



THE GEOLOGICAL SOCIETY OF MINNESOTA

News

*Volunteer
opportunities,
field trips,
lectures, and
public service,
since 1938*

From the President's Desk...

Where has summer gone? It seems like only yesterday the spring rains were making everything nice and green. But then it stopped raining, and now everything is a shade of brown.

I hope everyone has been having a great and safe summer. Summer is not done with us yet, and I'm looking forward to late summer and early fall. It is some of the best weather for being outside looking at rocks and stuff. In the near future, it is time for the State Fair. That's right, it's that time again, and GSM will be hosting a booth in the Education Building, continuing a tradition that started in 1970. We depend on volunteers to staff the booth, and if you have not signed up for a shift or two, it's not too late. It is always a great time interacting with visitors and promoting GSM's lectures and field trips. And of course, it fun to talk about the collection of rocks on the table.

Our Fall Banquet is scheduled for September 18th at the U Garden Restaurant. Greg Brick, a favorite speaker, will present "The Deep Caves of Minneapolis and the Shock of the Anthropocene." Yes, it's about groundwater, a very important topic. I hope to see you there. The Fall 2023 lecture schedule looks great. Thank you to Steve Erickson for putting our lectures and speakers together, as you have done for many years, again thank you!!! In addition to in-person lectures, Steve is scheduling two zoom lectures each semester. This will ensure that we will have new and different speakers from around the country. See the fall lecture schedule elsewhere in this newsletter.

Randy Strobel and Joanie Furlong have been planning an October field trip to the Missouri Ozarks. Their itinerary includes multiple historical and mining sites. See the teaser article in the newsletter for more information. Watch for an email notice of this trip too. Thanks in advance to Randy and Joanie!

What else?? It's time for GSM membership renewals. A renewal form is included in this newsletter. As your president, I deeply appreciate your dedication to this organization. Before summer says goodbye make sure you get out a few more times. I challenge you to explore a new park, hike a new trail, or paddle a new stream. Have a good time, and as always, be safe!

Roger Benepe



GSM President, Roger Benepe

Inside this issue:

Presidents message	1
Board Membership	2
Membership Renewal	2
Fall 2023 GSM Banquet	2
GSM Fall Lecture Schedule	3
Mineral Club Rock Show	3
Missouri Ozarks Field Trip	3
Member Profile	3
Notes from the Past	4
Spring Banquet Summary	4
Hot Groundwater, Minneapolis	6
Castle Rock, Dakota County	6
St. Anthony Falls in Peril?	8
Sands from Tennessee	10
The Driftless Area	11
Membership Form	12

[Visit us on FaceBook](#)



From GSM field trip: Iron Range, Eveleth, Spruce-Adams mine; July 1939



GSM

2023 Board of Directors:

Roger Benepe, President
 Patrick Pfundstein, Vice President
 Dave Kelso, Secretary
 Dave Kelso, Treasurer

Board Members: Dick Bottenberg; Kate Clover; Pete Hesse; Deborah Naffziger; John Westgaard; Steve Willging.

Field Trip Coordinator: David Wilhelm; Joe Newberg; Nancy Jannik

Geological Markers: Rebecca Galkiewicz

GSM Outreach: Joel Renner

Lecture Recording: Deborah Naffziger; Dick Bottenberg

Membership: Joanie Furlong

Newsletter: Kate Clover; Mark Ryan; Harvey Thorleifson; Rich Lively

Programs/Lectures/Labs: Steve Erickson

State Fair: Patrick Pfundstein

YouTube Administrators: Patrick Pfundstein, Randy Strobel

Video Library: David Wilhelm

Webmaster: Alan Smith

Web Site: gsmn.org

The Geological Society of Minnesota is a 501(c)3 nonprofit organization.

GSM Mail Address: Send all GSM membership dues, change of address cards, and renewals to: Joanie Furlong, GSM Membership Chair, P.O. Box 141065, Minneapolis, MN 55414-6065

Membership categories and dues:

Student (full time)	\$10
Individual	\$20
Family	\$30
Sustaining	\$50
Supporting	\$100
Guarantor	\$250

Individual and Family memberships can be renewed for 1, 2, or 3 years. Members donating at the Sustaining, Supporting or Guarantor levels will have their names highlighted in the GSM membership directory.

GSM News: The purpose of this newsletter is to inform members and friends of activities of interest to the Geological Society of Minnesota. GSM News is published four times a year during the months of February, May, August and November.

Newsletter contributions welcome:

GSM enthusiasts: Have you seen interesting

geology while traveling? If so, please consider sharing your experiences with others through our GSM Newsletter. Write a short article, add a photo or two and send it in. Deadline for submission is the first of the month before the publication date. Send your story to newsletter editor: Kate Clover, kclover@fastmail.fm Thank you in advance.

GSM Board Membership:

The GSM Board consists of members who have a special interest in advancing the goals of the society, including lectures, field trips, and community outreach. The Board currently has ten members, and our bylaws limit terms to four years to encourage turnover, and a change of perspectives and ideas.

