Revising the University of Virginia Rotunda Planetarium with Astronomical and Cultural Accuracy

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ABSTRACT

This project aimed to redesign the planetarium put on display in the University of Virginia's Rotunda in 2019 in order to more precisely display the visible stars in the night sky and their corresponding constellations. It also aimed to expand the cultural narrative on display by incorporating other cultures and their astronomical history into the display. This involved mapping star positions onto five separate images that would be displayed on the already present five projectors in the Rotunda's Dome Room. The result is a hopefully inclusive, educational, and scientifically accurate exhibit.

I. CURRENTLY EXISTING WORK

This project was originally begun by three doctoral students at UVA and funded by the Jefferson Trust. In 2019, their work went up, but momentarily stopped running in 2020 due to Covid-19. It was restarted in 2022 and now the Planetarium runs nonstop in the Rotunda, but is mainly only visible after sunset. The Dome Room is open to students during the fall and spring outside of the Rotunda's normal hours on Sunday through Tuesday from 5 to 10 p.m., which is when the exhibit is most viewed. For the past three years, the Rotunda has also run a Rotunda Planetarium Open House in the fall semester for the Charlottesville community to attend. The images are displayed on five Epson Powerlite 500 projectors connected to five Raspberry Pi 3 B+ computers. The projector's run on an automated cycle controlled by the EasyMp network projection software. They project images in a 4:3 ratio with overlap on the upper corners and a gap present in between the bottom corners of each projector, which was taken into consideration when designing images to be projected. This information, along with assistance in the process of testing images and general help with the equipment, was provided by Mr. Benji Boatwright, the Building Trades Supervisor in Facilities Management for the Central Grounds Zone of the University.

II. RESEARCH

The most important and time-consuming aspect of this project was working with the Native American communities around Charlottesville and across the country to create a mode of representation that was both accurate and inclusive. To begin, my advisor, Professor Edward Murphy, the department administrator, Whitney

Richardson, and myself travelled to the Monacan Indian Nation to visit their museum in Bear Mountain in Amherst County, VA. Once there, we had a very educational experience about the story of the Monacan people and the attempts history has made to erase them. Due to these circumstances, there was not any information available about the Astronomy practiced by the Monacans, but while there we acquired a contact for a Monacan artist, Ms. April Branham.

Throughout the project, we worked with the University's Tribal Liaison, Kody Grant, who provided us with helpful contacts within the University community and outside of it, along with tips and insights into how to perform our task respectfully. I feel it would be remiss to not mention that over the course of the semester, in compliance with an executive order meant to end DEI efforts in the public sector, the University's Board of Visitors voted to dissolve the office of Diversity, Equity, and Inclusion. Before this March 2025 decision, Kody Grant's contributions were very helpful in this project, but his capacity to support us after this act was greatly reduced.

Through Mr. Grant, I was brought into contact with Dr. Jacelle Ramon-Sauberan. She is the Tohono O'odham Nation Education Development Liaison for NSF NOIRLab at Kitt Peak National Observatory. She spoke to us at length about her experience as the bridge between her tribe and the observatory and the importance of education material having a balance between both connections. She also introduced us to the One Sky Project, "an international collaboration focused on increasing understanding about cultural and indigenous astronomy, its historical and modern applications, and how our One Sky connects us all" as it explains on the website. The One Sky Project incorporates multiple planetarium shows from across the world into one video, including part of the show by Sharing the Skies, a representation of the traditional astronomy of the Diné, or

the Navajo, which the UVA Astronomy Department already has the rights to show in our own portable planetariums. Eventually, with quite a bit of editing, it could be possible to display some of the other stories from the One Sky Project on the Rotunda.

For the images of the Greco-Roman constellations that will also be displayed in the show, images from Johannes Hevelius' star atlas, "Firmamentum Sobiescianum sive Uranographia" were used. These images were also used in the original 2019 version of the Rotunda Planetarium. The original images were drawn from the perspective of looking down on the celestial sphere from above, looking down on Earth, but for this project the mirrored images created by the U.S. Naval Observatory and Space Telescope Science Institute were used, so they would correspond to the constellations as they are seen from the ground.

III. IMPLEMENTATION

For the creation of the images, in order to avoid an unnatural and computerized look, the original star background images were taken from Stellarium. Due to the overlap created at the top of each image from the projectors and the warping caused by the stereographic projection used by Stellarium, I used a FOV of 60° instead of 72°. From there, I divided the sky into fifteen sections to attempt to have the least image warping over large constellations as possible. The projectors work best with white images on black backgrounds, so the Stellarium star setup was perfectly set up for this, but I removed the atmosphere and increased the absolute scale of the stars to 2.00 instead of the preset of 1.00 in order to maximize visibility. We decided on choosing January 25th, 1819 for the images, as this was the day Thomas Jefferson established the University of Virginia and the Board of Visitors met for the first time. At 1 a.m., the

prominent Winter constellation of Orion was visible and not so high up as to be excluded from the area the projectors cover, as there is no projection as it gets close to the oculus at the zenith of the Dome Room.

