

Minnesota Unraveled

# Episode 207 - All You See is Past: Histories of Star Knowledge

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**Andreia Carillo:** Welcome to Goodsell Observatory!

**Chantel Rodríguez:**

It is a cold starry February night at Carleton College in Northfield. This is my first time visiting *any* observatory or stargazing event. Several students wearing red headlights are setting up multiple telescopes outside.

Inside the observatory, there is a classroom of sorts with visitors gathered around a table for a star lesson.

I take the creaky wood stairs to the second floor, the air getting colder and the light growing dimmer with each step. I am rewarded at the top when I see the 22 foot long telescope.

One of the volunteers is talking about how to navigate the night sky. Tonight, they're focusing on Jupiter.

As a historian, I had never really thought about the stars. But I was wonderstruck when I realized that all of the light we see through the telescope is coming from the past. I knew I would be stargazing on a cold night, but I didn't think I was going to be *seeing* history.

Minnesota's dark skies are a wonder to behold. There is something magical about the celestial canvas that inspires curiosity. Standing in Goodsell Observatory, I thought about the many people who have lived, and continue to live, under stars in the land we now call Minnesota. Why do we look up at the stars? What are we searching for? How has star knowledge passed down through the generations?

I spoke with three people with an expansive knowledge of the cosmos.

**Ron Schmit:**

My name is Ron Schmidt. I'm the observatory coordinator here at Jackson Middle School in Champlin, Minnesota, part of the Anoka-Hennepin School District.

**Jim Rock:**

Hello, my relatives. I greet you today in my Sisseton Dakota father's language, Dakota language. I said, "Hello my relatives from a glad heart. I offer you my hand." And I said my name is. the dakota name, Wambdi Hanyetu, otherwise Jim Rock.

**Cindy Blaha:**

I'm Cindy Blaha. I am a professor of physics and astronomy, a retired professor of physics and astronomy. I taught at Carleton College for 36 years and I still maintain my connections with the observatory and my colleagues.

**Chantel:** Welcome to Minnesota Unraveled, I'm your host, Dr. Chantel Rodríguez. The history of stargazing is uncharted territory for me. To get my bearings, I spoke with Ron to get a general idea for how humankind has connected to the stars.

**Ron:**

Throughout time, astronomy has provided a great utility to mankind. The positions of the stars have been used for understanding your place on the planet. The North Star changes its height above the horizon, depending on where we are. If you went up to the North Pole right now, the North Star would be directly overhead. In the southern hemisphere, you can't see the north stars below the horizon. So you can find your place on the world by navigating through the stars. And that's what the ancients did. Even in the Pacific Ocean, they were able to navigate across these great stretches of water with no other reference than what they saw in the sky. So part of that is you can tell your latitude by how high the North Star is here at 45 degrees North, the North Star is 45 degrees above our horizon. If you go on to Texas, it's only 30 degrees above the horizon, but longitude is a whole other game.

And hundreds of years ago, people were running their ships aground because they didn't know where they were east to west. And the admiralty in England said, well, we got to figure this out because we're losing incredible amounts of money, and this is very costly and we're losing human lives. So they put in effort to figure out longitude. And one of those things that the solution to it was measuring the position of the stars in the sky and referencing where those stars would be. And so they had to learn how to build precise clocks that they could take on onboard ships.

And that was the solution to figuring out your longitude. To know those positions, you need devices that can measure a position. And down at Carleton

at the Good Cell Observatory, they had a transit scope. It's no longer operable. It sits off in a building somewhere in a case to be marveled at. But it would line up north south and it would watch the stars as they move by. And it would time how long before the star would appear due south, and you would mark down that time and you could use it to set your clocks.

So there's an interesting dichotomy in astronomy. There's the wonder and fascination of what's out there and the place where the ancients would tell their stories. And that's not just our culture. There are cultures throughout the world, same stars, different stories, different constellations tying in those images that we see in the sky. Again, a sense of place, but also a sense of time and history.

**Chantel:** Ron identified a number of reasons humanity has looked up at the stars. The idea that Goodsell Observatory at Carleton College played a role in timekeeping was new to me! To learn more, I spoke with Cindy.

**Cindy:**

Goodsell started being built in 1885 and by 1888, they were fully functional, but what many people don't know is that this is Carlton's second observatory. So the first observatory started in 1871 and they, by 1878, had the eight inch Elvin Clark telescope in the dome and a transit telescope to be able to keep time. They wanted to expand to gather more photons and be able to see more stars and galaxies and nebulae. And so the early astronomer, William Wallace Payne went to the board of trustees and said, "We need a new observatory." So they got a new transit telescope and they moved the eight inch Elvin Clark telescope to the smaller dome.

And in 1891, they lowered in the 16 inch telescope into the big dome. Now, when I say 16 inch telescope, that refers to, it's 16, actually 16.2 inches diameter lens.

It takes light coming through the lenses, it's a doublet, coming through to focus 22 feet below the actual lens that's collecting the photons. So this is a very big telescope. It needed a very big mount. But at that point, and still to this day, in order to have the telescope follow the apparent motion of the sky, you have to crank up a weight and like a grandfather clock operates, you let the weight fall down and that makes the telescope gears turn so that the telescope follows the apparent motion of whatever object you're looking at.

They decided to motorize the dome, however, so you don't have to use ropes and pulleys to turn the dome around. It now has a motor, and if it doesn't freeze up, which it sometimes does in the wintertime, we keep observing all year round.

