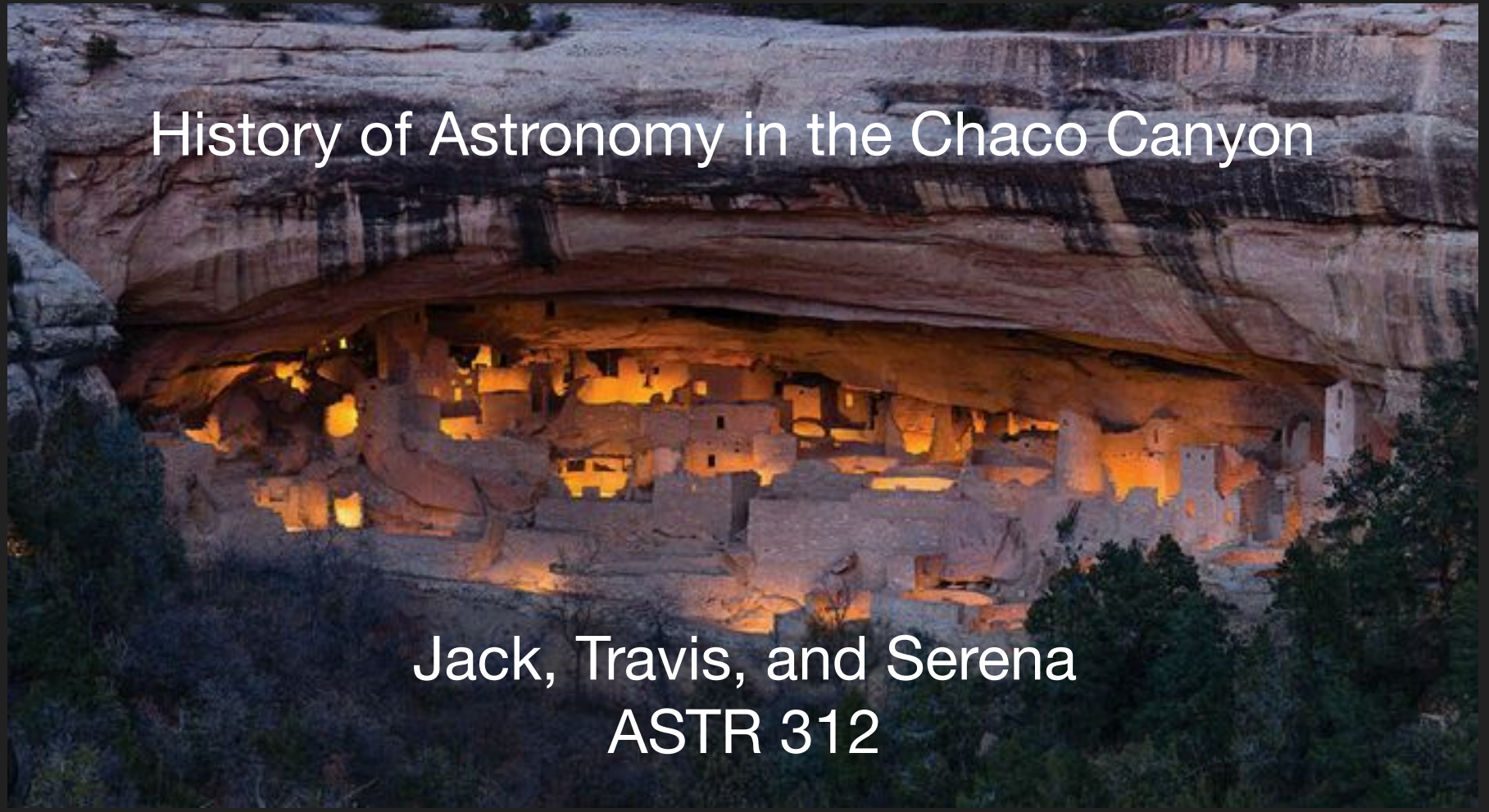


History of Astronomy in the Chaco Canyon

Jack, Travis, and Serena

ASTR 312

Outline

- Chaco People Origins
- Chaco Observations and Recordings
- The Decline of the Chacos
- What Remains Today
- Conclusion
- References

