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100 inch telescope on Mt. Wilson

Where the Earth Meets the Sky - Part I

by Bryan A. Snow

Last spring I was contacted by an old college buddy with an offer I couldn't refuse. Another fellow college graduate of the Astronomy program had booked a night on the historic 60 inch telescope atop Mount Wilson, in California, and wanted to know if I wanted to go along. I have about half a dozen different telescopes myself, but to spend a night looking through a large professional telescope at a multitude of heavenly objects was too good to pass up.

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IAPP e-Monitor

The IAPP e-Monitor was designed to give our membership a quick look at what is going on with the IAPP and with panoramic photography in general. It was originated to give our membership quicker information while they await the release of the PANORAMA.

We welcome any and all articles and photos from IAPP members for inclusion into the IAPP e-Monitor. This is a publication for the IAPP, by the IAPP, and about the IAPP.

Table of Contents

Dan, who booked the scope, is now retired but was the Planetarium Coordinator of the Department of Physics and Astronomy at Arizona State University. Ted, who contacted me, is retired from the U.S. Naval Observatory in Washington D.C. where he was the head of the

Dan, Ted, Jack, and Bryan posing with the 60 inch.

Astrometry Department. Another fellow graduate, Jack, who had shifted to geology but still retained his love for astronomy, is currently the geological advisor to a major Oil company. He, likewise, came along. Since my graduation I worked as, and retired from, being the Director of the Planetarium and Observatory at San Antonio College. The four of us decided to meet in Phoenix, Dan's home, and drive to southern California for the trip.

Since we were all coming from different parts of the country we decided to make a road trip of extraordinary interest to all of us. Through various contacts we were able to secure special tours of, not only Mt. Wilson's observatories, but also a private daytime tour of Mt. Palomar Observatory, the Steward Observatory Mirror Lab facility, and Kitt Peak Observatory. For astronomers, these facilities were equivalent to going to Egypt, Machu Picchu, or Rome for archeologists or historians. Mt. Wilson's 100 inch telescope was the largest telescope in the world from its completion in 1917 until 1948. Mt. Palomar's 200 inch telescope was the world's largest telescope from 1948 until 1975, and is known to many as "The Cathedral of Astronomy". The creation of this 200 inch mirror blank by Corning Glass Works in the 1940s and the subsequent transportation of this disk by rail to California was considered a tremendous engineering feat and was hailed by thousands of people who lined its transportation route.

Telescopes are classified in size by the diameter of their mirror, in a reflecting telescope, or their lens, in a refracting telescope. A refracting telescope is basically a large telephoto lens that can either be looked through or have a camera or other instrument attached to the back. The largest refracting telescope is the 40 inch refractor at Yerkes Observatory in Wisconsin. In a reflecting telescope, a large mirror is mounted at the rear of the scope and the incoming light is reflected from the large curved mirror to a smaller secondary mirror located at the entrance to the scope's tube. The incoming light is then bounced off the secondary mirror to a camera or other sensing instrument. Early telescopes were mostly refracting telescopes but, as the quest for larger and larger telescopes continued, it was found that glass mirrors could be made far larger than a lens system and all major telescopes are now reflecting ones.