The Board meets quarterly, on the second Thursdays of February, May, August, and November, or on a different date if conflicts arise. In-person meetings are from 7-9 PM at the Minnesota Geological Survey at 2609 W. Territorial Rd, St. Paul, MN 55114.

Board meetings are open to all GSM members. If you are a new or long-time member and Board membership is of interest to you, please consider attending a meeting. If you have a topic you would like the Board to consider, please contact Roger Benepe, rbtrilobite@gmail.com

GSM Members!! It's Membership Renewal Season

It's time to renew your membership. You can renew by giving Joanie Furlong, GSM's membership chair, your renewal form and check/cash at the Fall Banquet or at a Fall Lecture. The Membership Renewal form can be found on the last page of this newsletter. Or mail in your renewal.

To members who have multi-year memberships, an email will be sent to inform you if your membership is due this year or not. If you have questions, contact Joanie at jfurlong12345@yahoo.com.

Fall Banquet 2023

Monday, September 18th

U Garden

2725 University Ave SE, Minneapolis, MN 55414

Come and meet up with your GSM friends around 5-5:30 PM. Eat from the buffet or order from the menu. Announcements and the lecture begin about 7 PM.

Greg Brick will give the lecture: "The Deep Caves of Minneapolis and the Shock of the

Anthropocene."

Yes, this is about the warm groundwater issue, but if the lecture was titled Warm Groundwater— that would be a lukewarm title. . . and no one would show up!

For a preview of Greg's talk, read his story 'Minneapolis is in Hot (Ground) Water' published in this issue. Hmm, do you know? The amount of anthropogenic warming is 20°F!! That's shocking!

See you in September!

Fall 2023 GSM Lectures

September 18: Fall Banquet: Greg Brick "The Deep Caves of Minneapolis and the Shock of the Anthropocene"

October 2: Emily First, Assistant Professor of Geology, Macalester "Making magmas: Experimental insights on magma depth and temperature beneath Volcán Quizapu, Chile"

October 16: Scott Peterson, micrometeorite hunter "Urban micrometeorites and everything you need to know about them."

October 30: Anna Graber, U of M "The Great Lisbon Earthquake in Eighteenth-Century Philosophy and Seismology"

November 13: Ray Roger/Kristy Rogers TBD

November 27: (Zoom lecture) 7 PM start time. Ronald Zurawski, State Geologist, Tennessee Geological Survey "Tennessee's Mining Industry and Geology-Related Tourism"

December 11: (Zoom Lecture) NOTE: 6:00 pm Start time Ashley Hall, Outreach Program Manager, Museum of the Rockies "T. rex, Triceratops, and MOR: The Dynamic Dinosaurs of Museum of the Rockies"

Minnesota Mineral Club Rock Show!

When:

Saturday and Sunday, Sept 23 - 24, 2023

Saturday from 10 am to 5 pm

Sunday from 10 am to 4 pm

Where:

Minnesota State Fairgrounds Dairy Building

Parking: That's easy, there is plenty of on-street parking GSM will host a booth, and we will be looking for volunteers to staff the table after the State Fair. If interested, please contact Patrick Pfundstein.



Missouri Ozarks GSM Field Trip October 19 - 23, 2023

The dates and preliminary agenda for GSM's October field trip to the Missouri Ozarks have been planned. Joanie Furlong sent an email with the itinerary on 7/28/23. Please respond to Joanie ASAP if you are interested, in case there is still room. This does not mean you are committed to going, only that you want to be kept in the loop on further emails.

She and Randy will lead a tour of the granites and

rhyolites of the St. Francois Mountains and the surrounding Cambrian and Ordovician sedimentary rocks. They also have plans to visit both historical and mining related sites.

Joan Furlong: jfurlong12345@yahoo.com

Member Profile: Gregory Beckstrom How I Spent My Summer Vacation Story and photos by Greg Beckstrom

Do you remember those essays we had to write when we returned to school in the fall? You know, the ones that started with "How I spent my summer vacation..."? I think I used to bore my teachers with the same story every year – "I bailed hay, built fences, picked rocks, cleaned pens, and swam in a nearby river with my brothers." It



Greg Beckstrom on Denali glacier

was pretty much the same story every year. Now, if I have to write the essay, I have a different tale to tell. After I attempted to retire a couple years ago (I spent most of my career with Golder Associates, a consulting company specializing in environmental services and ground engineering), I decided to travel, work part-time, do some consulting, serve on company boards, and continue my volunteer service with a couple scientific societies. During my professional career, I traveled several times to Alaska and thought that it would be interesting to work and live here. I did a bit of research on seasonal gigs in Alaska and found that a flight services company called K2 Aviation Services needed all sorts of folks for the busy summer season. I had flown on K2 a couple times during earlier trips to Alaska, so I reached out to them and got hired in 2022 as a shuttle bus driver and customer service rep. I'm now working my second season here and am really enjoying the work, the people, and living in this fascinating part of the world.

