

# Reconstructing the astronomical heritage

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**Abstract.** Studies of the astronomical heritage can deal with the ancient astronomical knowledge, traditions and myths, as well as with old instruments and observatories. It is urgent to work for their recovery, before they are definitely forgotten, lost or destroyed. On the cultural side, the Joint ALMA Observatory is sponsoring the study of the local cosmology and sky of the indigenous people living in the region where ALMA is currently being build. In the case of ancient instruments, several success stories already exist, the most recent one being the reconstruction of the Madrid 25ft Herschel telescope. Examples of notable instruments pending reconstruction are listed.

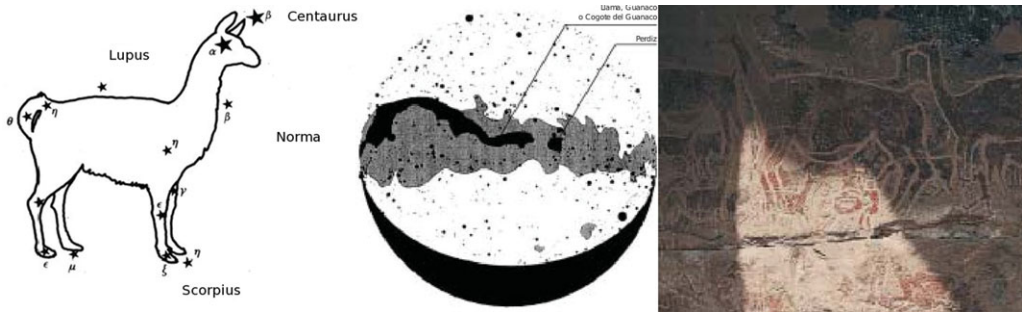
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## 1. Reconstructing the cultural astronomical heritage in El Loa province of Chile

The astronomical heritage of peoples, cultures and countries takes many forms. In the most successful cases the participation in the development of Astronomy may be part of the general culture, with old discoveries, observatories and astronomers being widely known. In other cases, when none of them has reached us, what remains may be embedded in the popular culture, usually an orally transmitted knowledge that is difficult to sort out. Archeology sometimes helps, but in some areas most of the knowledge has to be gathered from peoples. Efforts are being done to decode and save this popular heritage, that usually deals with calendar related subjects and with cosmological or cosmogony aspects of their universe. This has to be urgently studied, before the homogeneity of culture gets rid of this knowledge that lies, mostly, in the memories of the oldest ones and rarely is found in texts.

One of such efforts recently started in El Loa province in Northern Chile, where the Atacama Large Millimeter/submillimeter Array (known as ALMA) is currently being build. In fact, the Institute of Archaeological Research and Museum Gustavo Le Paige in San Pedro de Atacama, with the sponsorship and collaboration of the Joint ALMA Observatory, has started a study on “*Cosmology and astronomical knowledge in the Atacama basin region*”. The goal is to collect, elaborate and publish a deep study of the local cosmology and the traditional cultural links between the local world view and elements of the celestial sphere of the indigenous people in this area, for which a few preliminary studies exist (Vilches 2005 and Magaña 2006 deal with the High Loa area). This is a continuation of other archaeological (Barón 2005) and nature (Argandoña & Heisig 2007) studies already sponsored by ESO and ALMA in this region.



**Figure 1.** (left) The Llama Constellation in the Quechua-Aymara culture in Northern Chile, based on Rodríguez de la Fuente (quoted in Magaña 2006). (center) Night sky at winter solstice and (right) light/shadow effects in art rock during the summer solstice, from the study of the celestial and terrestrial space in Taira rock art by Vilches (2005).

## 2. The astronomical heritage in astronomical instruments

Another aspect of the cultural astronomical heritage is that of the instruments astronomers used for their research or their service tasks. Visits to collections of instruments in science museums and observatories are the main source of contact for school children and adults with the instruments used in the past. The visitors can marvel on how advanced were their ancient countrymen in the old mechanical or optical technology. And they may also be able to grasp the ingenuity of the astronomers that used such limited instruments in order to make their studies and discoveries, that constitute the astronomical heritage of their country. Interest in the current astronomical discoveries may also rise, thanks to the realization that it is real people, living and working in such places, who did and still do scientific research.