What Early Civilizations were interested in the Stars

- Human groups have been observing the stars for up to 35,000 Years
  (Ach Valley bone carvings)
- Stellar observation has been documented through cave paintings and oral history from every continent except Antarctica
- It was used to predict seasonal changes, lunar eclipse, and the future, with varied success

Figure 1. Bone carvings from the Ach Valley in Germany, interpreted as a possible star chart representing the constellation of Orion. Retrieved from http://news.bbc.co.uk/2/hi/science/nature/2679675.stm

Origin of the Chaco People

- The Chaco People are descendants of the Ancestral Puebloans
- Living in modern day South West United States
- They inhabited the Chaco Canyon region from 100 AD to 1300 AD
- They started as a hunter gatherer society and developed into a agricultural society, living primarily in caves and pit houses

Figure 2. Map showing the range of the ancestral Puebloans
https://pubs.usgs.gov/fs/2004/3035/pdf/fs-2004-3035.pdf

Chaco Canyon

- Chaco Canyon is home to the ancestral Pueblo peoples like the Hopi, Navajo, and Zuni.
- Petroglyphs found in Chaco Canyon and the surrounding area reveal the peoples had a great interest in astronomy.
- Many building are oriented to align with winter and summer solstices and observe lunar and solar eclipse
- The area surrounding the canyon is extremely dry allowing for the preservation of many petroglyphs and structures

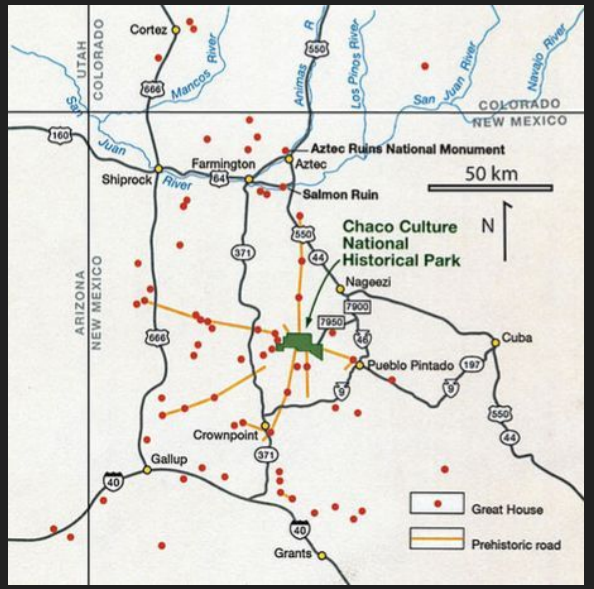


Figure 3/4. Aerial photo of chaco canyon with a informative map

https://pubs.usgs.gov/fs/2004/3035/pdf/fs-2004-3035.pdf

https://www.researchgate.net/figure/Aerial-view-of-Pueblo-Bonito-within-Chaco-Canyon-image-from-world-wide-web-open-access_fig4_284077169

Chaco Peoples Pictographs

Figures 5/6/7. Examples of cave paintings pictographs found within chaco canyon
https://www.gettyimages.ca/detail/photo/newspaper-rock-royalty-free-image/1054828642

The 1054AD Supernova

Figure 8. Image of supernova pictograph
https://earthsky.org/human-world/chaco-canyon-nm-rock-art-supernova-pictograph/

- Supernova 10x the brightness of Venus and visible for 23 days and 653 nights
- Recorded by the Chinese and Japanese
- July 5th, 1054 AD, the crab nebula supernova and the moon were 3 degrees from each other while the moon entered first quarter
- The pictograph matches the predictions and the drawing is likely to scale
- Survives as one of the best Supernovae depictions in the region

Mini Quiz

Who were the ancestors of the Chacoan People?

