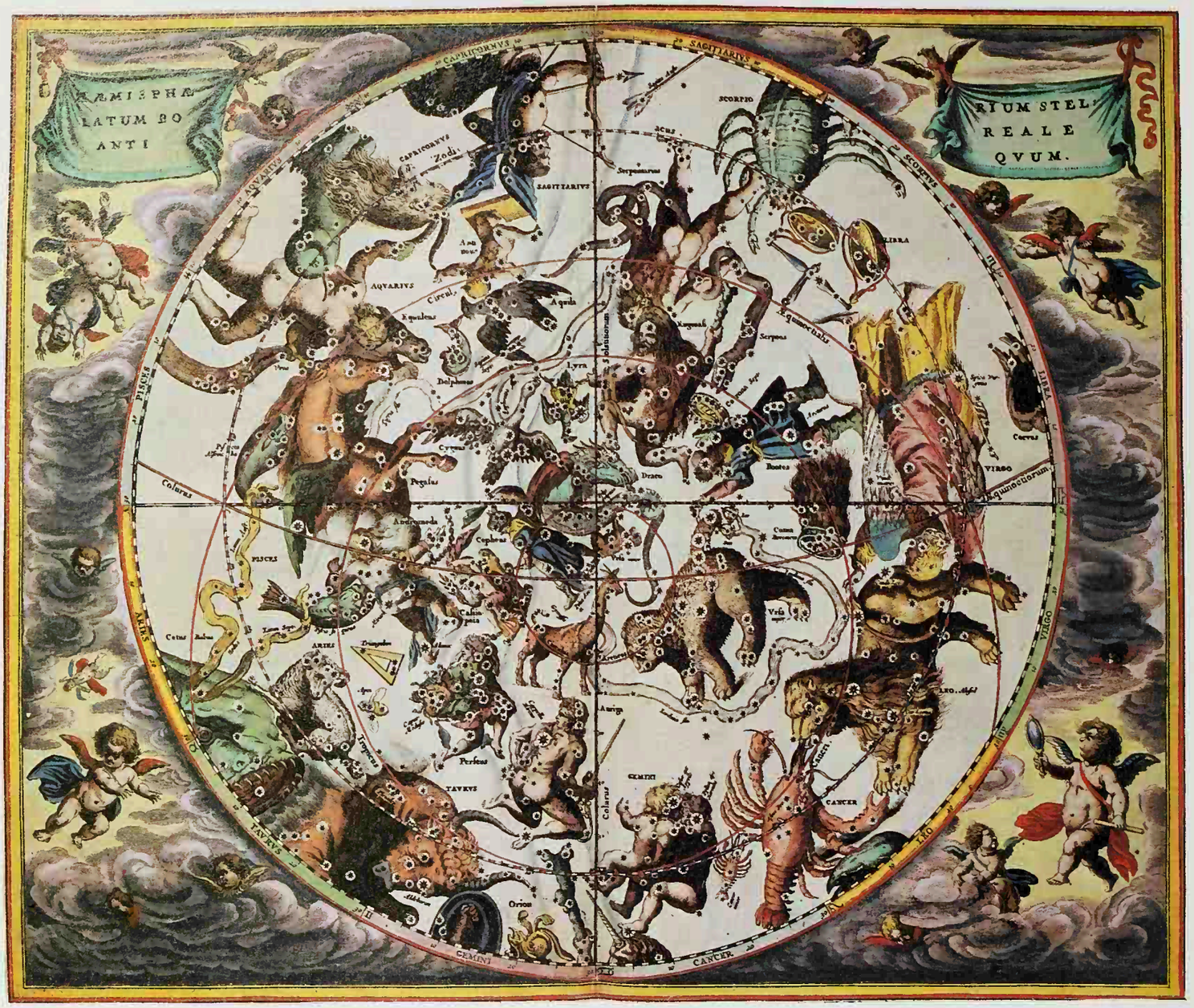

Part of a chart of the northern hemisphere constellation drawn up by the great observational astronomer Johannes Hevelius in 1645 and published by him in his Tabula Selenographia.

Beyond about 30 pc the angles become too small to be measurable with precision, and beyond 300 pc too small to detect; more indirect methods have then to be used. These involve analysing either the star's light, in some stars their periodic variations, and in even rarer cases the brightness of exploding stars. Something may also be done by measuring space velocities, but details must wait until we discuss the stars themselves (Chapter 3). However, the distances of the Sun and Moon are, of course, small compared with the stars and trigonometrical parallax methods may be used. Indeed the Moon is so close that its distance can be determined using observations made from two different points on the Earth's surface. Nevertheless, in the interests of obtaining their distances with as great an accuracy as possible, radar methods are now used. Pulses of radio waves are shot out into space and the time taken for them to bounce back to Earth is measured. Since radio pulses travel at the same speed as light, the distance of the Sun and Moon can be obtained with great precision.

One of the earliest problems that faced astronomers was posed by the wandering stars or **planets**. As soon as the stars had been grouped into constellations, it was noticed that a few of the brighter stars seemed attached to no particular constellation, but weaved their way across the sky quite independently. Their motions were complex; sometimes they moved forwards, sometimes backwards, and on certain occasions they stood still. It fell to the Greeks to try to systematize these motions, and for a variety of reasons they settled on explanations involving a series of circular orbits centred on the Earth. Systematized and described in the second century AD by the Greek astronomer Ptolemy, this Ptolemaic system satisfied the astronomical world until the sixteenth century. Then new explanations of old ideas were in fashion and Nicolaus Copernicus proposed a new model in which the planets orbited around the Sun. Copernicus had no proof, but his proposal was favoured by mathematicians and led to a vast amount of observational and mathematical research. Within the next 150 years, the old Earth-centred (geocentric) universe gave place to a Sun-centred (heliocentric) one, and due to the work of Tycho Brahe, Johannes Kepler, Galileo Galilei and Isaac Newton, the orbits of the planets were found to be ELLIPSES and their motions to be governed by universal gravitation. It