Coincidentally, there's an interesting connection between K2 and the University of Minnesota. The company's co-founder was Kimball Forrest from Washington State who received his PhD in Economic Geology from the University of Minnesota in 1983. Dr. Forrest's dissertation was on geologic and isotopic studies of the Lik deposit and the surrounding mineral district, DeLong Mountains, western Brooks Range, Alaska. K2, which is now owned by Suzanne Rust, is based in Talkeetna, about a 3-hour drive north of Anchorage. Talkeetna, a quick 40-minute flight from the base of Mt.

Denali, is the largest town in the Upper Susitna River Valley with a year-around population of about 300 people and serves as the commercial, transportation, and logistics center for climbers and adventurers heading to Denali. We operate a fleet of about a dozen “smallish” planes including seven DHC-3 de Havilland “Otters,” three DHC-2 de Havilland “Beavers,” two Cessna 185s, and one Piper Cherokee. We specialize in ski/wheel landings, taking off from the asphalt airport in Talkeetna and landing on glaciers and gravel strips in the Alaska Range within Denali National Park. Because of our unique expertise and specialized equipment, we fly mountain climbers and extreme skiers into the base camp at Mount Denali, tourists on flightseeing tours and glacier landing trips into the Alaska Range, and National Park Service people who are doing fire watch or resupplying remote work sites.

The Alaska Range is an arc of mountains about 600 miles long that trends in a southwest to northeast direction across the southern one third of Alaska. It is bisected by several glacial valleys and river basins. The signature feature of the range is Mount Denali (previously known as Mt. McKinley), the tallest mountain in North America, topping out at 20,310 feet above sea level. The spine of Denali is granite, and it is flanked by marine shales and some small volcanic intrusions. It is a massive mountain that creates its own weather (up to 50 feet of snow every year in the upper accumulation zones) and is surrounded by glaciers, some more than 4,000 feet thick and 50 miles long. These rivers of ice radiate mostly to the east and



Denali from the ground

south and provide meltwater to numerous rivers that flow south towards Anchorage and Cook Inlet and, ultimately, to the Gulf of Alaska and the Northern Pacific Ocean.



River of ice over Mt. Denali

One of the benefits of working for K2 is that I get to take an empty seat on our flights pretty regularly. During these flights, as the company “rockhound,” the pilots will oftentimes ask me to do a bit of geologic interpretation of the country we are flying through. Accompanying this note are a few photographs I’ve taken of

the area and views from a couple of my flights.

If you haven’t visited Alaska or haven’t taken a flightseeing trip into high alpine mountains like the Alaska Range, I urge you to add this



Denali from the air

experience to your bucket list. And should anyone from the GSM make their way up here, please reach out to me at gab4254@gmail.com, as I will gladly give you some ideas of things to do and places to stay while you are here. Alaska is a vast state and has so many attractions for outdoor enthusiasts that getting some ideas from someone who lives here could save you lots of time and/or make your visit more rewarding.

Notes from the Past

From the Minnesota Geologist, Official Bulletin of the Geological Society of Minnesota, volume 1, number 1, October 1943

Geological Society of Minnesota, 831 Second Ave. So., Minneapolis, Minn.

The Geological Society of Minnesota is devoted to the study of geology and mineralogy for their cultural values.

Officers: Charles H. Preston, President; Elmer H. Brown, Vice President; Alger R. Syme, Secretary; Joseph S. Zalusky, Treasurer; Edward P. Burch, Director; Eva F. Jones, Director; Theo. Zickrick, Director; Edward P. Burch, Counselor

Past Presidents: Edward P. Burch; Junior F. Hayden; Alger R. Syme

Our Society meets every Monday evening, not a holiday, in the large auditorium in the Museum, on the 4th floor of the Public Library at Hennepin Avenue and 10th Street, Minneapolis, Minnesota, at 7:30 P. M., from October to May. From May until October, we endeavor to have a field trip each week (when gasoline rationing doesn’t interfere). Visitors are very welcome. Dues are \$3.00 annually, and \$1.00 additional for your wife or husband, or dependent family members.

2023 Spring Banquet

The 2023 Geological Society of Minnesota Spring Banquet was held on Monday, May 8. Seventy people came to take part in the GSM’s longstanding tradition of the chance to enjoy the company of other geology enthusiasts through good food, conversation, and of course, the final lecture of the 2022-2023 season.

Volunteer Recognition: For almost fifteen years, we have taken a few minutes to recognize volunteers who have gone above and beyond in their tasks to make the GSM

the top notch organization that it is. The recognition was done approximately every other year until COVID-19, making our last recognition held in 2019. This year’s recipients of the beautiful Estwing rock hammers were; Joe Newberg – Board Member, President, and current Field Trip Coordinator. Additionally, Kate Clover – Board Member, GSM Newsletter Editor, Minnehaha Marker committee member, and State Fair volunteer among other positions. Mark Ryan – Board Member, GSM Newsletter photographer and writer, plus, he is a Facebook Page contributor. This brings us to our final recipient, Ted Chura. Ted was our Treasurer; he compiled a list of upcoming rock shows and other events in 2021. He has offered giveaways at Sandy and Ed’s Christmas Parties. Ted has been a long-standing volunteer at the State Fair, and has donated to our silent auctions. He has supplied rocks for the rock boxes, and helped on our “Ask GSM” site. Our thanks go out to this special group, and all of those volunteers that have kept our organization running for nearly 90 years.