A.) The Navajo

B.)Thee Zuni

C.) The Puebloans

D.) The Hopi

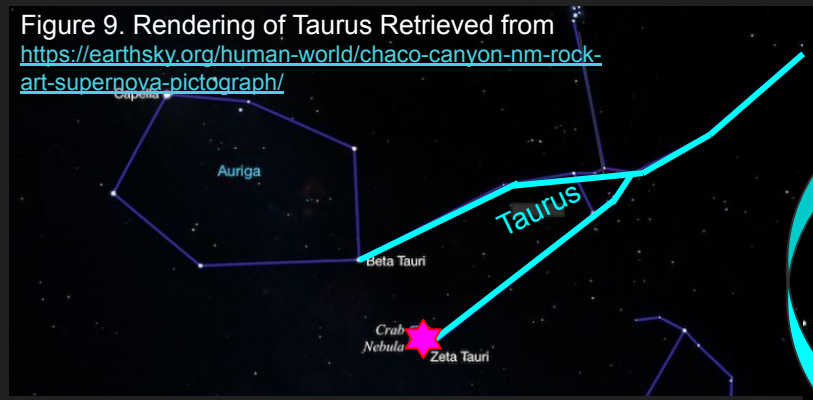


Figure 9. Rendering of Taurus Retrieved from https://earthsky.org/human-world/chaco-canyon-nm-rock-art-supernova-pictograph/

- The remnants of the supernova can still be seen today within the Crab Nebula in Taurus
- Located 6,500 light years from Earth
- 11 light years across
- Made of expanding gasses created from the supernova
- Home to the Crab Pulsar which rotates 30 times/second

