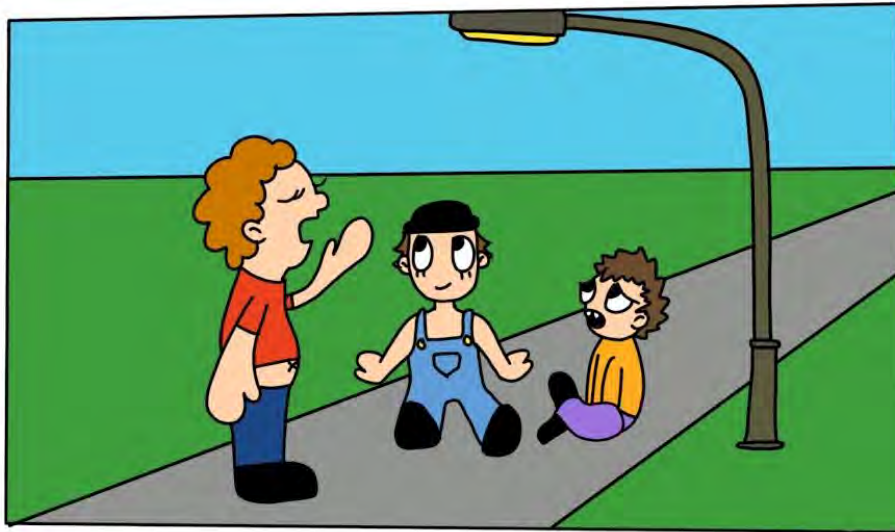


Cassiopeia
&
The Mystery
of
Eclipses

△ Tucker & Theo Kolbrener

Three good friends, Ava, Phoebe, and little Otter, are sitting in a park at dusk. They are telling stories as they wait for darkness to fall, so they can watch their first lunar eclipse!



“I’ve got a story that will scare you all!” Ava threatens her friends playfully, noticing her younger sibling was shivering nervously already.

“No you won’t, I *never* get scared” Phoebe exclaims.

The smallest kid, Otter, is quiet.

“Okay, once upon a time, there lived hundreds of people, when suddenly... the whole world went DARK.”

Otter, whines as the street lamp above them flickers ominously.

Ava tells a story about ancient civilizations who explored and learned about the solar system. Her words captivate her friends, who listen intently.

“But how did they know why the Sun went dark?” Phoebe mused.

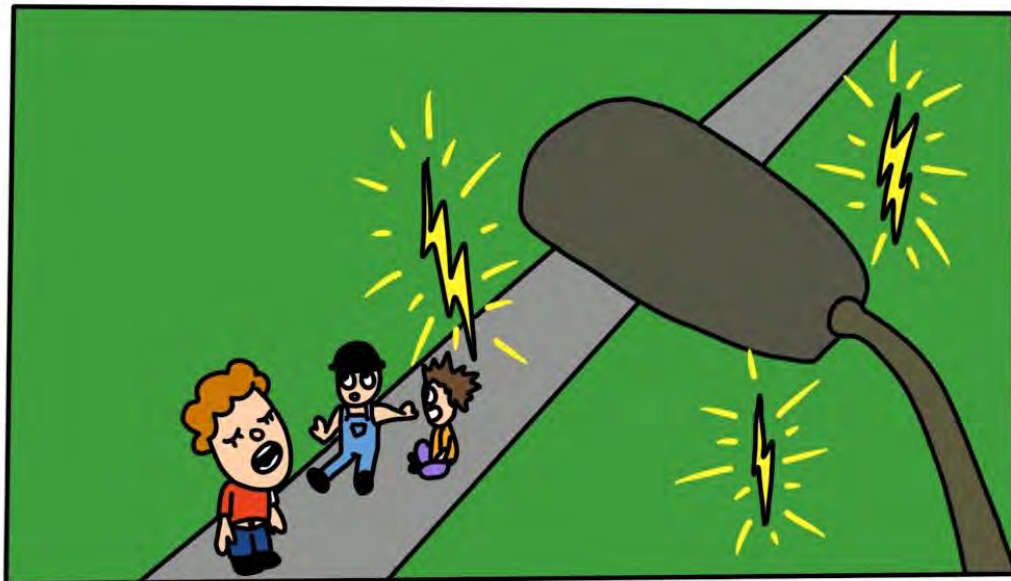
“How do you measure the Sun? How do you know when it’s gonna go dark again?”