The Stellarium star images were then imported into PowerPoint, where I then added lines for the Greco-Roman constellations that were fully visible within the screen. I tried to limit any going off the right and left edges, as the overlap and lack thereof made it difficult to line them up, but included the visible of those that were on the upper and lower edge. For each of the five images one of the upper two corners was blacked out where the overlap would be, depending on where the constellations were located on each consecutive image. Another image was created for each of the five projectors that included the Hevelius images over constellation line images, so that the resulting slideshow effect would have the stars appear, then the constellation lines, then the images. This was one of the most important changes from the previous version, both in that it is a rotating set of images instead of a single slide, but also that the stars behind the constellations were in the correct location. With the stars placed haphazardly and without order in the current projection, there is no way to transfer any knowledge gained by looking at the exhibit to looking at the real night sky, as there are obviously not floating drawings in the sky to point out recognizable constellations.

Following the Hevelius images and their corresponding lines fading away, a Mi'kmaq story of Muin (the Bear) and the Seven Hunters appears. As part of our effort to represent diverse Indigenous astronomical traditions, we collaborated with a Monacan artist, whose ancestral ties are rooted in the land where the University of Virginia stands, to illustrate a constellation story from the Mi'kmaq Nation, located in the northeastern region of North America. While the artist does not belong to the

Mi'kmaq Nation, this cross-cultural collaboration was approached with care and respect. This partnership underscores the importance of intertribal respect and the shared commitment to preserving and celebrating Indigenous astronomical knowledge. The story of Muin and the Seven Hunters is explained in Appendix A, but, while it has components for all seasons, the climax of the story occurs in summer to fall, so I changed the stars behind April Branham's drawings to be from a summer day and from a much smaller FOV of 30°, choosing Thomas Jefferson's date of passing and the 50th anniversary of the Declaration of Independence: July 4th, 1826. There was also hope of including the Diné story of the Náhookqs constellations, which are those that revolve around the North Star – Náhookqs Bi'ką' (the Male Revolving One, or the Big Dipper), Náhookòs Bi'áád (the Female Revolving One, or Cassiopeia), and Náhookòs Bikq' (the Central Fire, or Polaris) – but the Diné prefer to only have their astronomical stories to be told in the Winter, and there was not a clear way determined to make sure this was possible. Hopefully, in the future, this can be resolved in a way that is respectful to the Diné wishes and the Náhookqs stories can be displayed.

IV. CONCLUSION AND FUTURE

The five images per projector (the stars, the constellation lines, the Hevelius images, the summer stars, and April Branham's drawings) were then downloaded onto five flash drives that could be inserted into the five Raspberry Pi 4 Model B computers that the Astronomy department owns. This way, the original work done by the doctoral students would still be available and accessible instead of being written over. These images can be seen in Appendix B. Currently, the Raspberry Pis do not have the attachment to connect them to ethernet so that eventually they could communicate with

each other on timing, but the present belief is that if started at the same time, they would switch images synchronously.

In the future, the idea would be to have a set of images that rotates through images from all four seasons and more than just a single other culture's astronomical stories. There are endless possibilities for what to include and spotlight, as shown through the many stories already represented in the One Sky Project. Once the new images are displayed, there is an idea that there would be a corresponding page on the Astronomy Department website to provide the constellation background stories and even tips on how to spot them outside. Additionally, there was discussion of a possible collaboration with the Native American Student Union at the University to record some of the stories and have the audio recordings with transcripts also available on the website. Due to the collaborative nature of most of this project, the main difficulty was relying on outside sources to assist and respond on a timetable that most professionals do not operate on – the semesterly deadline. Regardless, there is quite a bit of room to expand upon this project and create an even more impactful experience in the University of Virginia's most prominent feature.