Theresa Tweet and Roger Benepe presenting the hammer awards



Dick Bottenberg memorialized Doug Zbikowski at the banquet.

It is with sadness that we reported that Doug Zbikowski passed away on March 25, 2023 in Phoenix, Arizona from heart failure. Doug had been our GSM President, Vice-President, and led the Publicity & Public Service Committee. Further, Doug established and led a partnership with various State organizations including, MnDOT, DNR, the Minnesota Historical Society, and the Minneapolis Park Board to design, manufacture and install new plaques across Minnesota as part of the GSM’s Geologic Marker Project.

Additionally, Doug founded the GSM’s Student Outreach program. Considered a win/win program, Macalester College geology graduate students made presentations in Metro area classrooms and to other organizations. As a result, these educational environments received a top-notch presentation and hands-on experience with rock and mineral samples. In addition, the teachers in these classrooms received rock boxes containing eighteen varieties of Minnesota rock specimens, a tradition also started by Doug Zbikowski. The Macalester geology students received a small honorarium and the chance to experience what it is like to teach elementary and middle school students. Unfortunately, due to COVID-19, the program had to be suspended.

Moreover, the Geological Society has been a standard fixture at the Minnesota Earth Science Teacher Association (MESTA) Conference for many years due to Doug. As a result, the MESTA Conference gives the GSM lectures, field trips, and programs more exposure to educators.

Doug was very generous: he was a lifetime donor and incredibly proud of his work with the Geological Society of Minnesota. Doug was innovative; he worked hard, expected the best, and represented GSM well. He will be greatly missed.

The seminar was presented by Justin Tweet, paleontological researcher with the National Park Service. The subject of fossils in Minnesota has been documented for about 200 years, and his talk was an overview of these fossils over geologic time from the Precambrian to the present. He focused on several



Justin Tweet, Fossils of Minnesota

different time periods, and due to my own “favorite” fossils, I will focus on the Precambrian, the early Paleozoic, the Cretaceous, and the last Ice Age portions of the talk.

From the Precambrian period, Justin discussed the stromatolites found in the northern part of the state. Beautifully banded, some delicately folded, stromatolites are not only interesting to look at, but are interesting as a fossil too. The Paleozoic era was a time when the area was a warm, shallow sea environment. For this stage, Justin used some examples of the very diverse collection of invertebrate fossils that can be found in southern Minnesota, including brachiopods, cephalopods, crinoids and trilobites. During the Cretaceous, as sea levels rose, the nature of the organisms and environments became even more complex, including coastal settings with both marine and terrestrial fossils such as plant leaves and pollen. From the last Ice Age, there are fossils from mammoths and bison. Justin also talked about different things that could be done with pollen and spores that you find in lake deposits.

There is so much more that I could write about the talk, but I will stop the lecture piece here, and instead invite those of you who did not, or were not able to join us at Spring Banquet to join us for our Fall Banquet, Annual Meeting, and Lecture, when we begin our new 2023-2024 Seminar season.

Thank you for the terrific lecture series, Steve and thanks to the GSM for such a wonderful closure on the 2022-2023 lecture season!

Theresa Tweet

Minneapolis is in Hot (Ground) Water

“Warming urban aquifers become fermentation vessels for water-borne pathogens, providing one more reason why replacing aging infrastructure is a good idea.”

Published May 25, 2023, MinnPost

When the French explorer Joseph Nicollet (for whom Nicollet Island was named) visited what is now Minneapolis, in 1836, he measured the temperature of Coldwater Spring, south of Minnehaha Park, as 46 degrees Fahrenheit. Summer or winter, it retained this temperature, which is based on our latitude north of the equator. Groundwater averages out the large seasonal fluctuations in air temperature that we experience.

As the DNR hydrologist most directly involved with mapping and measuring thousands of springs for the Minnesota Spring Inventory, I’ve been focused on the temperature of springs and groundwater for years. A large subterranean spring in a cave under downtown Minneapolis presented the highest groundwater temperature I’ve ever measured in the state, a whopping 66 degrees, which is 20 degrees above Nicollet’s baseline data. And it has public health implications that residents should be aware of.