And if you come to the observatory, we have an open house every first Friday of the month. If it's clear, you will see the little governor spinning to indicate that the weight is falling and the telescope is tracking.

**Chantel:** I still wasn't entirely sure how looking at the stars with this specific telescope was used to tell time. I asked Cindy to get into the details of exactly how it all works.

**Cindy:**

back in the day, we did not have a good, stable timekeeping device across the country and around the world. So people used the stars to be able to tell time. And so in order to tell very accurate time, you need to be able to know when a particular star crosses the meridian. So let me tell you about this meaning in your everyday life. Okay. So a transit telescope can only point along a line from due south on your horizon to overhead to due north. So that's what's known as the celestial meridian, and it splits the sky into an east half and a west half.

And so when the sun is at its highest point in the sky, it would be on the meridian. Before it, what time of day do we call it before the sun hits the meridian? Maybe let's say morning and it means we refer to it as AM

And then afternoon you would call PM. PM. AM means anti-meridian. PM means post-meridian.

**Chantel:** I did not know that.

So we do keep our time tied to the sun because noon is when the sun reaches its highest point in the sky. In order to tell the exact second when the star reaches the meridian, the sun gives us too many photons. We don't want to be looking at the sun crossing the meridian. So instead, they would look for particular stars to cross the meridian and then knowing the latitude and longitude of our site and the day of the year, they could calculate the time.

**Cindy:**

They telegraphed that time to all the places that subscribed to the Carlton Time Service, like the railroad system really needed accurate times so that the

trains weren't colliding and running on the same tracks. So Carlton set time for the upper Midwest from Illinois and Wisconsin, Minnesota, all the way to the Pacific from 1891, even earlier, 1880 that we had a smaller transit in the first observatory and we got a bigger transit telescope in the Goodsell Observatory.

So they continued the Carlton Time Service up until December of 1931 when the timekeeping was then all done by the US Naval Observatory.

**Chantel:**

I imagine there might have been other places in the US at least that were also telling time. Why was Carlton so good at time? Why was their time better?

**Cindy:**

First, on the East Coast, there were lots of observatories and there was the US Naval Observatory that was keeping time, but you would have to then telegraph that, right? And it takes time for the signal to travel down the wires. So you would like to have a reliable local source of time, relatively local, and also very stable and well calibrated. And so we had many clocks set to help in calibration and keeping the time when it was cloudy, right? And so that was part of the reason that people came to appreciate the Carlton Time Service was that it was very reliable and it was setting the Western part of the United States.

**Chantel:**

You mentioned that Carlton stopped keeping time regionally by 1931 or so. Why is that? Were there like technological changes that made that form of timekeeping obsolete? What was going on?

**Cindy:**

It wasn't obsolete, but there were better timekeeping measurements being made at the Naval Observatory, better methods of communication for that time across the nation. And it just became too hard to keep doing all of the observations that were needed to keep this time, given that it was available by many, by primarily at that time, the US Naval Observatory.

**Chantel:**

And what were some of those better methods or ...

**Cindy:**

Well, they used the same method that we did with transit telescopes, but then we became able to look at the vibrations of atoms and realize that these could be stable timekeeping. We didn't have to use the sky and depend on the sky for very accurate timing.

**Chantel:** Long before the Goodsell Observatory tracked the stars to tell time, the Dakota people had, and continue to have, their own deep connection to the stars. The Oceti Sakowin Oyate, or the Seven Council Fires, is comprised of the Dakota, Lakota, and Nakota nations. Jim told me that they are reflected in a sacred pattern in the stars.

**Jim:**

in our Oceti Sakowin Oyate cosmology, big fancy words, but we are the people of the seven star fire nations.

And most of us say that those are the seven stars of what you would know as the big dipper.

**Chantel:** Dakota people are Star People. Jim explained they not only come from the stars, they are stars.

**Jim:**

And it's our creation story, the very much like what is now the big bang and the term nucleosynthesis is the idea that stars made everything. Stars make all the atoms were made of. Carbon, nitrogen, hydrogen, oxygen, C-H-N-O, ch-no. It's CHNO, doncha know. Minnesota chemistry, Mni sota. So we're made of that. I like to say. Star stuff are us. The stuff of stars we are. Talk like Yoda we do.

**Chantel:** Dakota people have not one creation story, but *many*, all of which have utmost importance to their cosmological relationship. Many Dakota believe the confluence of the Mississippi and Minnesota rivers is the first place of creation where Dakota came down from the stars. Some Dakota regard Wakan Tipi, known by many today as Carver's Cave or the Bruce Vento Nature Sanctuary, as the site where their ancestors first arrived from the stars. For Jim, these creation stories all point to the stars.

**Jim:**

One of those deksi uncles, he's up in the stars there now, we sure miss him, but that's deksi Gary Sungi Cavender. And he said, "We come from a cave or

we come from a star or we've always been here." And he said, "Really, those three are not this or that or that. " It's, "Do we come from a cave or a star or have we always been here?" And the answer is yes.

So I see those as the three architectural principles of our origin, our cosmology, who we are, where we are from, how we are to live. We have constellation identification. We literally and symbolically, but identify with particular stars in particular constellations.

**Chantel:** Fundamental to understanding Dakota star knowledge is the concept of Kapemni, which means “as it is above, it is below.”

