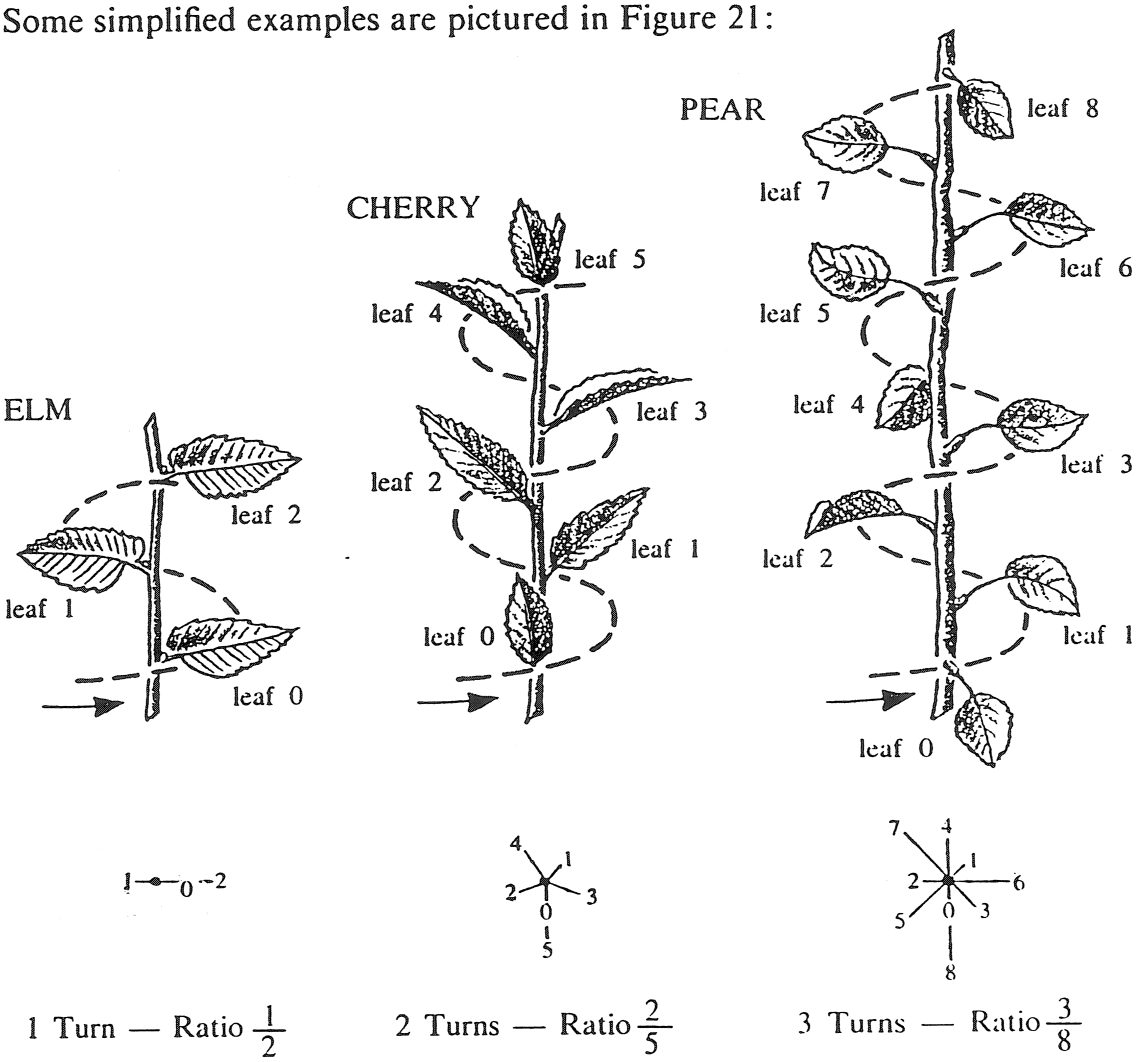
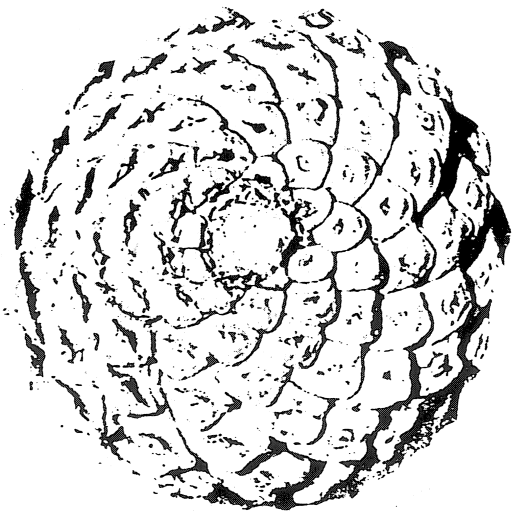


Figure 21

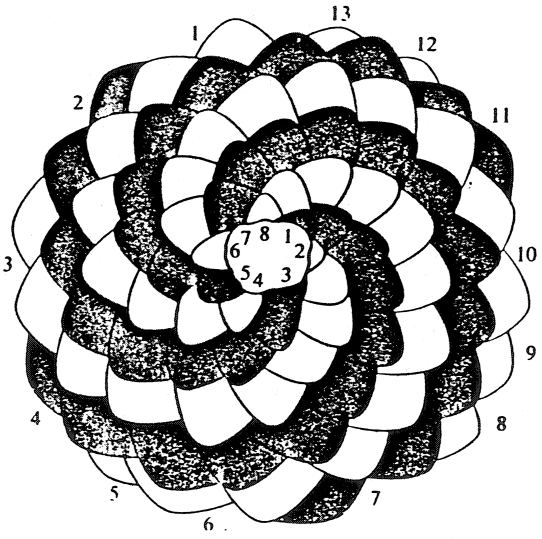
* Frank Land, *The Language of Mathematics* (London: John Murray, 1960), Chapter 13.