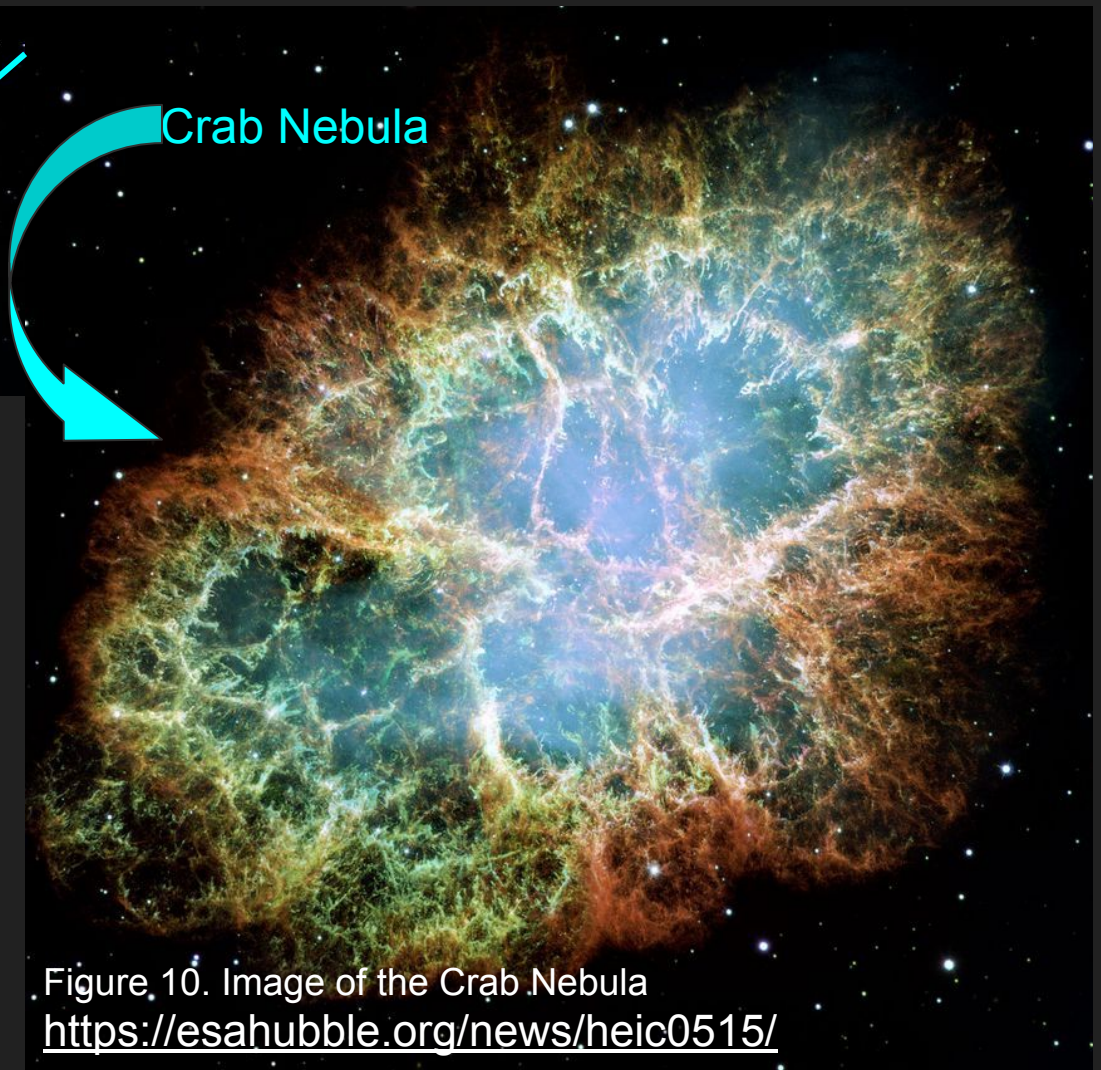


Figure 10. Image of the Crab Nebula https://esahubble.org/news/heic0515/

1066AD comet

- Halley's Comet appeared in AD 912, AD 989, AD 1066, and AD 1145 around the Chaco Canyon region
- The drawn comet is believed to be the 1066 comet due to its relative brightness compared to the others and its temporal proximity to the 1054AD supernova

Figure 11 & 12 . Image of comet pictograph Retrieved from https://rockartblog.blogspot.com/2010/11/halleys-comet-pictured-in-chaco-canyon.html Retrieved from https://earthsky.org/clusters-nebulae-galaxies/crab-nebula-was-an-exploding-star/

Pueblo Bonito

- Was the center of the Chacoan world
- Construction started around 850 AD and spanned over 268 years with multiple stages of expansion
- Consisted of 32 kivas, 3 great kivas, and 350 ground room floors
    - Kivas: Large circular ceremonial structures

Figure 13/14: Aerial image of Peublo Bonito archeological site. Retrieved from https://www.nps.gov/chcu/planyourvisit/pueblo-bonito.htm

Pueblo Bonito

- Roughly orientated in cardinal direction
  - Central dividing wall runs nearly north-south
  - Flat south facing wall runs nearly east-west
- Taller portion in the back (north) to promote solar heating
- Likely designed to align with daily and yearly motion of the sun

Figure 15: Image depicting orientation of Peublo Bonito. Retrieved from: https://www2.hao.ucar.edu/education/prehistoric-southwest/pueblo-bonito

Wijiji Sun-Watching Station

- Denoted position to track the sunrise of winter solstice
- Cutout from canyon wall that tracked the rising sun for 16-17 days leading up to winter solstice
- Allowed for time to prepare for culturally significant ceremonies
- “Signified renewal”

Figure 16: Image showing not from observer perspective. Retrieved from: https://annex.exploratorium.edu/ancientobs/chaco/HTML/wijiji.html