APPENDIX A

The Story of Muin (the Bear) and the Seven Hunters

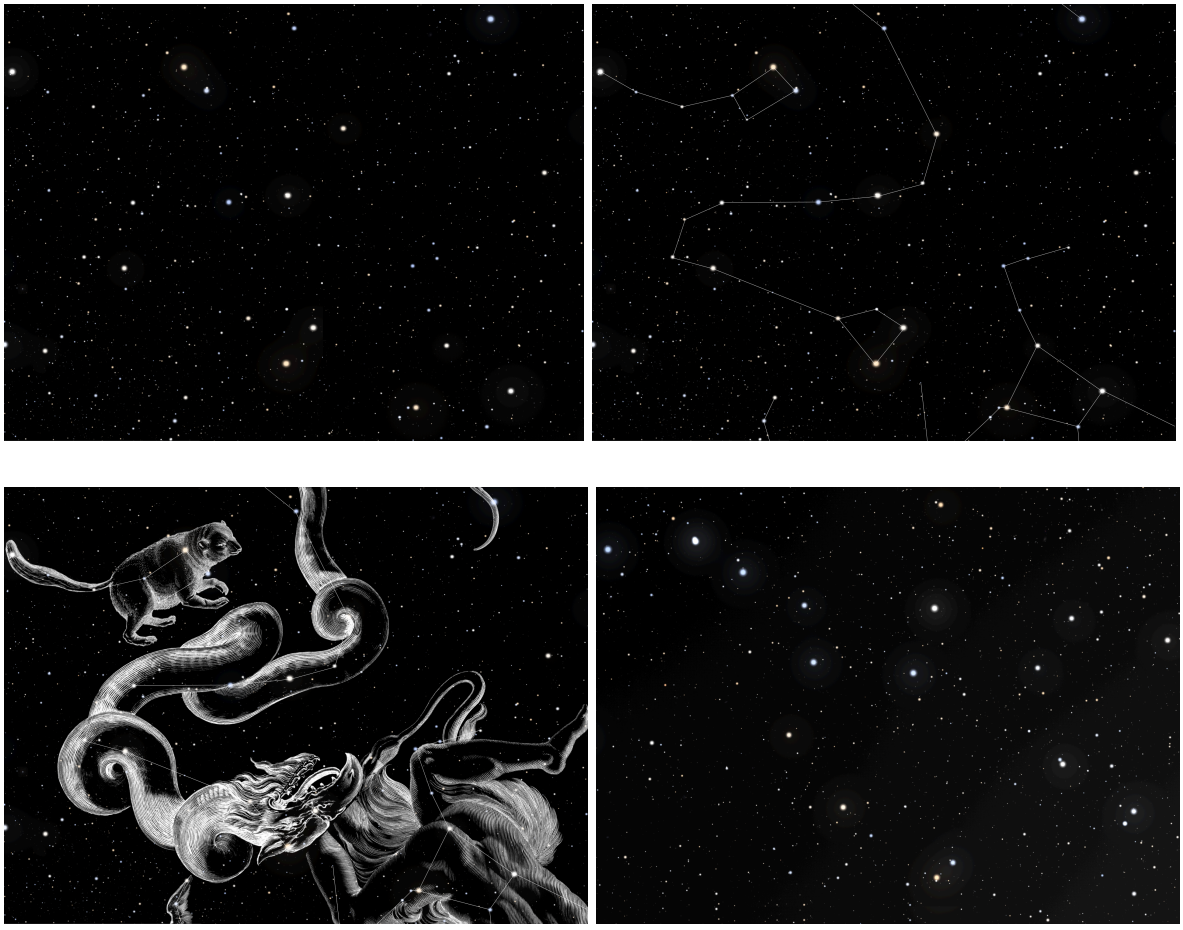
This story is paraphrased and summarized from resources provided by the Three Nations Education Group Inc. in New Brunswick, Canada. The four stars of the Big Dipper are Muin, the Bear, to the Mi'kmaq people. There are seven bird hunters chasing the Bear, and three of them (Robin, Chickadee, and Moose Bird) make up the handle of the Big Dipper. The other four bird hunters appear in the constellation Bootes: Pigeon, Blue Jay, Owl, and Saw-whet. The first three, as they are part of a circumpolar constellation, stay above the horizon year round, and so it is said they never "give up the chase" on the bear. The four hunters contained within Bootes "lose the chase" in late summer when they fall below the horizon. The Corona Borealis serves as the Bear's den. The seven hunters chase the Bear throughout the year, with Chickadee first spotting her in the Spring. They all pursue her across the sky in the summer, but four of the birds begin to lose steam as Autumn approaches. Towards the end of Autumn, the Bear grows tired and she is reached by Robin. Robin attacks and is covered in blood, used as an explanation for the robin's red belly, and blood spatters down to Earth, explaining the red leaves that appear on the trees at this time. In the winter, the Bear constellation looks to be on its back in the sky, representing her skeleton and her death. In spring, she awakens and the hunt begins again.

APPENDIX B

Each projector has three 01/25/1819 images and one 07/04/1826.

Projectors 1 and 5 have a fifth image with the April Branham illustrations.

Projector 1 (North) – Ursa Minor, Draco, Hercules, Cygnus; Moose-Bird, Chickadee, Robin, the Bear



Projector 2 – Bootes, Coma Berenices, Corona Borealis, Hercules, Serpens, Virgo

Projector 3 - Argo Navis (Puppis, Pyxis), Canis Major, Columba, Corvus, Crater, Hydra




Projector 4 – Auriga, Eridanus, Lepus, Monoceros, Orion, Taurus

Projector 5 – Andromeda, Camelopardalis, Cassiopeia, Cepheus, Perseus, Triangulum; Saw-Whet Owl, Screech Owl, Blue Jay, Pigeon

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