19 NICOLAUS COPERNICUS

1473-1543

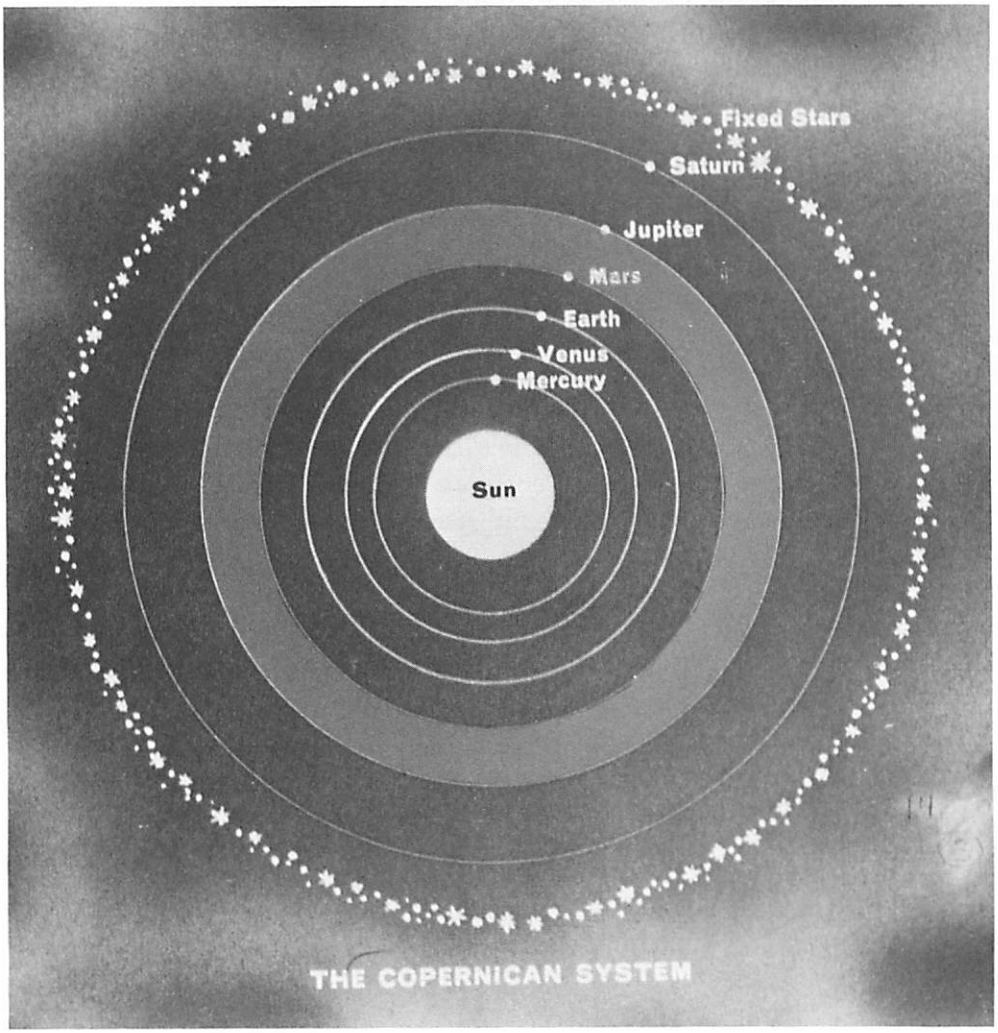
The great Polish astronomer Nicolaus Copernicus (Polish name: Mikolaj Kopernik), was born in 1473, in the city of Torún, on the Vistula River, in Poland. He came from a well-to-do family. As a young man, Copernicus studied at the University of Cracow, where he became interested in astronomy. In his mid-twenties he went to Italy, where he studied law and medicine at the Universities of Bologna and Padua, and later received a doctorate in canon law from the University of Ferrara. Copernicus spent most of his adult life on the staff of the cathedral at Frauenburg (Polish: Frombork), where he was a canon. Copernicus was never a professional astronomer, and the great work which has made him famous was accomplished in his spare time.

During his stay in Italy, Copernicus had become acquainted with the idea of the Greek philosopher, Aristarchus of Samos (third century B.C.), that the earth and the other planets revolved about the sun. Copernicus became convinced of the correctness of this heliocentric hypothesis, and when he was about forty he began to circulate among his friends a short, handwritten manuscript setting forth in preliminary form his own ideas on the subject. Copernicus spent many years taking the observations and making the calculations that were necessary for the composition of his great book, *De revolutionibus orbium coelestium (On the Revolution of the Celestial Spheres)*, in which he describes his theory in detail, and sets forth the evidence for it.

In 1533, when he was sixty years old, Copernicus delivered a series of lectures in Rome, in which he presented the principal points of his theory, without incurring papal disapproval. However, it was not until he was in his late sixties that Copernicus finally decided to have his book published; and it was not until the day he died, May 24, 1543, that he received the first copy of his book from the printer.

In his book, Copernicus correctly stated that the earth rotates on its axis; that the moon revolves around the earth; and that the earth and the other planets all revolve about the sun. However, like his predecessors, he badly underestimated the scale of the solar system. Also, he was wrong in believing that the orbits consist of circles or of epicycles. Thus, his theory was not only complicated mathematically, but inexact as well. Nevertheless, his book promptly aroused great interest. It also motivated other astronomers, most notably the great Danish astronomer, Tycho Brahe, to make more accurate observations of planetary motions. It was from the observational data accumulated by Tycho that Johannes Kepler was finally able to deduce the correct laws of planetary motion.

Though Aristarchus of Samos had propounded the heliocentric hypothesis more than seventeen centuries before Copernicus, it is appropriate that Copernicus has received the bulk of the credit. Aristarchus had made an inspired guess, but had never



The Copernican system of the universe.

presented his theory in sufficient detail to make it scientifically useful. When Copernicus worked out the mathematics of the hypothesis in detail, he transformed it into a useful scientific theory—one that could be used for prediction, that could be

checked against astronomical observations, and that could be meaningfully compared with the older theory that the earth was the center of the universe.

It is clear that the Copernican theory has revolutionized our conception of the universe, and has led to major changes in our whole philosophical outlook. But in evaluating the importance of Copernicus, it should be remembered that astronomy does not have the great range of practical applications that physics, chemistry, and biology do. In principle, one could construct such devices as a television set, an automobile, or a modern chemical factory without the slightest knowledge or application of Copernicus's theories. (One could not do so without applying the ideas of Faraday, Maxwell, Lavoisier, and Newton.)

But to consider only the *direct* influence on Copernicus on technology would be to completely miss his true significance. Copernicus's book was the indispensable prologue to the work of both Galileo and Kepler. They in turn were the major predecessors of Newton, and it was their discoveries which enabled Newton to formulate his laws of motion and gravitation. Historically, the publication of *De revolutionibus orbium coelestium* was the starting point of modern astronomy—and, more importantly, the starting point of modern science.