This warming creates a “microbial soup” scenario when sewage leaks occur, since warmer temperatures correlate with increasing threat from water-borne pathogens, which can be sucked into ruptured water mains through

“back siphonage.” In December 2022, for example, Minneapolis issued a boil water alert after a water-main break at North Second Street, based on concerns about back siphonage. Failure to heed such alerts can lead to gastrointestinal illnesses, usually involving diarrhea. Jackson, Mississippi, provides an instructive comparison. An outdated water-treatment plant and aging infrastructure have prompted numerous boil water alerts in recent years, some of them city wide and lasting for months. Water turbidity (cloudiness), associated with bacterial contamination, is usually cited as the reason for the precaution. While it’s unknown whether Jackson has artificially elevated groundwater temperature, its expected natural groundwater temperature, correlating with its latitude, is 63 degrees. In other words, the groundwater under downtown Minneapolis is warmer than that of Jackson, in the southern United States. While our infrastructure is in better shape, the potential for contamination, when breaks do occur, is similar.

Another concern should be among those drinking “raw water” from the natural springs of Minneapolis, especially those in the Mississippi River gorge. Most of these springs already have a mildly elevated temperature, and historically have been responsible for typhoid cases. In my mapping journeys along the river, I found empty one-gallon plastic jugs at more of these springs than you might expect.

Most of this warming can be attributed to heat conducted downwards by buildings and pavements. This subsurface urban heat island would exist regardless of climate change, which, however, contributes to the total temperature rise. This thermal anomaly is the strongest signal of anthropogenic groundwater warming measured in Minnesota, and the most striking groundwater phenomenon I’ve seen in my years as a hydrologist. While first described in my 2009 book “Subterranean Twin Cities,” the data has now been made available in the peer-reviewed scientific literature. Warming urban aquifers become fermentation vessels for water-borne pathogens originating from leaking sewage. This should be considered when investigating unexplained outbreaks of gastrointestinal illness. It provides one more reason why replacing aging infrastructure—from water mains to house connections—is a good idea.

Greg Brick, Ph.D., mapped thousands of springs around the state while employed by the Minnesota Department of Natural Resources and is the author of several books on Midwestern caves.

Dr. Greg Brick



Dr. Greg Brick

Inyan Bosndata: Minnesota's Castle Rock

Usually, when I go fossil hunting in Cannon Falls, the easiest way to get there from my house is to take Highway 52. But it’s a good bet that the easiest route will sometimes be under construction, forcing you to find

new ways to get where you're going.

During one of these detours, I found myself on Highway 3, heading south toward Northfield. At the turnoff to go over to Cannon Falls, I remember seeing a tavern on the side of the highway with the name Castle Rock attached to it. It made me wonder - why was it named as such since I had never seen any evidence of such a structure in the rolling landscape of Dakota county?

I have relatives who live in Castle Rock, Colorado, a community south of Denver named for the huge rhyolite-capped butte that looms 370 feet above the town. It seems it's a common name for similar geological formations seen throughout the Western landscape. But as it turns out, several Midwestern and Eastern states, including Minnesota (and Kansas even) have towns or locations bearing that same name. In further investigation, I learned that there's a small community in Dakota County named Castle Rock. But, again, how did it get that name? If you drive through the town (as I did one day), you may miss it, and you won't see anything much taller than the post office flag. So where did the name originate? My answer came at a postcard show.



1870s Stereoview of Castle Rock in Dakota County, Minnesota. Mark Ryan collection

Besides fossils, I also collect early paleontology and geology ephemera, vintage illustrations, old postcards, photographs, books, etc. Over the years, I've accumulated a substantial collection; but for me, too much is never enough. This past April, while perusing a local postcard and paper show, I came across an interesting 1870s stereoview of the elusive Castle Rock that used to tower above the prairie in Dakota County. Of course, I had to have it. Stereoviews were extremely popular in the 19th and early 20th centuries, and allowed people to view 3-D images of just about anything or anywhere that could be photographed. Special stereocameras were used to capture duo images of a subject replicating the human eyes' stereo-vision by capturing two slightly offset images in a single photograph. Mounted on a 7 x 3.5 inch (or larger) piece of cardboard and viewed through a special stereoscope viewer, the pair of 2-D photographs magically merged into a single 3-D image. It was a popular way to see the world without having to travel far, which back then, most people couldn't do anyway. The wooden, metal, and glass stereoscopes would be eventually replaced by the popular plastic View-Master with its circular cardboard reel of stereo pictures.

Whenever I acquire a new (to me) piece of memorabilia, it usually opens up a new rabbit hole of research, one that I eagerly delve into to learn as much as I can. Hence this story.

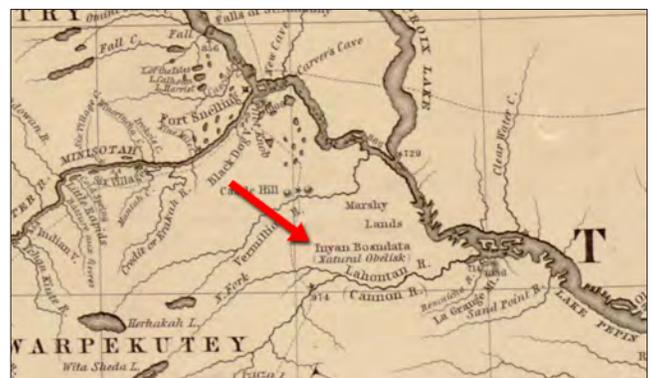
Around the mid-1800s when Europeans began to arrive in Dakota county, the original Castle Rock stood conspicuously high above the prairie and was visible from twenty miles away. Although the settlers called the sandstone anomaly, Castle Rock, the native tribes in the area, the Dakota Sioux, had long called it Inyan Bosndata which translates to "rock standing on end." In Dakota culture, rocks were considered the oldest objects on Earth, imbued with powerful spiritual forces, and something to be revered. Inyan is also the name of a powerful Dakota god – the oldest god, thus bestowing a sense of sacredness to the unusual rock formation. Sacred ceremonies were performed there in Inyan's honor.