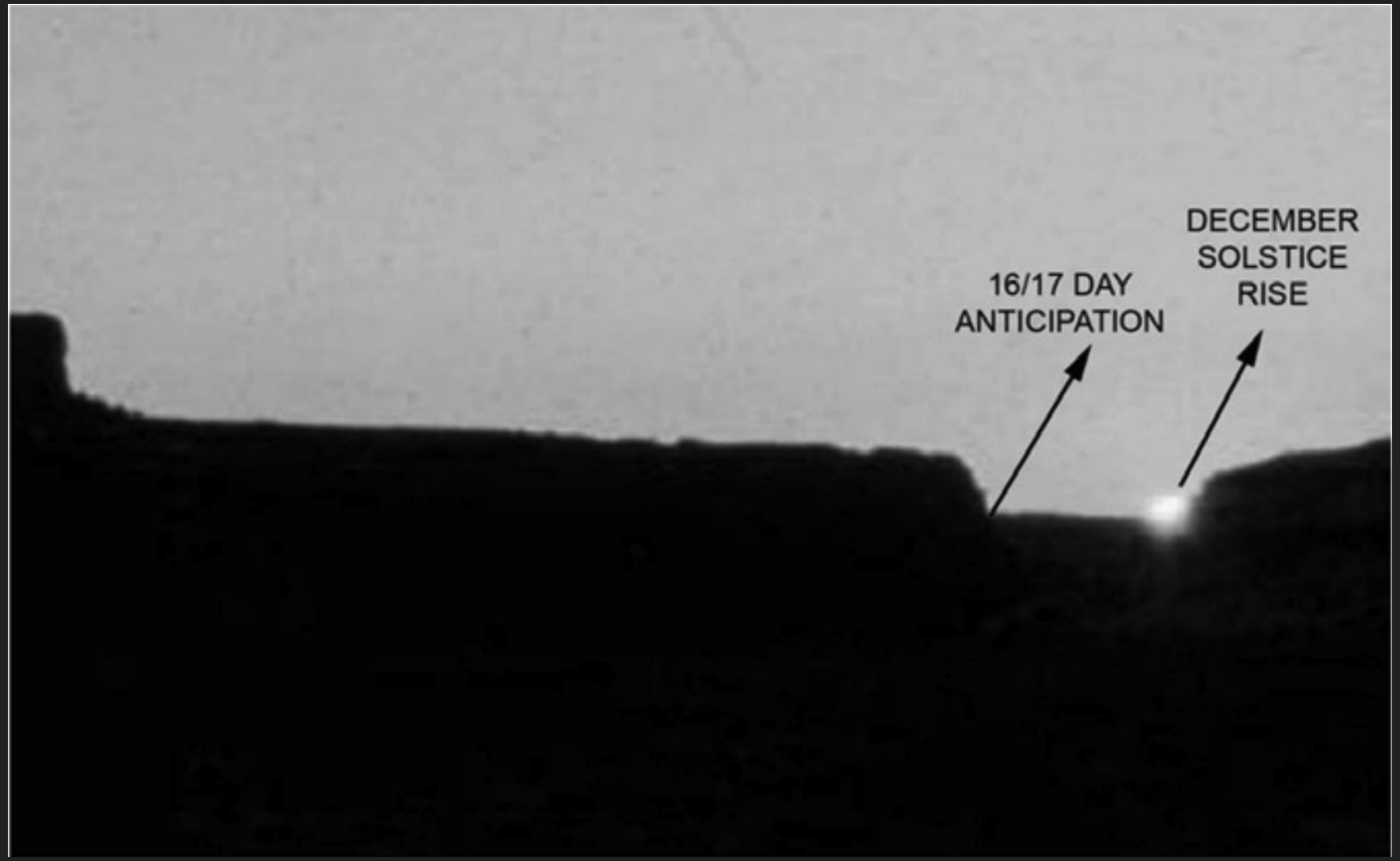


Figure 17: Image showing the rising sun on day of the winter solstice. Retrieved from https://www.researchgate.net/publication/333677810_The_Astronomical_Context_of_the_Archaeology_and_Architecture_of_the_Chacoan_Culture

Fajada Butte - Sundaggers

- Sunlight penetrating through crevices between stone slabs created distinctive “sun daggers” of light on an adjacent cliff wall
- Chacoans pecked two spirals on the adjacent wall to align with annual solstices and equinoxes
- Acts as calendar
- Displays a well established knowledge of the seasons