The children buzzed with exciting questions.

“Were they scared when the world went dark so suddenly?” Phoebe questions.

Otter whimpered once more.

Above them, the street lamp begins to flicker faster.



The streetlamp ERUPTS and from the flames emerges a woman seemingly made of all stars.

She is Cassiopeia, a constellation named after a mythological queen from Ancient Greece!

The kids stand frozen in shock.



“You children must have a great interest in astronomy...I am only called on when there is great enthusiasm for ancient astronomy!”

¹ Cassiopeia A is a constellation, named after Cassiopeia, the beautiful queen from Greek mythology. Queen Cassiopeia was the queen of Aethiopia who, due to her beauty, became extremely vain. Her vanity caused her to offend the Greek gods and eventually lead to the death of her daughter Andromeda.

"Cassiopeia." *Greek Mythology.com*. Accessed 8 Dec. 2019.

“Come with me! I’ll show you the history of eclipses in ancient civilizations.” Cassiopeia beckons.

“Woah...well what are y’all waiting for?” Ava giggles and her siblings nervously join her.

The kids grab hands with Cass, one by one, and are swept away by her magic through space and time.



The kids stumble about after they land and look around, taking in their surroundings.

“Many people studied Eclipses throughout time,” Cass explains warmly, looking at the children’s awe.

She begins to walk away and continues to explain,

“Different cultures studies eclipses in different ways, but we will begin our journey in India.”



The children all felt confused but excited.

“Follow me!” Cass calls.

The kids quickly grab hands and listen intently to their new friend.

**“In India, they once believed an Eclipse to be a bad omen,”
Cassiopeia explains.**

“I told you it was spooky!” Ava cried out.

“Shh!!” hushed both Otter and Phoebe.

**Cass explains that in ancient India, they believed in a demon
named Rahu. Rahu used magic to make the sun disappear from the sky
until the humans appealed to the great sage Atri, who would undo the
eclipse and restore the power of the Sun.²**



² We are using this journal to create a foundational understanding of how Eclipses were studied in Ancient India. Specifically we are drawing from sections that use vivid imagery to describe myths and early understandings of astronomy to aid in how we demonstrate the process of astronomical development within our story. Some of our favorite quotes include: “The earliest reference to an eclipse in the subcontinent can be found the earliest of India written records in Rig Veda book V verse 40 dated to around 1400 BC (Subbarayappa 2010). In a description there, a demon (Swarbhanu), using magic makes the sun disappear from the sky with devastating consequences for humans and gods. The gods then appeal to the great sage Atri to undo the magic of the demon. Atri obliges and undoes the magic of the demon and the Sun is restored to his original glory” (Mayank N Vahia and B V Subbarayappa 1-2).

Vahia, Mayank N., and B V. Subbarayappa. "Eclipses in Ancient India." *Tata Institute of Fundamental Research*, pp. 1-2.

“Woah,” Otter exclaims, “that’s so cool!”

“Then,” Cass continues, “the great astronomer Aryabhata came and introduced a new explanation for this phenomena!”

“In 499 AD, Indian mathematician and astronomer Aryabhata discovered that the moon and planets are made visible by reflected sunlight.³ This allowed him to find that eclipses occur when the moon comes between the sun and the earth or the moon goes into the shadow of the earth.”



³ We are compelled by this piece because it invokes Aryabhata who we have previously engaged with. We are interested in how this piece puts Aryabhat's contributions in conversation with other theories and mathematics of the time to show a clear trajectory in the development of the field. As we continue with this project we hope to pull more from the Aryabhata reading as a further source to put in conversation with our current project. “Aryabhata states that moon and planets shine by reflected sunlight... explains eclipses in terms of shadows cast by, and falling on earth... provides the computation and the size of the eclipsed part during an eclipse. Later Indian astronomers improved on the calculations, but Aryabhata's methods provided the core. Aryabhata applied plane trigonometry to spherical geometry by projecting points and lines on the surface of a sphere onto appropriate planes. This included the prediction of solar and lunar eclipses and an explicit statement that the apparent westward motion of the stars is due to the spherical earth's rotation about its axis” (2).