**Jim:**

It is basically the sky earth connection. And as I say that, I realize in audio you're not seeing that I take three fingers from one hand and intersperse three fingers from the other as above so below is kind of that phrasing, but if those are the first three teepee poles, more will be added between them in a circle. So you have a circle of poles pointing above and another circle pointing and touching, resting below. So from the mother as earth to the sky as father, there are patterns and mni, water, mni. And so as some say, it is how we live in a place where the sky is reflected upon the waters, where the waters reflect the sky.

So very much Kapemni is like a reflection, a mirror, and water's a wonderful surface for that.

So that basically says there's a circle of stars. There's more than one. There are many ways to envelop stars and see them in gatherings, in circles and other shapes. And that's kind of the first principle that has led me over a lifetime.

**Chantel:** Jim was born in St. Paul near Wakan Tipi. He remembers learning about Wakan Tipi, and the mounds above it along the bluff, from family and elders. Wakan Tipi means “dwelling place of the sacred” and it tells the story of Dakota’s cosmic origins. The sacred site was largely bulldozed to make way for the railroad in the late 1800s. Today, all that remains are 6 of the original 37 mounds, and 2 of the original 6 caves.

**Jim:**

I remember being in elementary school, upper elementary to junior high, and because those mounds were nearby and you would hear certain things, but

there wasn't a lot said. It came piecemeal over many years, years apart sometimes. But when you would find out that there were carvings, drawings, then the fancy words, petroglyphs or pictographs, those have specific meanings. The carvings are the petroglyphs, but they were animal forms, buffalo, snake, turtle, salamander. Then it really starts to connect for you that aha. I remember an elder telling this story about, say, a turtle and a salamander in the sky.

And so basically another simple way to say this using colonial language, and I apologize to my community and those elders might hear this down the road, but this cave is far more than a planetarium because it is the sacred, again, using colonial terms, a cathedral, a sacred dome, a space which once entered, there's water, there's a lake in there. And if you had a torch, flaming torch, you could just imagine that the shadowy three dimensional forms moving on the ceiling with the flickering lights and it very much is what a planetarium does for us or a mosque, a church, a cathedral, a temple, right? It's a sacred space.

**Chantel:** Wakan Tipi has long been a meeting place for the Oceti Sakowin and other Native nations. It is a sacred place where the elements of birth, death, water, earth, and sky converge.

For decades, Jim has been studying Dakota star knowledge at Wakan Tipi. It is only recently that he has been able to show that Wakan Tipi is a vital connecting point between Earth and Sky.

**Jim:**

It was in some ways an intuition, and it's taken 50 to nearly 70 now years to confirm through language and other research, and even my science, graduate level astronomy and chemistry, and everything I could possibly pull together, now I am very confident in being able to assert that those mounted, rounded hills are as a pregnant mother's belly, and the cave beneath would be her womb. And so that seems pretty obvious now, but just saying these in an analogy kind of way has never worked with those who seem to always have more degrees and publications.

It's a wetland because the birth water, the amniotic fluid would leave that cave and journey a very short distance to the Haha Wakpa, the Mississippi.

These aren't flimsy analogies. You can see they're very literal. This is realism and it's grounded in indigenous phenomenology. If we have to have a European name for our philosophy, our cosmology, we agree that it is

phenomenology, which is a very long-term system of observations and learning to live in good relationship with all those relatives.

**Chantel:** Kapemni, the Dakota concept that means “as it is above, it is below”, is vital to understanding Wakan Tipi as a mother’s womb. Jim explained that the teepee plays an important role in the connection between above and below at Wakan Tipi.

**Jim:**

The word teepee, it's not just the noun, which refers to the cave, but it's a verb. The teepee means they live. So how do we live or they live? We live as those teepee poles. They are leading together, as we mentioned. They're circling, they're twisting, they're connected. And that's also part of, to get back to your previous question. Kapemni means like spinning, twisting, circling.

**Chantel:** The teepee itself acts like a rope, connecting Earth to Sky. But Jim reminded me that Wakan Tipi is a mother’s womb so the teepee rope has greater meaning.

The teepee rope is as our umbilical cord. Why? Because the first teepee in which we live is our mother, our mother's womb. She is that connection to us that all the ancestors is. That's what it's about, honoring our mothers. And it's just tearfully thinking of all the food they prepared and the love they gave and watching us take our first steps and soothing our wounds and our emotional upsets.

**Chantel:** Dakota spirits travel the spirit road, more commonly known as the Milky Way, when they come down to earth and when they depart it. Jim told me that there is a doorkeeper who lives at the center of the big dipper who guides spirits on this journey. Her name is Blue Star Woman. The baby spirit takes the spirit road through the turtle and salamander stars on its way to Earth. Dakota people honor this journey in various ways.

**Jim:**

So when the baby then is born, there are essentially two kinds of leather pouches that the mother or grandmas, the aunties probably have prepared, a turtle beaded pouch and a salamander beaded pouch to put umbilical in there so that the child will always have that connection.-Yeah, there are songs and ceremonies and ways, probably shouldn't go into too much here.

**Chantel:** Dakota people and the many communities who call Minnesota home may come from different cultural backgrounds, but they live under the same sky and

share an interest in gazing up at the stars. I asked my guests to share when they became fascinated by the cosmos.

