# Replicating the Great Quadrant

*History repeats itself, beautifully!*

▲ Jon Voisey and his friend Meg Cassidy take a measurement with Jon's replica of Tycho Brahe's Great Quadrant.

**WHEN YOU THINK OF** medieval recreation, you probably think of Renaissance clothing, feasts, calligraphy, and swordfights. All of these, and more, are the sorts of things that members of the Society for Creative Anachronism (SCA) engage in. It's a group dedicated to understanding history through engaging in it. But one area that's often overlooked is astronomy.

When you think of scientists, you often think of researchers breaking new ground with new discoveries, but one of the most important things a scientist can do is to replicate the methods and the results of a previous experiment. Understanding how it was done is both personally satisfying and scientifically (and historically) important.

Enter Jon Voisey, known in the SCA as Lord Jon Chesey of the Barony of Three Rivers in the Kingdom of Calontir, who also holds a degree in astronomy. He fused these two passions after becoming interested in how Johannes Kepler worked out his elliptical heliocentric model of planetary motion before the invention of the telescope. Jon wanted to recreate Kepler's discovery, using Kepler's methods. So, Jon, like Kepler, turned to Tycho Brahe, whose instruments measured the night sky with a precision unmatched in his time (the second half of the 16th century) and whose data laid the foundation for Kepler's work.

To take his measurements, Jon decided to build a replica of Tycho's Great Quadrant, one of the instruments with which Tycho measured the position of the stars and planets. Using observations from this instrument, Jon intends to collect sufficient data of his own to follow Kepler's methodology and derive the orbits of the naked-eye planets. Because Kepler used measurements taken at opposition, and planetary oppositions are relatively rare events, this will take many years. So he's also using the quadrant in the meantime to plot the position of hundreds of stars as Tycho did as well, leading to the first accurate star map, Johannes Bayer's *Uranometria*, in 1603.

Jon's father is a contractor and carpenter, so he helped Jon build the Quadrant over the weekends of almost two months. They started with the curved arc, which they drew on a sheet of plywood and cut with a jigsaw. Then they made the internal lattice, ripping 2-by-4s down to 1½″ × 1½″ and making cross-lap joints with a dado blade. They built the 5″-square central column out of plywood and the base out of plywood and 4″ × 4″ posts. They then made an axle out of ½″ iron pipe and hung the quadrant from the axle. A plumb bob also hangs from the axle and is used to level the instrument as well as take the reading where the plumb line crosses the scale.

Drawing that scale was the killer. Tycho boasted that his instrument was accurate to **⅛** of one minute of arc. Jon's replica is smaller, so his scale is smaller as well, but he wanted it to at least be accurate to within a few arcminutes. Unfortunately, the period methods used to create accurate scales proved elusive, so Jon made the scale in the drafting software program *AutoCAD*. After printing, he transferred the scale to the wood by cutting through the drawing with a razor knife, then enhancing the marks with a Sharpie. The scale zigzags to provide greater

GREAT QUADRANT REPLICA: WILL DAY; ORIGINAL QUADRANT: *ASTRONOMIAE INSTAURATAE MECHANICA*; LATTICE UNDER CONSTRUCTION: JON VOISEY

▶ The lattice was made with 1.5″ wooden strips bearing cross-lap joints.

separation between points, making it easier to read.

Tycho's instrument lacked an azimuthal scale, so Jon initially tried following suit, observing objects only as they crossed the meridian, but that proved too restrictive. So he installed an azimuth scale and takes his measurements in both altitude and azimuth, which are converted to RA and declination for comparison to modern values.

The finished quadrant is, of course, a hit at SCA events, but on clear nights Jon can often be found under the night sky, patiently collecting data on his own. Why does he do it? Jon says, "The big reason is the sense that I'm doing something important. While this path has certainly been walked before, it's so rare that anyone has done it that the path is overgrown."

Jon is certainly clearing that path here, with a beautiful melding of science, history, craftsmanship, and art.

For more information about the Great Quadrant, visit Jon's website at **jonvoisey.net/blog**.

■ Contributing Editor **JERRY OLTION** has made a replica of Galileo's telescope and used it to confirm that Jupiter's moons do indeed orbit the gas giant and not Earth.

▼ The plumb bob's fine brass wire and the staggered scale allow measurement accuracy of about three arcminutes.

JON VOISEY