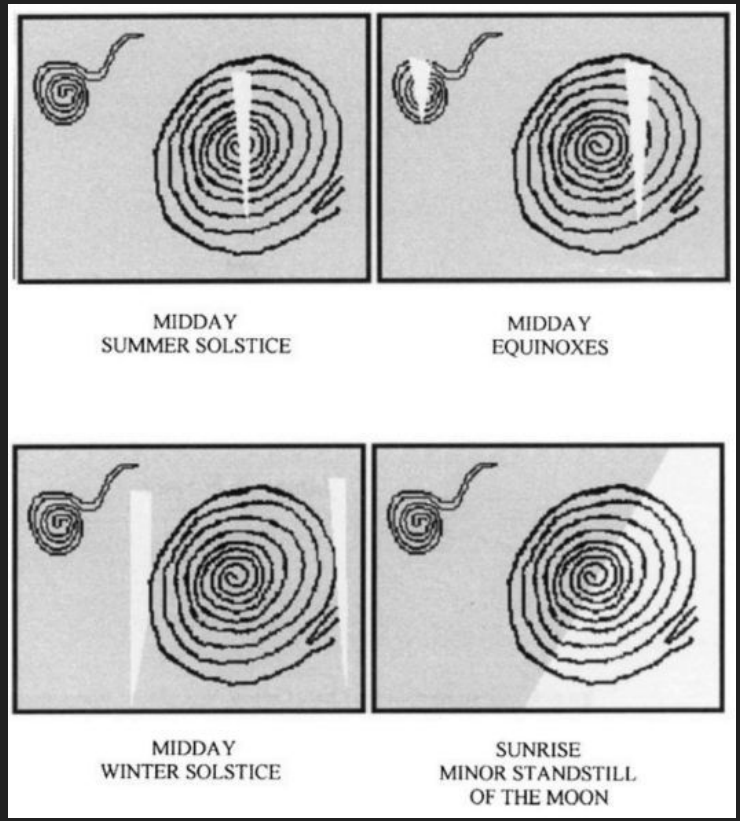


Figure 18: Illustration representing Fajada Butte Sundaggers during different solar events. Retrieved from https://books.google.ca/books?hl=en&lr=&id=TjK_DQAAQBAJ&oi=fnd&pg=PT88&dq=Chacoan+society+astronomy&ots=BaMEaJ7jiJ&sig=RPE6Gy00khtvzUSCFtPDb4NYKo#v=onepage&q=Chacoan%20society%20astronomy&f=false

Mini Quiz

What solar event is the Wijiji sun-watching station used to track?

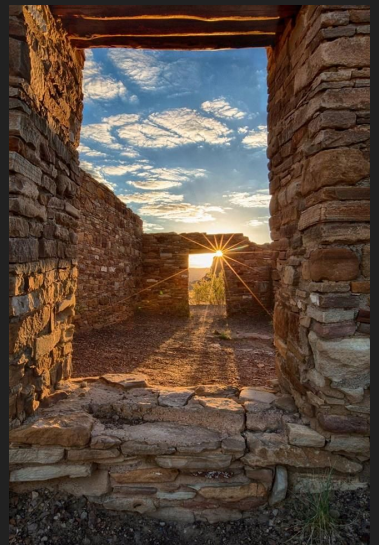
a) Summer Solstice
b) Winter Solstice
c) March Equinox
d) September Equinox

What happened to the people?

- People of Chaco Canyon moved away around 1300
  - Moved to new areas like White Mountains of Arizona, Rio Grande Valley
- Depopulation may have been caused by deforestation, drought, or increased conflict
  - Deforestation may have led to erosion and decline in agriculture
  - Deforestation may have been caused by human activity or drought
  - Great Drought occurred 1276 - 1299
  - Increased conflict with Navajo and Apache groups
- Left behind 13 major ruins and over 400 smaller archaeological sites
  - Pueblo Bonito is the largest and most completely excavated

Figure 19 (Above): Pueblo Bonito from the Pubelo Alto Trail (Andrew Kearns). Retrieved from https://www.nps.gov/chcu/learn/historyculture/index.htm

Figure 20 (Below): Spring sun alignment (Davis). Retrieved from https://www.nps.gov/chcu/learn/historyculture/index.htm



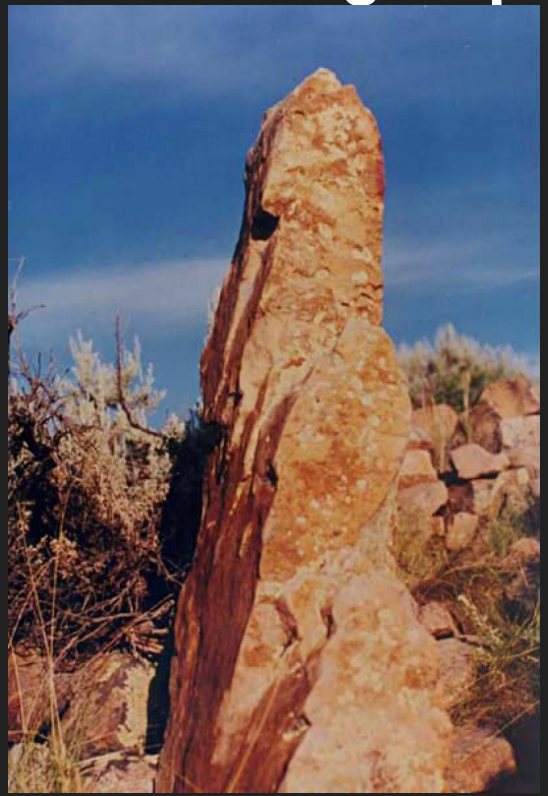
Did other groups do something similar?