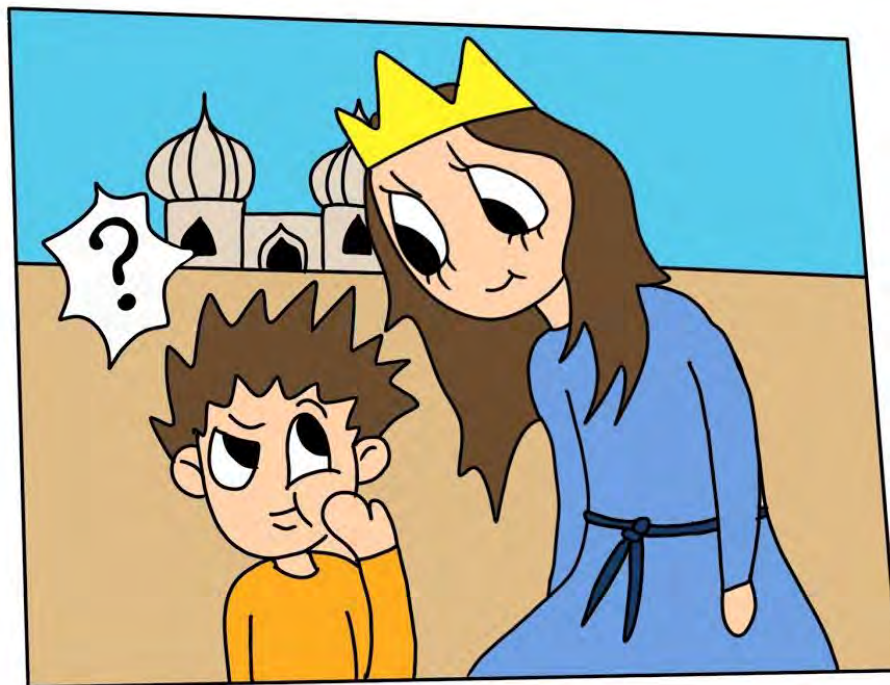
Hojnowski, Taylor and Showalter, Alek, "How the Indians Discovered Solar Eclipses" (2017). Academic Excellence Showcase Proceedings. 87.

Otter sits down to think about all he has learned and exclaims,

“But don’t we need to know when this happens for it to make any sense? How did the ancient Indians figure this out? It’s all so confusing!”

Cass chuckles,

“Of course it is confusing! These mathematicians and astronomers were doing a lot of hard work to figure any of this out.”



She gently pats Otter on the head. “Come children, let’s go to ancient Babylonia and see how they discovered more about predicting eclipses!”

They again grab hands and are magically transported through space and time.

They land in Ancient Babylonia in the beautiful gardens of Babylon, right on the bank of the Euphrates River.



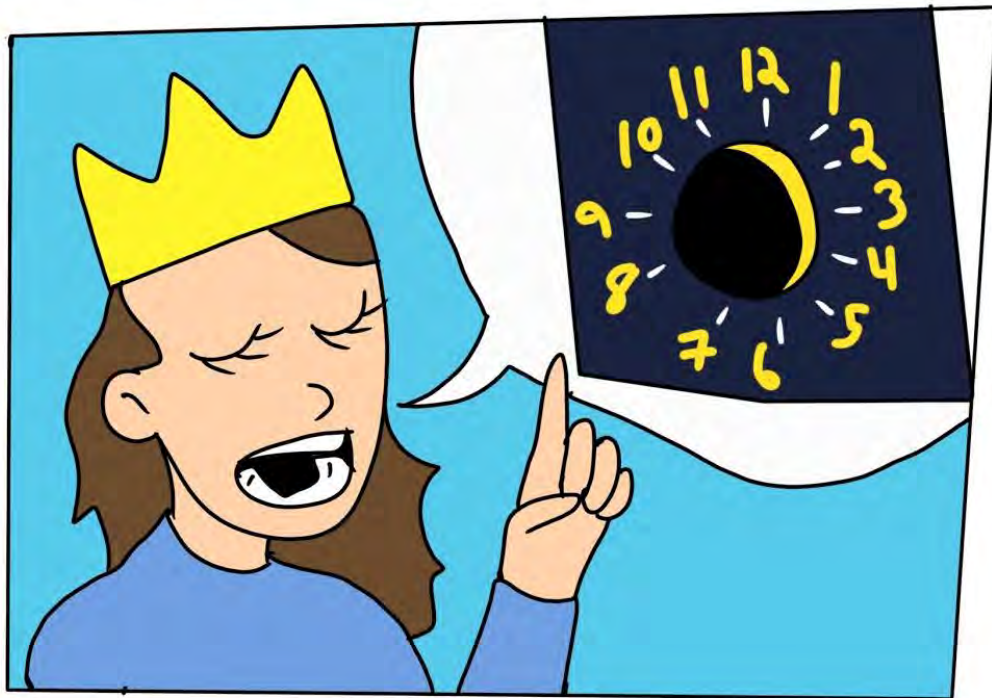
As they look around, Cass begins her tale,