**Jim:**

I have always been a nerd. And before the word nerd, there were words like dork or whatever, in the '60s, '70s. And part of that is because I needed glasses. And even at two, three years old, you're bumping into things and your family has to find a way to get you some glasses or whatever. And I didn't much like them until I realized, oh, these lenses here, they make little things down there in all the sand grains, the ants and the ... You could see, but they're also, you point them up above. So in other words, a lens is like for making a microscope or a telescope. And so if people didn't want to play with you because you were kind of a nerd, well, as you get to those junior high years or maybe even upper elementary, you realize that the sun can focus those rays if you think of them and concentrate them, again, like teepee poles.

And pretty soon that little point of light is hot enough to burn some leaves. And so it's like, "Hey, Jimmy, are you playing with matches again?" "Oh no, no, no. You didn't light that fire?" "Well, not with matches." No. So see, then you get friends when they realize, oh, sort of a MacGyver effect, but always curiosity, the desire to want to know.

**Cindy:**

I was interested in the stars for as long as I can remember. My older brothers and sister would always be able to find the big dipper and I didn't know what they were talking about because I at first couldn't see them. So I thought, "Oh, I must learn this." And so I started looking at books and they started showing me the stars we could see from St. Paul.

I grew up in the, well, in essence, in the '60s, I was doing my first forays into looking at the stars in the '70s. And the light pollution was not as bad as it is now, but there were many constellations that I saw in the books that I couldn't see on the skies because it was a little bit of sky glow all over the place, but I could see the brighter stars. I could see the big dipper and the little dipper. And now when I look at it, I think, "Oh, it's much worse now." But from the cities, but coming down to Northfield, Minnesota, I was very impressed with the number of stars I could see right outside my back door.

**Chantel:** Ron's passion for the stars is rooted in a big cultural moment—the Apollo 11 moon landing on July 20, 1969.

**Ron:**

So I'm a child of Apollo. I grew up watching the Apollo program and our first foray to the moon. One of my first memories as a child is my parents said, rented a cabin in the summertime and they brought a TV along. They rented a TV so they could have it out at the cabin and they could watch the broadcast of Apollo 11. So I remember it was one of those big wooden boxes with a little tiny screen, but I remember it now. It was only about four at the time, so it was pretty exciting.

Of course there was some rudimentary computer animation because we didn't have cameras on the outside of the spacecraft. The video that we would get from the down link was grainy, not very impressive, but just the idea that they're 240,000 miles from home and Mr. Johnson next door had a color television as amazing as that technology was. And so he went over there for part of the coverage and had Uncle Walter walk us through the moon landings and all the amazement, and they always had an astronaut on with him that could explain it more clearly what was going on and provide the technical background of what they were seeing and what we were seeing on the TV and watching it unfold.

Then I spent the rest of my youth following the rest of the Apollo program all the way up to Apollo 17 in 1972 when they left the moon afterwards, Skylab and then the Apollo, Soyuz program and then the follow on to the space shuttle. And by the time the space shuttle flew in 1981, I was in high school and just always fascinated with the space program and fascinated with astronomy as well. Carl Sagan's Cosmos series was just a tour de force of all things astronomy, but not just astronomy, but the cosmos itself and where we are in part of that and how that's part of us and how we literally are star stuff.

**Chantel:** My guests' love for the stars led them to be educators.

While Ron is currently the observatory coordinator at Jackson Middle School, he didn't immediately set out on a path to become an astronomy educator. He earned his degree in mechanical engineering and spent time teaching astronomy as a hobby. He took courses on model rockets in his spare time and got increasingly involved in teaching and public-facing astronomy. He is a member of the Minnesota Astronomical Society, which was founded in 1972. It currently has over 700 members and they have observing sites throughout the metro.

**Ron:**

I started to do outreach programs with them. When people would call and say, Hey, we've got a scout group. We want to come out to the telescope.

Can you give us a tour of the sky?

They have a loaner program where you can actually borrow a telescope, take it home and use it for a month. And there's a great variety of them. So before you start spending hundreds of dollars on a telescope you can try before you buy, and that's a great utility that they have.

And then they do star parties throughout the metro. The big outreach site is out at Baylor Regional Park in Norwood, young America and big telescopes, three buildings out there, a classroom, two observatories, and about three or four times a month in the summertime, they have star parties out there where they just open things up and show you the sky and give you a tour and it doesn't cost you a thing.

Then in 2001, I was selected to be a solar system ambassador with JPL. And so JPL is the part of NASA that's in charge of the robotic exploration of the solar system, the Jet Propulsion Laboratory. And there are about 900 of us throughout the US now, and we get together with the scientists, the engineers and the technicians. They get to tell us where they want to go, what they hope to learn, how they're going to get there, and then they get to share the results with us once the mission's over and then I get to turn around and spread the word.

Now I'm still a solar system ambassador, and I get down to Johnson Space Center in Houston once a year, and I get to meet with those people and meet with the engineers and the scientists and the astronauts and get to find out how it was done and how they're planning on doing in the future.

**Chantel:** While Ron eventually found his way to education, Cindy always knew she wanted to be a teacher.

**Cindy:**

I didn't know that you could be an astronomer and a teacher and being a teacher was what I really knew I wanted to do. And when I was in high school, I joined the Twin City Astronomy Club Youth section and I went to a lecture by Ednai, Professor Ednai from the University of Minnesota, where I found, oh, he teaches and he's an astronomer.

So the rest is history.

**Chantel:** Cindy attended the College of St. Teresa in Winona before transferring to the University of Minnesota where she earned her bachelors, masters, and PhD. She taught at Augsburg College for a few years before landing at Carleton College where she taught students and was involved in the open house nights at Goodsell Observatory. For Cindy, stars have always been a family affair.