- Hovenweep
  - Wall openings at Hovenweep Castle shone light in specific places on solstices and equinoxes
  - Petroglyphs on boulders only illuminated by sun on and around summer solstice
  - Similar masonry indicates connection with Chaco people, sun daggers from Fajada Butte may have provided inspiration

Figure 21: Holly Petroglyph panel. Retrieved from https://www.nps.gov/places/hollypetropanel.htm

Figure 22: Hovenweep Castle. Retrieved from https://www.nps.gov/places/hovenweep-castle.htm

Did other groups do something similar?



- Yellow Jacket
  - Monoliths aligned with position of sun on summer solstice, possible calendar
  - Top of monolith aligned with solstice sunrise, projected shadows
- Chimney Rock
  - Pueblo built in view of chimneys, may have observed lunar standstill
  - Griffith Observatory broadcasts lunar standstill from Chimney Rock

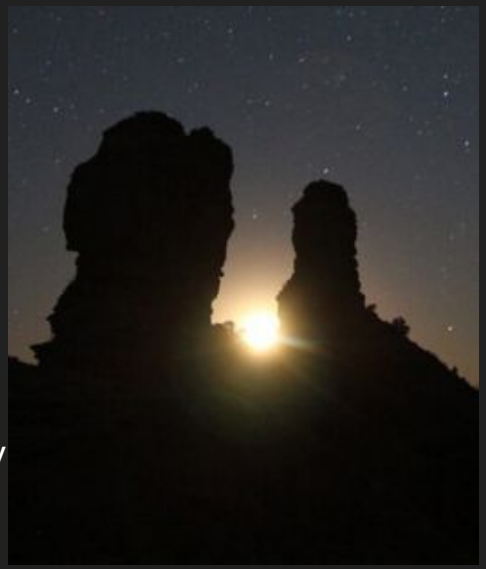


Figure 24: Lunar standstill at Chimney Rock. Retrieved from https://griffithobservatory.org/event/major-standstill-northern-moonrise-at-chimney-rock-colorado-night-one/

Figure 23: Standing monolith at Yellow Jacket. Retrieved from https://www2.hao.ucar.edu/education/prehistoric-southwest/yellow-jacket

Modern astronomy in Chaco Canyon

- International Dark Sky Park since 2013
- Partnership with Albuquerque Astronomical Society (TAAS) since 1991
- Permanent observatory constructed in 1998
    - Observatory offers educational programs, night sky and solar observations

Figure 25: Chaco Canyon observatory. Retrieved from https://www.astronomy.org/chaco/mission/index.html

Figure 26 (Above): Timelapse of stars surrounding Fajada Butte (Davis). Retrieved from https://www.nps.gov/chcu/planyourvisit/nightsky.htm

Figure 27 (Below): Timelapse of stars surrounding Casa Rinconada (D. Davis). Retrieved from https://www.nps.gov/chcu/learn/nature/darkskypark.htm

Summary

- The ancestral Pueblo people inhabited Chaco canyon region for over a thousand years and built extensive structures
- Structures and petroglyphs in Chaco canyon demonstrate an interest in astronomy
  - Pictographs depict Crab Nebula supernova and Halley's Comet
  - Structures were built in alignment with movement of sun
  - Sun daggers at Fajada Butte acted as calendar
- Other groups in the Southwest also left behind similar evidence of astronomical interest
- Chaco Canyon is now an International Dark Sky Park for present and future astronomical observations