Although he'd never set eyes on the Castle Rock himself, British-American geologist George William Featherstonhaugh was first to describe it, using information he had gathered in conversation with someone who had actually seen it. The mystery person also supplied Featherstonhaugh with a rough sketch of the formation.

Not long afterwards, while investigating the Mississippi River Valley for the U.S. Government in the 1830s, French explorer Joseph Nicolle visited the geological structure and compiled slightly more accurate measurements. As he liked to do, the explorer left his mark on Castle Rock, carving his name into the soft sandstone, a tradition hundreds of later tourists would follow. Nicolle also included the structure on his 1843 Map of the Hydrographical Basin of the Upper Mississippi.



Castle Rock figure from Featherstonhaugh's report



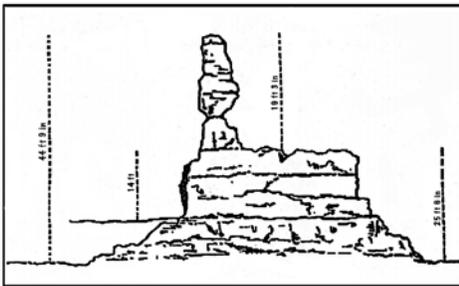
Portion of Joseph Nicolle's Map of the Hydrographical Basin of the Upper Mississippi showing the location of Inyan Bosndata (Castle Rock)

Almost a half-century after Nicolle's visit, Castle Rock was described by Minnesota's first survey director, Newton Horace Winchell, in the First Annual Report of the Geological and Natural History Survey of Minnesota

for the year 1872. Three illustrations appeared in the second annual report, and both text and illustration appeared in the second volume of his final report. He described the feature as:

“The singular pillar in Dakota county, known as Castle rock, consists of the St. Peter sandstone. It stands on the arch of the local anticlinal axis from which the beds dip gently both toward the north and toward the south, and is an outlier from which most of the formation has been removed over an area of some miles. Its form is that of a somewhat regular right prism, or parallelepipedon elongated north and south, supporting on its northern end a pinnacle of bedded sandstone about four feet in diameter at the base which rises above the general mass nineteen feet and three inches.”

At the time of Winchell's first visit in 1872, the structure stood 44 feet, 7 inches high, and was composed of 3 distinct sections: the base was 11 feet, the castle portion 14 feet 6 inches, and the spire 19 feet. He visited it again in 1883 and recorded that although its appearance hadn't changed much in the past decade, the spire appeared unstable and probably wouldn't be able to withstand a strong breeze.



West view of the rock formation, Second Annual Report of the Geological and Natural History Survey of Minnesota for the year 1873

Today, the ruin of the structure is located on private property and practically invisible from the road, especially when the foliage is out. I talked with the owner of the adjacent

property, and he generously allowed me to hike through his property to get a view of what was left of Castle Rock. It held no resemblance to its former glory and the



View of Castle Rock ruins (July 2023), Dakota County, Minnesota. Photo by Mark Ryan

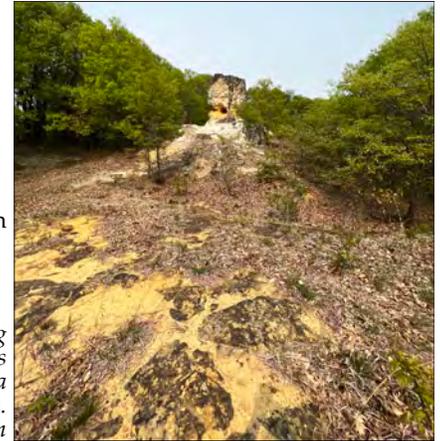
structure Nicollet and Winchell had seen. The spire was no longer there (as Winchell predicted), and what remained of the base has been eroded by the elements and years of visitor abuse. As it continues to disintegrate, a delta of sand fans out from the base heading southeast

back toward the Cannon River, and I suppose, eventually to the Gulf of Mexico where it will contribute to a future delta deposit.

On September 28, 1884, the spire was toppled during a wind storm, just as Winchell predicted a year before. This was long after the Dakota had been pushed out of the area, but some of them believed it happened because Inyan was no longer worshiped there. In 1920, a tornado swept through the town of Castle Rock (a mile or two to

the west of the rock), and it's a good bet that the storm further eroded the structure's remaining base.