**Cindy:**

I have two daughters and one is a historian, as you know, and the other is a physics and astronomy high school teacher. And so they were always part of my teaching world and any astronomical event. They remember many, many, an evening sitting on the floor of Goodsell Observatory or looking through the telescope. I even made them get up in the middle of the night so they could come and look at Saturn when its rings edge on and you couldn't see the rings. My youngest, or my oldest, I should say, when she was younger, we went to see Halley's comet and we went to the O'Brien Observatory of the University of Minnesota's observatory on Marine on the St. Croix. And she looked through the telescope to see Halley's comet. It had an image intensifier on it, so it was just this green glob.

She was very excited and she knew it was a comment and was going to come back. So she said, "Mom, we can see it next time together." And she was only three, but I didn't want to lie to her. So I said, "Oh, honey, I'm sorry. I don't think I'll live that long, but you see it for me." And she, to this day, reminds me of that scarring experience. And so I learned at an early age that I can withhold some information without telling a bald face lie.

**Chantel:** Like Ron and Cindy, Jim has been teaching for quite some time. He has been an educator for 50 years and is currently teaching at the University of Minnesota Duluth. Jim is an archaeoastronomer and an ethnoastronomer. An archaeoastronomer studies archaeological sites with astronomical importance; places like the world famous Stonehenge in England and Jeffers Petroglyphs in southwestern Minnesota. An ethnoastronomer studies human cultures and their myths, legends, religious beliefs, and current practices as they relate to the cosmos.

The students that enter Jim's classroom learn that while Native science and western science are very different models for studying the cosmos they can be blended. But there is an important distinction between Native science and western science.

**Jim:**

Western science, it doesn't have to be that different except western way tends to analyze, breaks things into pieces. So we're more about the ethics, the

questions of why would I do that? I'm not just going to make long plastic molecules that stick around forever.

I need more people to feel this. We have emotion. Our science comes with heart. It's not just head, but heart. They must be connected. My dad would say that.

**Chantel:** Indigenous star knowledge is the culmination of time-tested observations. For thousands of years they watched the skies, recording the movement and position of the stars and planets. They used this information to form the basis of their hunting, agricultural and ceremonial calendars, among other things.

Star knowledge has been passed down through the generations, often through oral traditions. But it can also be found in physical locations, like Jeffers Petroglyphs—a sacred place where Native people have worshipped and recorded the story of their lives in rock carvings for thousands of years. At the 160-acre site in southwestern Minnesota, there are an estimated 8,000 petroglyphs, or rock carvings, pecked into horizontally exposed Sioux quartzite outcrops.

The thousands of petroglyphs depict animals, humans, objects, and tools. Native elders believe the carvings were made directly by spirits and/or by inspired humans. Native people came to fast, seek guidance, commune with the spirits, and conduct ceremonies. The glyphs were used for a number of reasons, including to give travelers directions and enable elders to teach younger generations about the stories pictured on the rock.

**Jim:**

We've been moving around since the glaciers, 13,000 years. We were here before that. We came back. When we came back, we brought the corn and that corn requires a calendar. So we can tell by how the carvings out at places like Jeffers petroglyphs, the hard red rock, the hard pipestone type, carvings. And one of those carvings out there is of a hand. And that's also one of our constellations. And that's one of our most important stories because it's about one of our seven ceremonies and the ways that we're supposed to live so that the buffalo and the corn and our people will be fed and the world will get the right amount of water, not drought or floods, not fires.

And we've been through this many cycles. So that's all encoded knowledge. It's like a university library and many came from far away and wrote in those stones.

**Chantel:** The handprint petroglyph Jim mentioned is 1 of at least 14 at Jeffers. The hand carries many meanings across Native cultures. Native people of the northern plains refer to one of the most familiar grouping of stars in the sky as “the Hand”—also known to many as Orion. At Jeffers, one of the handprint petroglyphs has an eye inside of it. Some Native elders believe this glyph reflects the Hand constellation and represents the entrance to the spirit world.

The Jeffers site provides descendants today with a spiritual link to their ancestors through a shared knowledge of the cosmos and the timeless experience of observing the night sky.

Jim also spends time guiding Indigenous programming at Jeffers and other sites to help visitors understand that Native and western science have come to similar conclusions about the stars throughout history; they just got there differently. For example, Dakota people used their own units of measurement to track the stars.

**Jim:**

The wicispa, the wicispa is a cubit from the inside elbow to the longest finger, middle finger, that distance. There's also from the ear to the outstretched fingertip.

These measurements were used for the spacing of stars or how far a star had risen or where it was arcing across like that at the Meridian point, we say the meridian is that fancy word for ... Imagine from the north pole to the south pole, there's like this arc and it goes from north to south.

**Chantel:** Both Ron and Cindy spend a majority of their time in observatories teaching students and the general public about the universe from a western perspective. An observatory allows visitors to observe the night sky in real-time. Ron is the observatory coordinator at Jackson Middle School where he mostly teaches 6<sup>th</sup> through 8<sup>th</sup> grade students, but also does public outreach.

**Ron:**

The observatory was built back in 2005 as the school switched to a math science focus. That was when STEM was all the rage. And there were state funds available, they call it specialty schools. And so for about \$400,000, we built this standalone building behind the school. It's got a classroom that fits 40, and then the big telescope upstairs.

