

### Senior Project Paper

For my senior project I worked with Mr. Formato in the field of Astronomy. For as long as I can remember I have been fascinated by the beauty of the night sky, and the possibilities that exist outside of our own planet. After taking the Astronomy class this year I jumped at the opportunity to learn more about this science by focusing on it for my senior project. Because being able to study Astronomy is dependant on having clear skies and weather I had to wait until I knew what I would be able to see before I could establish an idea for my senior project. Although the dependence on the weather was a hindrance in some cases it did give me more time to think about and discuss multiple specific studies that I may not have been able to focus on if I had one specific goal from the start of my project. This allowed me work on multiple studies at the same time. I was able to work on mapping stars using TPoint software, studying Saturn, and learning about the history of Astronomy all at the same time. I could work on whichever project the conditions were best for at a moment when the conditions weren't as good for the other projects.

The main focus of my project was mapping the stars using the TPoint software. The telescope, camera, computer, and dome in the observatory are all connected to each other and work together to make working the observatory as easy and accurate as possible. Using a model of the TPoint software the computer can map the locations of stars and other stellar objects, and tracks them across the sky. TPoint connects to TheSky6 which is the

software which links the telescope and the computer and displays where all the objects are in the sky. After meeting with Mr. Formato, we discussed what TPoint was and how it worked. He explained how the current model that was being used wasn't great and that it would be a good idea to try to improve the current model.

In order to do that Ben Leith and I had to begin by telling the telescope to find a bright star which is easy to find and identify. Once we found that star we would have to move the telescope manually so that the star was right in the center of the field of view. Then we would have to make sure the focus was right. First we did this using a low power eyepiece. The eyepiece changes the magnification of the telescope and it can be changed to increase or decrease the amount of magnification. The low power eyepiece allows the viewer to see a larger section of the sky, but the detail of the image isn't as good. The high power eyepiece offers better magnification and detail, but the field of view isn't as large. After centering and focusing the objects in the low power eyepiece we did the same for the high power eyepiece. The TPoint model becomes more and more accurate with every star that is successfully mapped, so Ben and I ended up mapping about 120 stars over the course of two weeks. Our goal was to get the TPoint model accurate to about ten arcseconds, the point at which we would have been able to track satellites. However the weather limited the number of nights we were able to map the stars so we didn't collect as much data as we needed in order to bring the accuracy down to ten arcseconds. We were able to bring the accuracy down to about 125 arcseconds which was a significant

improvement considering that the accuracy was well over 1000 arcseconds when we began.

This new model was helpful for the other projects that I worked on aside from mapping stars.

Along with mapping the stars a lot of my attention during the project was focused on learning about Saturn. Over the course of the school year the Astronomy classes focused heavily on nearby planets, and during my senior project Saturn was the most prominent planet in the sky. I read a number of articles on Saturn, particularly on its moons and rings. Saturn has over 60 moons although I focused on the ones that are visible through the telescope. Mr. Formato showed me a moon chart from the magazine *Sky & Telescope* which showed when an observer should be able to see the moons. I attempted to replicate this chart using the data that I collected from my observations of Saturn however; I had insufficient data to make an accurate chart. On average I was only able to see two very dim objects in the telescope's field of view, and these objects were consistent with the *Sky & Telescope* chart so I am almost certain they were moons but that wasn't quite enough to make a chart of my own. I believe my inability to see these moons was the result of light pollution in the area from the rest of Braintree and Boston.

I also learned about Saturn's rings. I was able to observe the rings through the telescope, although at the time of my project the rings were edge on, meaning that the surface of the rings was hard to view. In addition to observing the rings Mr. Formato gave me several articles about the formation of the rings. One of the most commonly held

theories is that of Edouard Roche. Roche proposed that the rings were once moons whose orbits took the moons too close to the surface of Saturn and crossed the Roche Limit which is the point where moons will get torn apart and become rings by Saturn's gravity.

Finally for my senior project I also learned about the history of Astronomy. I read *Cosmos* by Carl Sagan for the project and in his book he focused on Astronomy today and how it is related to astronomy of the past. Sagan was particularly interested in the connection between the scientific beliefs of the creation and religious beliefs of the creation and how they connect to astronomy. In order for future Astronomy classes to explore these connections farther Mr. Formato and I discussed creating a creation myth curriculum for the planetarium here at Thayer. The planetarium runs on software that anyone can download at home so using that software I was able to create a tour of the most important stars to some of the creation myths that various ancient peoples believed.

Although the conditions for my project were not ideal, I feel as though I learned much about astronomy and using the observatory. I enjoyed taking the Astronomy course during the school year and I was pleased that I was able to learn more through my senior project. I feel as though Ben and I were able to create a good model for TPoint, and that I was able to learn more about the history of Astronomy and Saturn. The only thing I would have changed about my project would have been to do it when there was better weather.