

## Chapter 21

# MECHANISMS



The mathematical investigations referred to bring the whole apparatus of a great science to the examination of the properties of a given mechanism, and have accumulated in this direction rich material, of enduring and increasing value. What is left unexamined is however the other, immensely deeper part of the problem, the question: How did the mechanism, or the elements of which it is composed, originate? What laws govern its building up? — F. Reuleaux, *Kinematics* (1876), p. 3

In this chapter we will study mechanisms, which for our purposes we define as collections of rigid bodies with moveable connections having the purpose of transforming motion. We have already studied two mechanisms: an angle-trisecting mechanism in Problem **15.4d** and the Peaucellier-Lipkin straight-line mechanism in Problem **16.3**. A machine can be considered as a combination of mechanisms connected together in a way to do useful work. In this chapter we will use the Law of Cosines and the Law of Sines for the plane and sphere in Problems **21.1** and **21.2**. Otherwise the material demands only basic understanding of plane and spheres.

### INTERACTIONS OF MECHANISMS WITH MATHEMATICS

We mentioned in Chapter 0 that one of the strands in the history of geometry is the Motion/Machines Strand; and we showed in Chapter 1 how this strand led to mechanism for producing straight line motion. It is known that the Greeks, in particular Aristotle, studied the so-called simple machines: the wheel, lever, pulleys, and inclined plane. He also described gear wheel drive in windlasses and pointed out that the direction of rotation