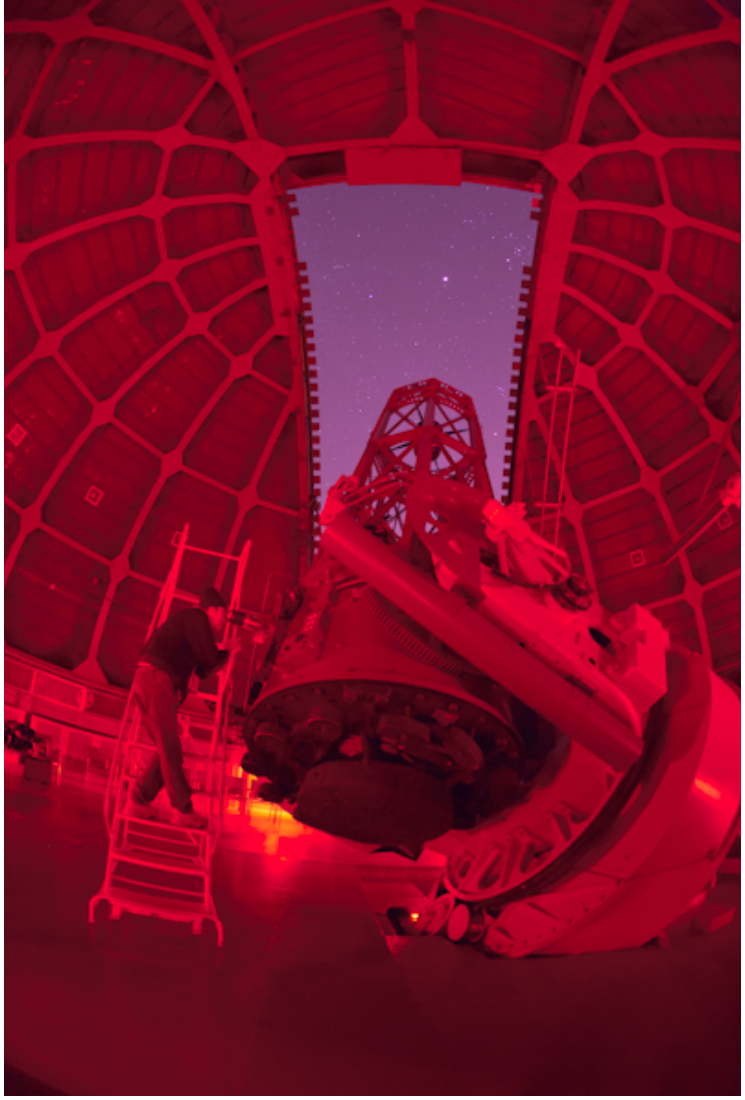
60 inch reflecting telescope

The Telescopes of Mt. Wilson

When taking photographs of anything in the daytime you are usually free to choose the aperture best suited to the target you are shooting. You usually use the lens's aperture to control depth of field and exposure. With telescopes, the aperture is fixed and its only purpose is to maximize the amount of light that will get to your detector. Since most telescopes are imaging targets that are too faint to be seen with the unaided eye they need to capture the photons of light as efficiently as possible, and, to do this they need a very large aperture. Hence the quest for larger and larger mirrors for larger and larger telescopes. In the early part of the 20th Century it was planned to make the world's largest telescope and place it atop Mt. Wilson, just north of Pasadena, in California. To work properly a telescope must be placed where the air is very steady. If you've ever looked out over an asphalt roadway in the summer and noticed the shimmering of heated air off the road you have seen what unsteady air looks like. In photographing through that shimmer, it is impossible to get a steady image. Since a telescope magnifies everything it sees, it magnifies the unsteady air at the same time as it magnifies its target, and the resulting combined image of target and unsteady air makes for a horrible image. To remedy this, telescopes are usually located in places where steady air is the norm. This usually places the telescopes high atop mountains and, many times, along a coastline where a steady, laminar flow of air that has traveled hundreds of miles over the ocean reaches the telescope and gives the steadiest of images. The decision to place the world's largest telescope (at the time) atop Mt. Wilson took into account the steadiness of the air and the close proximity of the resources of southern California. As a result, the 100 inch telescope was born (see page 1).

Early telescopes were used visually, that is, an eyepiece was placed at the focus of the telescope and the operator would view the resulting image. This worked fine for bright images but to keep records the operator had to draw what was being seen through the scope. With the advent of the photographic plate the telescopes became what they are today - giant telephotos - giant FAST telephotos.

The engineering of a telescope has always been one of the biggest challenges in modern times. The mirror itself weighs several tons and that weight needs to be moved around to point to any location in the sky. Not only that, but the mirror, once it acquires its target, must move to exactly



counteract the Earth's daily motion to keep its target precisely aligned to deliver its light to the camera or other detector. In the early days of the 20th Century the photographic plates were glacially slow in speed, akin to an ISO of 4 to 10. To capture faint images the telescope operator would guide the motorized telescope to precisely keep its target star on the crosshairs for exposures of 10 to 30 HOURS. They would locate the target, focus the scope, affix the glass plate, and open the dark slide as soon as the sky was dark, and guide the scope until the first sign of daylight. Then they would cover the plate with the dark slide and remove it from the scope and store it safely in a light-tight vault until sunset. Once it was dark the process would be repeated with that same plate for the next entire night. In that way the light of the faint objects would build up on the plate and allow the faint objects to be seen.

The 100 inch telescope on Mt. Wilson was used every clear night for decades by some of the best known astronomers of the time. The backlog of astronomers to use the scope was so long that they built a smaller 60 inch telescope to take up some of the slack. It was with this 60 inch telescope that our group would be able to view many of the wonders of the night sky

Atop Mt. Wilson there also exists several solar telescopes that were made to only investigate the Sun. The first is a horizontal telescope that has the mirrors laid horizontally while the mirrors reflect the image of the Sun to a spectroscope that can isolate a variety of different wavelengths of light and record the solar disk in any of the wavelengths. This scope is named "The Snow Telescope", not to honor me in any way, but was paid for in part by a wealthy benefactor by the name of Helen Snow. Later, it was found that the air was steadier if you could place the reflecting mirrors higher above the earth than the ones in the Snow Telescope and so two solar towers, a 60 foot and a 150 foot were placed in use.