Some old large instruments, well maintained (e.g. the Ming astronomical bureau bronze instruments in Beijing, 15<sup>th</sup> century, and the Jantar Mantar observatory in Jaipur, India, 19<sup>th</sup> century), reassembled (e.g. the Leviathan telescope of Lord Rosse in Ireland, 19<sup>th</sup> century) and, merely, excavated (e.g. the Ulugh Beg huge sextant in Samarkand, Uzbekistan, 15<sup>th</sup> century), have even become tourist attractions.

However, often the most relevant instruments in the past, that can better exemplify the golden eras of astronomical research, are missing, either abandoned, destroyed or lost. My proposal is to work for their recovery, by fixing their remains or constructing a replica of old instruments that had a significant role in the astronomical heritage of a community, a country, or the world. You may reasonably think that local/state authorities may not be willing to fund the reconstruction of big ancient instruments, but this is not always the case.

## 3. A success case of full reconstruction: the Madrid 25ft Herschel telescope

Shortly after its foundation in 1790, the Royal Astronomical Observatory of Madrid ordered a large telescope to William Herschel, the largest he could reasonably build. After the failure of the 40ft telescope (Hoskin 2003), Herschel concluded that the largest telescope he could build with success was a 25 ft long tube equipped with a 2 ft in diameter mirror. In fact, the Madrid telescope turned out to be superior to any other large telescope he ever build (Bennett 1976). First light in Madrid happened no later than August 1804, with a partially installed structure (Tinoco 1951). In 1808 it was destroyed by the Napoleon Army under general Senarmont. The two 2ft mirrors, and six



**Figure 2.** The 25 ft long telescope that the Kingdom of Spain commissioned to W. Herschel by the end of the 18<sup>th</sup> century has been full-scale rebuild using the extant notebooks and drawings, and a lot of ingenuity and enthusiasm. What was learned could serve as a guide for any future attempt to rebuild an old, big scientific instrument.

notebooks with detailed information and two sets of large watercolor drawings ordered by José de Mendoza y Ríos, the Spanish naval officer and astronomer who supervised the project in London, were saved from destruction by the observatory director Salvador Jiménez Coronado (cf. López Arroyo 2004).

These extant notebooks and drawings have been the basis for the full size reconstruction of the telescope by the Observatorio Astronómico Nacional of Spain (Instituto Geográfico Nacional, Ministerio de Fomento). A feasibility study was followed by the construction of a 1:10 scale model and a full project, that was carried out at the Bermeo shipyard in Northern Spain. The optical system was also reconstructed, the mirror cast in metal as the original ones, in Aranjuez, near Madrid. An enclosure was build in the grounds of the old observatory, in the South East corner the Retiro park in Madrid. The telescope was installed in August 2004, exactly two centuries after the presumed first light of the original one.

Although this telescope is a reconstruction, it performs very well as an astronomical cultural landmark for Spain as it represents one of the most emblematic attempts in Enlightenment Spain to increase its scientific level. Currently, the 25ft Herschel telescope is the main attraction for the visitors to the over two-hundred years old Madrid Observatory.

#### 4. A few suggestions for possible instruments reconstruction

We have learned from this experience that documentation is essential: all textual and graphical information on the telescope to be reconstructed and on similar ones build in the same country and epoch, has to be gathered. The operation of each piece has to be well understood and an accurate scale model has to be build. A decision has to be made to whether it will be operative or ornamental, a comprehensive construction project has then to be made with a cost estimate, including that of the enclosure if required. Finally,

an adequate workshop, better if nearby, with an enthusiastic and clever team has to be found to carry out the reconstruction, and to solve any unforeseen difficulty.

There is no lack of important telescopes and astronomical instruments of the past to be reconstructed. A few suggestions follow: the Tycho quadrant in Denmark, the 27 ft 18.5 inches Schröter telescope in Lilienthal (Germany), for which a scale model is already available (Lühning 2002), or the 24 inches Lassell equatorial telescope in Malta. Some ancient buildings in America are thought to be astronomical instruments, like El Caracol building in Chitchén Itzá, Mexico (Aveni, Gibbs & Hartung 1975). The flood of tourists in this area of the Riviera Maya prevents a deep explanation or even the practical test of the astronomical uses claimed for this observation place. Instead, a full size reconstruction, in brick or wood, could allow both the researchers and the interested visitors to carry out and experience the sort of day and night time observations of the ancient Mayan astronomers. It could be build out of the park grounds in order to easy its access, specially for night time observations.

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