

### 3.0 Purpose of Investigation

The astrolabe played a crucial role in the scientific development of Islamic and Christian cultures, remaining in use for over 600 years in European and over 1000 years in Islamic societies. This provides an interesting opportunity for study; a class of artifact that was used extensively throughout two dissimilar cultures for such a long period of time while the artifact remained essentially the same. There have been many studies of astrolabes in the past, however these have focused predominantly on astronomical accuracy [**Chapman; Lamprey**], authentication [**Brieux**], specific geographical production centers [**Van Cleempoel**], or cataloguing [**Turner; Webster and Webster; Mayer**]. There have been very few studies of the metallurgy and metal forming techniques used in astrolabe production. Only two very limited scale studies have investigated the metallurgy and metal forming techniques of astrolabes by traditional metallography [**Gordon, 1986; Gordon, 1987**]. This is because traditional metallography is a destructive technique requiring either cutting a metal sample from astrolabe or grinding and polishing a region of the astrolabe. Astrolabes are constructed from many different components, so the need to sample every component would be necessary for study completeness. Due to their extreme value, this is not appealing to current instrument collectors and is often forbidden outright in museum collections.

In 2001 Stephenson et al. published a study of two astrolabes investigating their metallurgy and metal forming techniques by emerging and completely non-destructive techniques based on synchrotron X-rays [**Stephenson et al.**]. This

revolutionary technique allowed data collection that was previously only available through destructive metallographic analysis. By combining radiography, diffraction, and fluorescence experiments they were able to answer questions about the authenticity of the astrolabes without causing any harm to the instruments by sampling. The Stephenson et al. study has touched on the capabilities of the synchrotron-based techniques; however it only examined two instruments.

In this study, the techniques and scale of the Stephenson et al. study are expanded to examine the astrolabe as a cross-cultural touchstone with which to study the metallurgy and metal forming techniques used in astrolabe manufacture. It is the aim of this study to nondestructively:

- Study a representative cross-section of major astrolabe production centers (both Islamic and European), makers, and dates.
- Create a metal technology timeline to investigate how metalworkers addressed astrolabe construction throughout history.
- Compare manufacturing techniques between individual makers within a production location.
- Compare instruments from different time periods within a production location.
- Determine if astrolabe metallurgy and manufacturing techniques varied by astrolabe component class.
- Examine historically questionable astrolabes and astrolabe components to determine if they are authentic.

It has been documented in the literature that the knowledge and theory of the astrolabe transferred between Eastern and Western cultures [**Turner, p.16**]. In this study it will be determined whether metallurgical and metalworking knowledge were transferred as well.