“Ancient Babylonian astronomer Rasil talked to his emperor, explained that the eclipse that had just occurred was premature. He declared that this meant the “Rise of a rebel king was to come....”⁴

⁴This piece offers incredible insight into early developments of astronomy. We used the idea of the “bad omen” to help shape the stories the children tell each other at the beginning. This idea of bad omens is integral to our story for both its historical value in the field as well as the children’s interaction with myth and “evilness” throughout the story. “The prognosis of the eclipse on 29th Iyyar (Ayar, month 2) sent by Babylonian astrologer Rasil to the Assyrian emperor: ‘the god of all four quarters will become confused; rise of a rebel king; will kill his father, a brother will kill his brother’ For Rasil, the eclipse was destructive because it took place prematurely” (247). Eclipses, especially premature eclipses, were often viewed as the sign of a bad omen.

Selin, Helaine. "Astronomy Across Cultures: The History of Non-Western Astronomy." *Springer-Science + Business Media, B.V.*, vol. 1st, 2000, p. 247, Accessed 24 Oct. 2019.

She continues, painting the children a picture with her words, “Eclipses were seen as scary and evil, just like Ava’s story! Babylonian astronomers then learned that eclipses had to do with the Sun and Moon, and became skilled at determining when an eclipse would take place and recording the amount of time the eclipse lasted.”



“See!” Ava beamed with pride.

Cass laughs, “You would’ve made a great Ancient Babylonian Astronomer, Ava!”

The other kids laugh as they all grab hands again and transport to their last destination.

They arrive at their final ancient civilisation, the incredible Ancient China!

The kids once again look around in awe at the scenery, as Cass begins her next astronomical tale.

“In Ancient China, they used to believe that eclipses happened if a dragon tried to eat the sun or moon!”



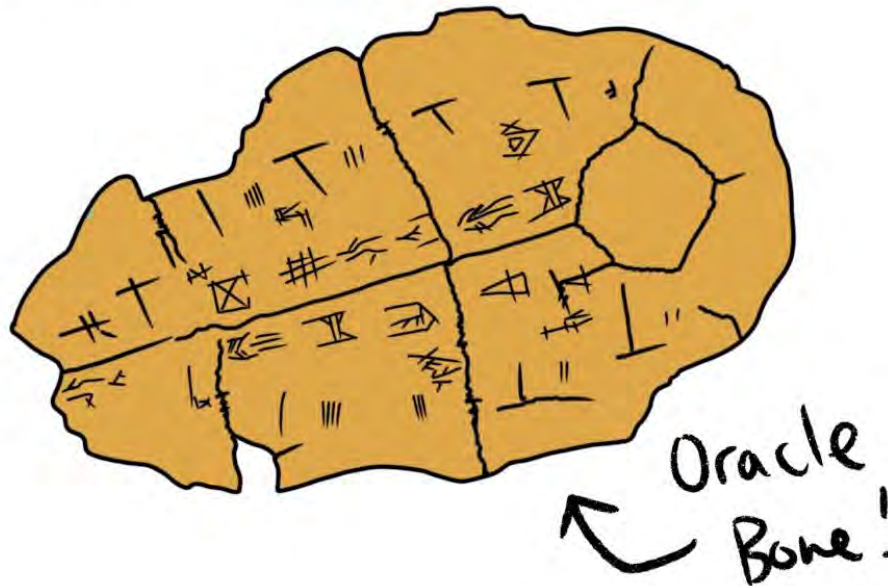
“Woah,” The kids all murmured in amazement.