Mark Ryan



View of debris eroding from Castle Rock ruins (July 2023), Dakota County, Minnesota. Photo by Mark Ryan

Is the Fragile Geology of St. Anthony Falls Imperiled?

By Mike Mosedale, Minnesota Reformer

Originally published, May 4, 2023. Reprinted under Creative Commons license

Geologists and emergency managers are pleading the Legislature to fund a study of the key infrastructure under the falls.

A 2021 report from the Corps of Engineers addressed what would happen in the event the dam at St. Anthony Falls failed. Without extensive stabilization, the study states, the falls would be transformed into a series of rapids and a “head cutting erosion would extend far upstream, affecting roads, bridges, homes and other infrastructure.”

In 1992, Greg Brick secured permission to access a rarely visited place on the Mississippi River not far from downtown Minneapolis: the vestigial remains of the Eastman Tunnel.

Brick is a geologist with a passion for exploring underground spaces, so he knew the disastrous collapse of the unfinished tunnel in 1869



The Mississippi River at St Anthony Falls, Minneapolis during Spring melt. Photo by Mike Mosedale for the Minnesota Reformer

utterly transformed St. Anthony Falls. What was once a natural, 50-foot high waterfall with an irregular limestone ledge became the highly engineered, concrete-encased structure you see when you walk across the Stone Arch Bridge.

Brick's interest in accessing the tunnel was driven in part by an obscure curiosity. Could he use it to catch a glimpse of a very old, well-concealed but critical piece of riverine infrastructure known as “the cutoff wall?”

The immense concrete dike, which runs deep under the riverbed, was constructed by the U.S. Army Corps of Engineers in the 1870s to prevent the Eastman Tunnel



The collapse of the Eastman Tunnel under St. Anthony Falls, Minneapolis 1869. Public domain photo from the Minnesota Historical Society collection.

collapse from eroding St. Anthony Falls into oblivion — a potentially ruinous development for a young city dependent on water power.

According to the Minnesota Historical Society, “On October 5, 1869, water seeped and then gushed into a tunnel underneath St.

Anthony Falls creating an enormous whirlpool. The falls were nearly destroyed. It was years before the area was fully stabilized and the falls were again safe from collapse.”

Upon entering the Eastman Tunnel through a trap door at the St. Anthony Falls Laboratory, Brick immediately noticed the unusual nature of the muck he found himself slogging through. “All the sediments were very peculiar, like quick sand. It was unlike the other sediments I’ve seen in the mill district,” recalled Brick, who chronicled the expedition (and many others) in his 2009 book, “Subterranean Twin Cities.”

After trudging about 100 feet through the dark passage, Brick came to a dead end. The concrete bulkhead that blocked him, he realized, was an exposed portion of the cutoff wall.

Brick observed water steadily but noticeably dribbling out of tiny holes in the concrete. He hypothesized that the fine sediment he encountered in the tunnel came from soft sandstone on the other side of the wall, carried there by the flowing water in a process referred to as entrainment.

To Brick, the implications were clear. A void must be forming on the other side. And if a void was forming, he wondered, would that have consequences for the cutoff wall? Would the fragile geology of St. Anthony Falls be imperiled if such a void grew too large and enabled the river to carve a new, subterranean path downriver? What would that mean for all the infrastructure in the highly developed vicinity of the falls?

Brick said he shared these observations at the time with officials at Northern States Power (now Xcel Energy) because he knew the company’s nearby hydro plant could be impacted. But, he said, that only elicited shrugs.

Concern spreads about a potential disaster

Thirty years later, Brick’s solitary inklings of concern about the state of the cutoff wall — and the damage its potential failure could cause — are no longer solitary.

Renewed interest in the forgotten infrastructure was spurred by the U.S. Army Corps of Engineers’ efforts to offload St. Anthony Falls dam and the adjacent navigational lock. (Owing to concerns about the upriver spread of invasive carp, Congress authorized the closure of the lock in 2015, which effectively eliminated the Corps’ navigation-driven mission on this stretch of the river.)

John Anfinson, a former historian for the Corps and, later, superintendent of the Mississippi National River & Recreation Area, said he began thinking more about the condition of the cutoff wall after he realized that the Corps, in soliciting proposals for the future ownership of the lock and dam, neglected to include the cutoff wall in the discussion.

Who is responsible for inspection and maintenance of the wall? Who owns it? The answers to those questions are not clear, which is what worries Anfinson. “There is no default owner and no one accepts ownership because no one wants to get stuck with it,” Anfinson said.

“Without knowing the owner, there is no one responsible for inspection, maintenance, or an emergency action plan if it fails. It’s unconscionable.”

Despite those uncertainties, Anfinson, along with non-profit groups such as Friends of the Mississippi (where he serves on the board) urged state lawmakers to fund a comprehensive look at the condition of the cutoff wall.

Good news! The legislature recently appropriated \$1 million to the University of Minnesota to conduct a



“Falls of Saint Anthony, Upper Mississippi,” 1847. The artist, Henry Lewis traveled the upper Mississippi River in the mid-nineteenth century. The painting is at Museo Nacional Thyssen-Bornemisza in Madrid.

geophysical survey of the wall and surrounding infrastructure, develop models of what would happen in the event of a failure, and devise an emergency action plan for worst case scenarios.