The telescope we have at Jackson is a 14 inch telescope and the size of the mirror, the diameter of the mirror gives you some idea of how much light it can gather. The larger the mirror, the more light it can gather. And so the big telescopes on top of the mountains throughout the world are eight meters

across or 10 meters across, and those are the ones that can see out to the very edge of our universe. Even better if you can get that up above the atmosphere like Hubble and James Webb, because then you don't have the atmosphere interfering. But the scope we have here is pretty much as big as you'll get for amateurs. Thankfully I don't have to pick it up and carry it outside. It is mounted to a pipe that goes down and misses the building entirely. It goes all the way into the ground, two floors down and is anchored there. So up on the second floor when we're walking around, we don't shake the telescope, and there's a big 20 foot dome that sits over the top of it. So all we have to do is bring the class up, turn everything on, slide the dome open, and we are looking at the sky.

**Chantel:**

And I'm sorry if I missed this, but it's a 14 inch telescope. What's the furthest you can see? I don't know if that's in light years or maybe the furthest star or how far can you see with this telescope?

**Ron:**

So the stars that we see in our sky with our eyes are all within about a thousand light years. So we see if you were to take the Milky Way and put it on a map, it's about 105,000 light years across. And if you put a dot where the sun is just a little bit larger than that, dot is the sky that we see with our eyes and everything else we miss out on. So it's the use of a camera or the use of a telescope that augments that view and allows us to see farther. So there are galaxies that we can see that are 2, 3, 5, 15, 20 million light years away. But of course as you get farther out, the objects get dimmer and then you're challenged with the urban light pollution in our area.

We were open last week on Tuesday and Thursday, we invite you to come out, give you a tour of the sky, show you all this stuff. Saturn looks amazing right now. Jupiter is coming back into the evening sky, and of course the winter constellations are just fantastic.

**Chantel:** Cindy is a retired Carleton College professor, but she continues to teach the stars at the Goodsell Observatory's open house.

**Cindy:**

At its maximum capacity, there's probably about 50 people snaking around the base of the dome, waiting in line to be able to see through the telescope. They have to climb up on a ladder because if the telescope is up on a pier and it's 22 feet, if it looks closer to the horizon and that you view through is now

pretty high up. So you climb up on this big ladder that rolls around in the observatory. I guess in my experience over time, I have had open houses where it's been like below zero and there are maybe 20 to 30 people who come out to observe.

And then if it's a nice night and people are eager to see the planets or see the moon, we can have as many as several hundred people. For eclipses, maybe 300 people.

The last eclipse we had in September when it was nice out, families came and had picnic blankets out around the observatory and they would pop in and take a look through the telescope as the shadow progressed across the moon, but they could look at it with their eye as it was going on in real time.

**Chantel:**

You mentioned temperature. So beyond obviously people not wanting to be in below zero temperatures, why does temperature matter to the observatory or to the telescopes functioning?

**Cindy:**

You want the temperature inside the dome to be the same as the temperature outside so that you don't have shimmering heat waves coming out of the slit and disturbing the quality of the, what we call seeing or how much detail you can see in an object. Same outside, you don't want to have heaters to keep yourself comfortable near the telescopes because the heat will rise and that will cause air currents that disturb the view.

**Chantel:** At the Jackson Middle School and Goodsell Observatories, Ron and Cindy share similar approaches when teaching the stars. The cosmos can feel big and far removed from our lives here on earth. Helping students to engage directly with the frontiers of space is important.

**Ron:**

Our current event we had last week when they were out was about the Euclid mission, and the Euclid is a telescope that's out there taking wide angle shots of the cosmos. And the video is just incredible where they just zoom in and zoom in and zoom in, and you're looking at just two galaxies that are probably about 30 billion light years away, and the technology that's available now is just stunning. So getting to show students the very latest from the frontier, if they're not introduced to some of this, it just kind of is part of the background, static of the information they get or the internet, but to personalize it, to make

it an experience for them, and they can see, oh, here's what we're hoping to learn and here's what they learned.

**Chantel:** Making the stars personal is one way that Cindy gets students excited about astronomy.

**Cindy:**

I asked them on the first lab day, "What is your earliest memory of looking at the night sky?" And so we could build on what they learned and learn about all of their colleagues and classmates and then we'd go out and I'd teach them how to read a star map, teach them with my laser pointer, try to point out the constellations so that they too could find the way around the sky.

It was excellent to be able to have these students who were curious about their world, their cosmos, the universe, and have the opportunity to take them on a tour and tell them, work with them to understand how the universe works, how we know how the universe works and what are our limitations and what would we really like to expand and continue to do.

Some of them hadn't seen as many stars as they could see from next to Goodsell Observatory ever in their life. And so they were astounded.

sometimes they'll look at Saturn, for example, and, " Oh, that looks like a fried egg. "I don't know why, but that's a common kid experience about the look of Saturn through a telescope, but it doesn't really matter how old you are. I've had people in their 80s come on up and take a look through and just gasp and be so excited as well as three year olds.

It's important to me that everybody know that they are welcome to come and enjoy the stars and planets through the telescope so that they can see things. Maybe they can't see in their backyards and the next generation of our cosmic explorers are the little kids now. So I really want to be able to get them to be able to enjoy.

**Chantel:** There is a lot of technology out there beyond telescopes that help us to see far into the universe. But for Ron, all of these bells and whistles take away from the experience of interacting directly with light from the past.