⁵ There were many superstitions that existed in ancient China, which we utilize in our story and are valuable in understanding how different cultures engaged with Eclipses and studying them. A myth that our story dovetails from includes the idea that “Eclipses are due to a dragon trying to eat the sun or moon” (61).

Werner, E.T. C. *Myths and Legends of China*. Dover Publications. New York, NY. 1992. pp.61
Accessed 24 Oct. 2019.

Cass continues,

“Later they began to understand what eclipses were and recorded them on tablets. They called these sets “oracle bones.”⁶



Cass translates the bones and explains how they record a series of 6 solar eclipses that were visible in China in the 12th-century⁷

⁶ We used this piece to contextualize China’s early astronomy developments. We were particularly interested in the ways in which oracle bones were used because their textual material and cultural significance is particularly fascinating compared to other early forms of astronomy. “NASA astronomers used fourteenth-century B.C. oracle bones... Based on the analysis of the tortoiseshell inscriptions, they had fixed the exact date and path of a solar eclipse seen in China in 1302 B.C.” (Dick Teresi, 147) A collection of 5,000 oracle bones found in An-yang in 1972 recorded a series of sky events from ancient China. “The Chinese astronomical historian Zhang Peiyu found that six dates recorded in the inscriptions matched perfectly with a series of solar eclipse visible from Henan [China] area in the twelfth century B.C.” (148).

Teresi, Dick. *Lost Discoveries : The Ancient Roots of Modern Science-- from the Babylonians to the Maya*. Simon & Schuster, 2002.

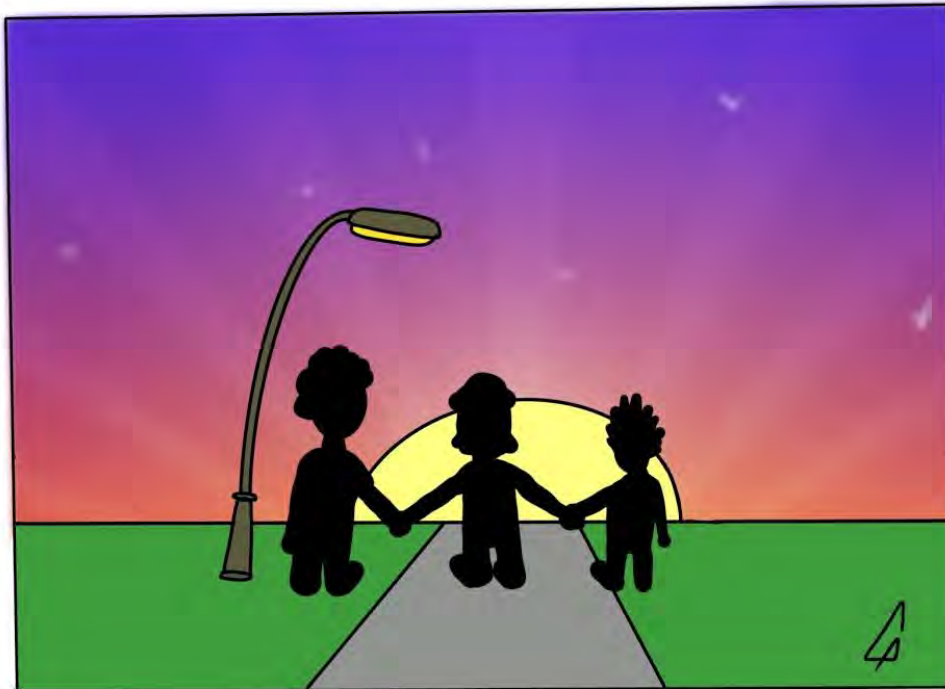
⁷ Ibid. pp148.

“Ancient Chinese astronomers became so good at predicting eclipses that emperors would actually punish their astronomers if they failed to predict an eclipse.” Cass continued.

“Oh no!” Otter interrupts.

Cass reassures the worried children, “It was just part of the learning process during this time! Let that be a lesson that astronomy has always been a very important part of life, even in ancient times!

And with that, they all grab hands and Cass returns the children back to their home in modern times, leaving them with a new passion for mathematics, astronomy, and a super cool time-traveling secret!



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