150 foot solar telescope

Panoramic Photography on Mt. Wilson

Prior to sunset on October 13th, 2012 we had a tour of the facilities of Mt. Wilson during which many of the resulting images in this article were taken. One of the purposes of attending was to test out the panoramic imaging of the new iPhone 5.

DSLR Pan

This camera has an eight megapixel camera and I was anxious to see how it would work in the field. I would not be attaching it to the telescopes but the views of the Observatory grounds should allow many images to be made. I had my panoramic adapter and my usual setup for shooting digital images with a DSLR Canon 5D but I was also going to use a 15 mm f/2.8 lens when shooting in the domes of the observatories to get the maximum coverage available in the limited light.

The whole purpose for the trip was four-fold: To see the historical observatories; to view through the 60 inch; to make a photographic record and capture images of targets of worth; and to test out the iPhone 5's panoramic capabilities.

Testing the Panoramic Camera

The first thing I did when I got out of the car was to set up the panoramic systems and capture a panoramic image. The target was not spectacular in the least but I wanted to get images "in the can" just in case something happened and no other images could be taken. It shows a nearby mountain top where, 96 years ago, the 100 inch mirror made its slow and awkward journey up a mountain on a donkey path that was barely widened enough to get a truck and trailer with the mirror through. From that lower mountain the mirror was brought up to the peak where this image was taken.

The first image (above) is taken by my Canon 5D on the Jasper Panoramic Adapter attached to a Giotto carbon-fiber tripod. The lens is a Canon 45mm perspective control lens. It is composed of three overlapping shots that are stitched with AutoPano Pro software. The comparison shot was taken with the iPhone 5. Shooting a pan with the iPhone 5 is relatively simple. You click on "camera" and when the camera screen comes on you click on "options" in the top-middle of the screen. This opens the options of "Grid",

iPhone 5 Pan

"HDR", and "Panorama". When you click on "Panorama" the live scene is overlaid with a rectangle with a horizontal line inside and a right-pointing arrow centered on the line. The iPhone is held vertically instead of horizontally. Under the rectangle are the words "Move iPhone continuously when taking a Panorama." When you press the shutter button you then rotate the iPhone to the right slowly as it takes a video of the panoramic image. Press the shutter button again to stop taking the panorama. That's all there is to it. Sometimes, especially when the landscape is not level, it is difficult to keep the arrow moving along the straight line. It does require practice. The resulting image is much better than previous iPhone cameras and, as such, makes quick panoramas with your phone an easy thing to do. How do they compare with a full DSLR pan? I wouldn't attempt to blow the resulting iPhone image up to large size but it can stand reasonable blowups. The iPhone 5 can also generate HDR images but not HDR Panoramic images. The iPhone 5 does exactly what it is supposed to do - generate quick panoramic images. The resulting panoramas can be brought into Lightroom or Photoshop and adjusted somewhat but they don't seem to have the dynamic range that a full DSLR has. But you wouldn't expect them to. Would I leave my backpack with all my panoramic cameras, lenses, and adapters at home and just take the iPhone 5? No. But it can take a decent panorama of a scene when you do not have your normal camera gear with you.

Next month we will investigate some of the photo apps that can be used with the iPhone 5, especially one called 645 Pro. This software allows you to change aspect ratios to emulate a 6x4.5, 6x6, 6x7, 6x12, and 6x17 formats. We continue with images from Mt. Palomar and the 200 inch as Part II of Where Earth Meets the Sky continues.

Is this the only article in this issue?

Yes, because no one else sent in any other articles this month. Likewise, if I receive no articles for December, I will only have Part II of this issue's article. So take the time to write an article and get it to me by November 15th and you can get more variety for future issues.

2013 IAPP Spring Conference

The officers and Board Members of the IAPP are diligently working on the next conference which is scheduled for April of next year. A tentative schedule will be published in the December issue of the e-Monitor for all to see. It will have a lot of panoramic photography built into the time schedule so their will be no excuses for not going home from the conference with a ton of wonderful photography.

Location - near Seattle, Washington in the Pacific Northwest. Between the water, the mountain ranges, the tulip fields, and the rain forest you might want to plan several extra days either before or after the conference (or both) to continue your panoramic photography.

Please set aside the dates: April 14th-18th and more for what is planning to be the best IAPP Conference yet.

Offer to Membership

I have a few first edition copies of my book "Glacier Panorama" left in inventory, while the second edition is still selling quite well. Amazon.com has used copies that often go for more than the original selling price of $50.

I would like to donate autographed copies to any IAPP member contributing $100 to the IAPP general fund as an assist in getting the next conference committed and scheduled.

Will Landon

If interested contact the editor and I will contact Will and the IAPP Treasurer to make the deal.

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