**Ron:**

I'm a big naked eye guy or using your eye? We can take pictures through it, but you can show anyone a picture on a screen. And I find that terribly unsatisfying when someone's looking at Saturn and they know that that light is from a billion miles away or they're looking at the Andromeda galaxy and

that light has come two and a half million years to smash into your eyeball. I mean, you got to be there for it. You can't just, well, here, send it to a camera. I'll look at it when I have time.

It's like, no, you got to be there and experience that light hitting your retina, turning into a signal that tells your brain to drop its jaw open. This is amazing. And you can't imagine you would see this thing with your eyes. And that's one of the things that we really try to do here is to provide them a view that's not a proxy, not a virtual view, not augmented reality or whatever. This is the real thing. And it's amazing how many people look at Saturn through the telescope and they can't believe they're actually looking at it.

And it's an interesting experience to see someone cry at an eyepiece or to just be completely rendered spellbound by what they're looking at. I've led eclipse trips too, I think this was number eight I was on last time. And the spectacle of a total solar eclipse is just a holistic experience and it just burrows into you. It's like nothing you've ever seen before. And to experience that with your eyes is just incredible. Actually, cameras don't do it justice. You can see pictures of someone at an eclipse, and here's the picture I took. It's not even close. Our eyes can pick up that subtle change in light and the different shades. The sky turns this beautiful silvery purple and the blackest thing in the sky is where the sun used to be, and it just looks like a hole and someone's popped open a drain and the sky is rushing out through that drain and disappearing into eternity. It's an incredible experience.

**Chantel:**

I'm a historian, I'm not a scientist. And so what I'm really fascinated by in our conversation is earlier you said whoever looks through this telescope, being able to actually see the light come into your retina and have it be processed, and knowing that that light took thousands and thousands and thousands of years to get to your eyeball.

It's just fascinating, right? Like well, it's both. You're here in the present and you're looking out and it's like the past is coming at you.

**Ron:**

Exactly. The farther out you look the farther back in time.

**Chantel:** This lesson—that all the light we see is coming from the past—is one that Cindy's students often struggle with.

**Cindy:**

I think getting their head around the fact that when they looked at objects, they were looking back in history because they saw the Andromeda Galaxy as it was 2.5 million years ago and those photons were just hitting their eyeballs now. So I tried to encourage them to appreciate that fact that **they were sampling history** as they looked out among the stars and galaxies.

**Chantel:** I asked Ron why he thinks it is important for us to look up at the stars.

**Ron:**

it gives us a sense of place. I mean, people are interested in genealogy and looking back at taking their DNA and finding out where they've come from. Well, you might not be related to everything on earth that's living, but everything on earth that's living is on earth. And we are in a corner of the Milky Way galaxy, and that's part of our sense of place. You look at Jupiter and Saturn and the earth is just a little tiny marble comparatively. One of my favorite astronomical facts is the sun is so big. If it were hollow, you'd be able to put a million earths inside it. There are sun spots on the sun right now, and pretty much every single one of them is larger than the earth. So they can look at that and go, oh, that tiny spot right there. Yeah, bigger than the whole earth. You can't substitute that scale and that sense of, oh, we're that small. You can throw numbers out, but you get to a certain amount of numbers and your eyes just kind of glaze over.

**Chantel:**

It's just incomprehensible, right?

**Ron:**

It's ginormous. But to actually see it and the comparison of scale, and that's one of the things that's really fun to do, is to take on a zoom out, start here at Earth, back up through our solar system and then beyond our galaxy to the very edge of observable space. And the amount of stuff that's out there is just a subtle hint to the amount of size that's out there and how big the cosmos is.

And that's often some of my favorite memories. We did one of those zoom outs and I'm sending them off, they're leaving and I'm wishing them well as they head out the door. And one of the kids turns to me and says, I feel so small. I said, hold on to that for a second. Kind of sit there for a little bit. That's a good spot to be. There's a reconnection, there's a humility that comes with taking a look at all these giant forces at work and the immense size of all of this stuff. And here you are just one of 8.4 billion people currently on a planet around a pretty average star in a pretty unspectacular part of a galaxy that's

just one of a trillion galaxies that are out there. So a trillion galaxies each with a couple hundred billion stars, probably most of them have planets around them.

So we're talking about trillions of planets. But in all of that immensity, there's just one you. So how rare and precious are you? And just to make that a personal experience for our students is kind of the ultimate goal.

**Chantel:** Our view of the stars changes based on our physical location on earth. The star canvas I see in Minnesota is different from what I saw growing up in South Texas. But our view of the stars also changes based on the rotation of the earth, and the earth's location in orbit around the sun. I spoke with my guests during the winter months so I was curious to know which constellations are in the Minnesota skies this time of year.

**Ron:**

Well, the neat thing about wintertime is that of the 20 brightest stars in the sky, 16 of them are in the winter sky. When we have summertime, we look to the south and we can see the milky way is due south stretching way up overhead. That is the bulk of our galaxy right there. And if you find a dark sight, you can actually see it. It's almost like a cloud. But in the wintertime, that's when we're looking away from the center of our galaxy and our Milky Way comes through the winter sky, but it is looking outward towards the edge of the disc. Well, that's actually the part of the galaxy that we're closer to. We're on the inside of the Orion spur of the Perseus arm, and the stars that we see in the wintertime are our next door neighbors. And so the big bright ones, you look and go, oh, the stars must be so bright because the sky is dry and it's cold and it makes everything look brighter. That helps. But those stars really are brighter.