The beech tree has a ratio of $\frac{1}{3}$, and the ratio for the pussy willow is $\frac{5}{13}$! Such arrangement of leaves on a stem is called *phyllotaxis* (from Greek *phyllon* meaning *leaf* and *taxis* meaning *arrangement*).

Perhaps the best known examples of the appearance of Fibonacci numbers (and occasionally Lucas numbers) in nature are the numbers of spirals in the seed patterns of sunflowers, the scale patterns of pine cones, and so on. A pine cone is pictured in Figure 22, and the two sets of spirals are pictured in the diagram beside it.



The seed-bearing scales of a pine cone grow outward in a spiral pattern from the point where it is attached to the branch.



13 strips spiral to the left.
8 strips spiral to the right.

Figure 22

The author has raised a sunflower that had 89 spirals to the right and 55 spirals to the left and also one, eighteen inches across, that had 144 spirals to the right, 89 spirals to the left, and 55 shallow spirals to the right. An excellent photograph of the head of a daisy is shown on page 93 of the volume on *Mathematics* in the *Life Science Library*.* The diagram accompanying it shows clearly its 34 spirals to the left and 21 to the right.

A particularly interesting specimen of sunflower was given by the author to Brother Alfred Brousseau of St. Mary's College, California. After he had patiently counted the spirals, he found 123 spirals to the right, 76 spirals to the left, and a shallow set of 47 spirals to the right — a Lucas number sunflower! Brother Alfred Brousseau has also collected and classified by their Fibonacci spiral patterns cones from all but one of the twenty species of California pines. He reported his results in an article, "On the Trail of the California Pine," in *The Fibonacci Quarterly*, Vol. 6, No. 1 (February, 1968), pp. 69–76.

* David Bergamini and the Editors of *Life*, *Mathematics*, Life Science Library (New York: Time Incorporated, 1963).

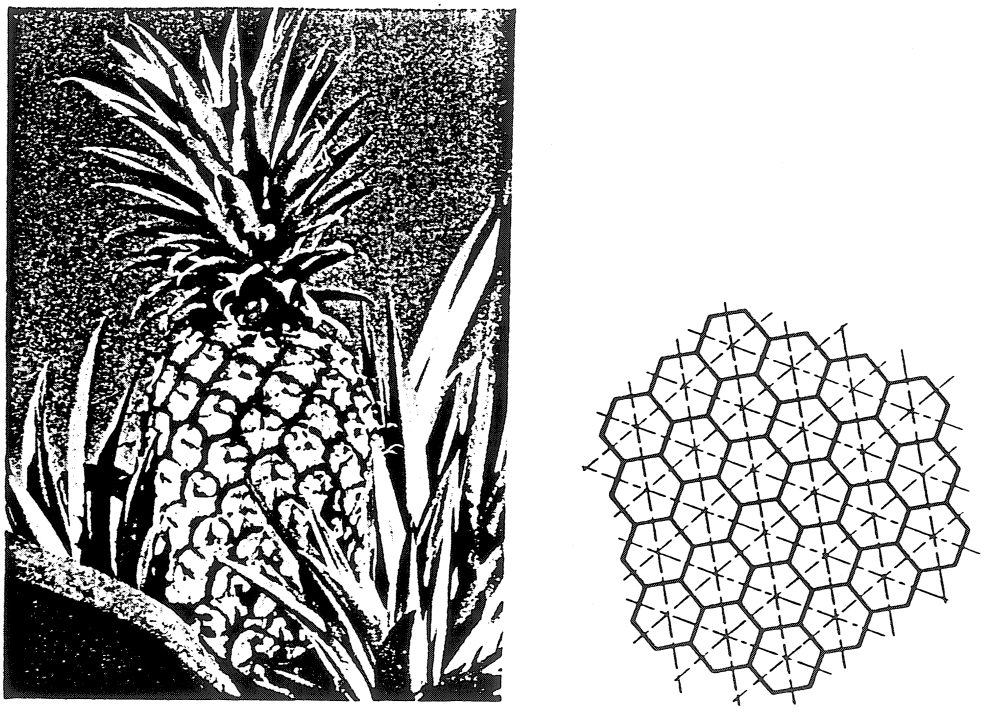


Figure 23

The spiral curves described on page 81 are called *parastichies* (from Greek *para* meaning *beside* and *stichos* meaning *row*). Parastichies on pineapples are especially interesting. Since pineapple scales are roughly hexagonal in shape, three sets of spirals can be found, as pictured in Figure 23. Parastichies on pineapples are described on pages 21–22 of *Mathematical Diversions* by J. A. H. Hunter and Joseph S. Madachy (Princeton, N. J.: D. Van Nostrand Co., Inc., 1963).

Other references for discussions of Fibonacci numbers in nature are:

E. J. Karchmar, "Phyllotaxis," *The Fibonacci Quarterly*, Vol. 3, No. 1 (February, 1965), pp. 64–66.

Sr. Mary de Sales McNabb, "Phyllotaxis," *The Fibonacci Quarterly*, Vol. 1, No. 4 (December, 1963), pp. 57–60.