**ABSTRACT**

- The emerging science of astrophysics began in the early 19th Century. Astronomy leading up to this moment was based on empirical observations and astrometry.
- Two distinct observational techniques changed astronomy and society forever: these were spectroscopy and astrophotography.
- These became the basic tools and instruments for the new science of astrophysics.
- The building of the Lick Observatory is an underappreciated event that impacted astronomy and astrophysics.
- Prior to this, astrophysics had three limitations: the instruments, the building, and the staff of astronomers.
- The building of the Lick Observatory changed all three and as a result built a solid foundation for the new science of astrophysics.

**Development of Spectroscopy**

- 1864-Sir William Huggins uses a spectroscope with a telescope, showing some nebula are glowing gases as they produce bright line spectra, which indicates they are at a very high temperature.
- 1872-Henry Draper made the first spectrograph of a star, a photo of the star’s spectrum.
- 1880-Publication of the first Henry Draper Catalogue of 10,000 spectra in 7 types A, B, F, G, K, M, N.

**Development of Astrophotography**

- 1850-1876 Variety of methods being used in various observatories.
- 1871- The introduction of dry plate astrophotography, a significant technological leap from other methods being employed.
- 1876-Sir William Huggins used the dry plate method to record spectra.
- 1888-1890 James E. Keeler used the 36” Crossley Reflector for astrophotography, making a large reflector necessary for observatories.

**SITE SELECTION AND ARCHITECTURE: THE FIRST MOUNTAINTOP OBSERVATORY**

- S. W. Burnham, an expert double star observer spent two months on Mt. Hamilton.
- Mt. Hamilton is 4250 feet and is the tallest in the region, so views were unobstructed and meant less atmosphere to observe through.
- The location was above the thermal layer, providing excellent “seeing” on 49 out of 60 nights, due to low humidity.
- The number of clear nights most substantially more-observing could be accomplished.
- The bedrock or “trap” rock provided stable footing for the telescopes.
- An observatory needs a well-stocked library.

**The Lick Refractor, Lick Observatory, Taken September 11, 2009. Photo: Gordon L. Houston**

**The Instruments**

- The Lick Refractor was the largest refracting telescope in the world when completed.
- The Lick Refractor proved that larger instruments coupled with superior cameras and spectroscopes produced superior science results.
- There were larger reflecting telescopes than the Crossley Reflector, but when paired with astrophotography, it set a standard that all observatories adhere to today.

**The Crossley Reflector**

- Photo: UC Observatories Mary Lea Shane Archives

**The Staff**

- The final aspect of lasting significance of the building of the Lick Observatory is the assembling of a professional staff to be dedicated to astronomical research. The original staff included Holden, Burnham, Schaepbele, Keeler, and Barnard, and assistant astronomer Hill.

Edward S. Holden

- The first director of the Lick Observatory, he along with Simon Newcomb designed the Lick Observatory.
- He recruited the first staff of astronomers who each skills in complimentary areas of astronomical research.
- He wore constantly, much of which was published to viewing public. In this regard he substantially heightened the awareness of astronomy to the public (Neuhauser 1958b). He pioneered in Lunar astrophotography with the Lick Refractor. His most lasting legacy, one of which is still a major contributor to the science and education of astronomy today, was the formation of the Astronomical Society of the Pacific (Franklin 2009). All of the staff astronomers were charter members.

James E. Keeler

- He was a trained and educated astrophysicist. He was considered the outstanding astrophysicist of the late 19th century (Ostrothek 1870). His work with the Crossley Reflector has been mentioned. He was an expert spectroscopist with some results still equal to modern day measurements.
- He was a big influence of George E. Hale, with whom he co-founded The Astrophysical Journal. He was a founding member of the American Astronomical Society. Became the second Director of the Lick Observatory in 1898.

Edward Emerson (EE) Barnard

- E. E. Barnard was a self-taught astronomer who had significant visual observation skills. He was one of the most prolific discoverers of comets in the 19th Century (Hockey 2007). Mt Simon Newcomb When he was 20 who told him to be grounded in mathematics. Worked in a photography shop for 17 years. Discovered the 5th moon of Jupiter with the Lick Refractor…the last to be discovered visually. He had discovered the dark extended interstellar absorption regions in the Milky Way, which later became classified as Barnard dark nebulae. Left the Lick and joined Hale at the Yerkes, completing a dark Nebulae catalogue. At Yerkes, he mentored Edwin Hubble in astrophotography.

Sherburne W. Burnham

- He was an amateur astronomer and expert double star observer. He was employed to do the site evaluation at Mt. Hamilton. His report to the Lick Trustees is an essential guide of site evaluation for all future observatories. Created an extensive double star catalogue. He was later hired by Hale at Yerkes, where he made his last observations in 1914.

W. W. Campbell

- He was an engineer. He learned spectroscopy from Keeler and took over when Keeler left. He found visual spectroscopy limiting and designed the Mills Spectrograph. It was the observation of variable radial velocities which led to the discovery of spectroscopic binaries. Became the third Director of the Lick when Keeler passed away.

John M. Schaepberle

- He was a civil engineer, mainly did meridian observations. Designed the 40 foot Schaepberle Camera taking the best photos of the solar corona.

**Conclusions**

The building of the Lick Observatory was a significant moment in astronomy, advancing the new science of astrophysics, that is under appreciated today. Pioneering work was done that set the standard of the day, that still influences researchers today.