The winter circle has got a bunch of bright stars, the brightest star in our sky, Sirius, the dog star, is part of the winter sky, Betelgeuse, Rigel, Aldebaran, Capella, all of them very bright. And that's all part of our winter sky. And I think observing in the wintertime is magical. When I was a kid, I would freeze my eyelashes to the eyepiece. It was just something I really wanted to see, and it was worth it. Sometimes you'd go out in your pajamas, but you'd pull on your galoshes and your parka and you'd get out there. And because the winter sky is just magical.

**Chantel:** For Dakota people, winter is a special time for telling stories and connecting with their star relatives.

**Jim:**

There's a time of year where those stars are visible and a time where they're not. And that's part of our protocol when we are able and when we're not. In the wintertime, we were trying to stay alive around a fire. And in the summer, you're working too hard, growing your food and hunting and preparing and stuff. So you didn't sit around telling stories then, but there's a lot of reasons for what you shared and how and when. And my dad said to his grandmas during the wintertime would tell those stories a little bit each night.

**Chantel:** Storytelling through the stars is widely practiced throughout the world. Oftentimes a single constellation can hold many different stories. Here's Ron.

**Ron:**

I've got one book that has the constellation stories for the pattern of stars that we call Ursa major or the Great Bear. And there's like 60 different stories. In England, they see a plow, like the kind of plow that Charles Ingalls would've dragged across the prairie. There's the steel blade and the handles. In Scotland, they see a wagon in France, they see a casserole, we would call it a hot dish, but in China, they see the emperor's cart, the emperor's on a cart being drawn through the town waving to his subjects. In Japan, we see the emperor's court where the emperor and the empress and then his court of advisors. But I think the Egyptians take the cake. They see a bull with a reclining man and a hippopotamus with a crocodile on his back.

So you toss that at the kids and they're like, wait a minute. What was going on with these Egyptians? A lot of imagination was going on and just like seeing Elvis in a potato chip or a bunny in a cloud pattern, we apply those same whimsical tendencies when we look at the sky. And sometimes it's just something fun, but sometimes it's a reflection of a story from long ago. And sometimes those are origin myths where it tells us why something is the way it is. And sometimes there's an application of a morality going on up there. There's heroes, there's villains, there are mythological creatures, there's inanimate objects, there's people, all that stuff we can find in the sky, and that connects us with all the stuff going on above us, but also connects us with what's going on inside.

**Chantel:** I asked my guests to reflect on why star knowledge matters. For Jim, learning about the stars is an ongoing process.

**Jim:**

And year after year after year, it's like you learn a little bit at kindergarten level and then pretty soon you're high school and graduate level. My dad would say, learn all you can from those books, but remember, there's much more written all around you and within you than in those books. So be willing to read a turtle shell, read the feathers.

**Cindy:**

I think the star knowledge is what allows us to fully appreciate how we are part of the universe. We can appreciate how teeny tiny we are as we look out at all the stars, sending out light and it's traveling for eons before it reaches us. And it gives us a perspective on, well, what are these stars? How are they like our sun? How are they different? What has gone on with the stars, their life cycles? What can we learn about how the universe has changed throughout time, how our sun will change, how many planets there are around stars. And so it fuels the imagination as well as just driving intense curiosity and giving you a great view of your place in space and time.

**Ron:**

Stories are ultimately a driving force behind so much that we do. Stories allow us to see things or experience things that we wouldn't have thought we could experience. And yet the best stories are the stories that resonate with us. They touch something in us that we can relate to, and that's why you look up in the sky and instead of talking about the distance between these things and the various spectral class and what's going on chemically on those stars, you talk about, oh, that's a rabbit and that's a bear, and that's the baby bear. And all of a sudden what you see up there connects you to the people that came before us.

**Chantel:** For thousands of years, millions of people have lived here, even if they didn't call it Minnesota. They gazed up at the stars and drew connections and meanings from the cosmos.

Stargazing is a timeless, shared human activity, connecting people across cultures, continents, and generations. The same sky that guided Dakota ancestors at Wakan Tipi and helped Goodsell Observatory set clocks across the Upper Midwest still inspires curiosity today.

As I left the observatory that cold February night, I kept thinking about what it means that all the light we see is from the past. The stars inspire us to ask big questions – about the universe, our place in it, and how we live on Earth. They invite us to consider multiple perspectives.



As a historian, I have read countless histories in books and listened to communities speak their histories. My guests helped me to see that we also write our histories in the stars.

What star stories do you have? Let us know by sharing them on social media with the #MNUnraveled.

Special thanks to Andreia Carillo for welcoming us to Goodsell Observatory and to Deacon DeBoer.

You've been listening to *Minnesota Unraveled: pulling on the threads of Minnesota history*. I'm your host Dr. Chantel Rodríguez.

You can find more information on this episode, including transcripts, bibliographic resources and MNopedia articles at our website [mnhs.org/unraveled](http://mnhs.org/unraveled)

Minnesota Unraveled is produced by the Minnesota Historical Society in partnership with Rose Productions. Our research team is Ari Fields, Alex Magnolia, Hayden Nelson and me, Chantel Rodriguez. Our production team is Brett Baldwin and Meghan Buttner, with recording, sound design and editing by Chris Heagle and Zack Rose.

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Thank you for listening. Until next time, stay curious and remember, the tapestries of history are all around you. Just waiting to be unraveled.