Like Whitney Clark, the executive director of the Friends of the Mississippi, Anfinson takes pains to note that he is not predicting the imminent collapse of the cutoff wall. “There may be nothing wrong. I don’t know if this will fail next year or in another 146 years,” Anfinson

said. "No one does. That's the problem." In pressing his case, Anfinson said, he has made formal presentations to several groups, including the Geological Society of Minnesota. "I said, tell me if I'm off here," Anfinson added. "And they said, 'It's probably worse than you think.'"

Carrie Jennings, a geologist with Freshwater, a Minnesota-based environmental nonprofit, points out that St. Anthony Falls has steadily retreated upriver for the past 12,000 years and, without human intervention, probably would have dissipated into a long series of rapids by now. Even though there is no evidence that the cutoff wall is likely to fail, she added, there is also no evidence to the contrary.

"We need to get a good look at what's going on down there," said Jennings. Eric Waage, director of Hennepin County Emergency Management, concurs. "It could be that this is really low risk and we don't need to worry. But not asking the question is a risk," Waage said. A failure of the cutoff wall, he added, has the potential to create havoc both above and below the falls.

Nearby infrastructure, such as the Third Avenue Bridge, would be damaged if a new water course were to erode the sandstone that lies underneath the limestone and shale upon which the bridge's piers sit.

Upriver, the potential disruptions could be worse, conceivably impacting Minneapolis' water supply. The chief author of the bill in the House, Rep. Sydney Jordan, DFL-Minneapolis, said in a hearing in March that a disruption of the drinking water supply is the prospect that keeps her up at night.

Waage pointed to a 2021 report from the Corps of Engineers that addressed what would happen in the event the dam at St. Anthony Falls failed. Without extensive stabilization, the study states, the falls would be transformed into a series of rapids and "head cutting erosion would extend far upstream, affecting roads, bridges, homes and other infrastructure." "The 19th century architects of the falls recognized that the loss of the falls would be catastrophic," the study continues. "With the upstream and downstream development on the river, the same conclusion applies today."

For his part, Greg Brick has zero ambivalence about the need for a comprehensive survey of the cutoff wall. Given his long-ago observations in the Eastman Tunnel, he finds it difficult to believe that there are no substantial voids forming in the sandstone above the falls.

But he is less certain about whether policy makers will meet the moment. "I suppose it's like back before the I-35 Bridge collapse, when the now-infamous 'rusty gusset plates' were pointed out," Brick ventured. "Easy to dismiss as 'nothing'."

W is for Wells Creek, Seward County Tennessee

Many GSMers know I collect and study sands. Yes, I probably have 12,000 samples from around the world. And beyond just collecting sand, I love looking at samples under magnification and trying to figure out the

back story of the samples. What are the grains? Where did they originate? What does the sample tell about the geologic history at the source? The industrial history of the region? The marine life in the area today or in ancient times? I work with Leo Kenney who shoots beautiful photographs of the sands, photos that really capture their uniqueness and beauty.

During the 2022 Winter, we wrote a series for the International Sand Collectors' Society: USA Sands from A to Z. Here I share "W is for Wells Creek, Seward County, Tennessee."

Wells Creek is situated in the northern part of middle Tennessee, a region known as the Western Highland Rim. It is 70 miles (112 km) west of Nashville.

Today, the land is overgrown, forested, and hilly with numerous creeks. In the early-mid 1800s, iron was mined and smelted here. Farmers reported good soil. And for many years, it has been a destination for geology enthusiasts and fossil collectors.

There is a lot going on in this sample. The blue slag is a byproduct from iron smelters in the early-to-middle 1800s. This led me to ask where is/was iron ore mined in Tennessee? There are fossil crinoids in the sand. What age are they? And with a little research, I learned that people collect "shatter cones" at Wells Creek; these are typically associated with a meteorite impact site.

1) The blue slag: In the iron smelters near Nashville, the furnaces ran 24 hours a day. They chemically reduced large amounts of ore and limestone flux into molten metal and waste material. The process was accomplished by subjecting the charcoal fuel to a continuous blast of air that produced temperatures high enough to separate the iron from the impurities. These impurities floated to the top of the melt and were drawn off as slag. The slag ranges in color from clear Robin's Egg blue to greenish and purplish. It is glassy looking and brittle and often pitted with air bubbles created when the molten slag was cooling.

2) The iron ore: Tennessee has two regions with iron ore deposits. So-called "brown ore" occurs in the western Highland Rim of Middle Tennessee, and this ore was mined and smelted near Wells Creek. "Red ores" come from the eastern part of the state. Coal is pretty ubiquitous in Tennessee, and remnants of charcoal kilns are found around the region too.

In 1847, there were two dozen blast furnaces, forges, and mills near Nashville. However, by the middle 1850s, the industry was in decline with changes in technology and

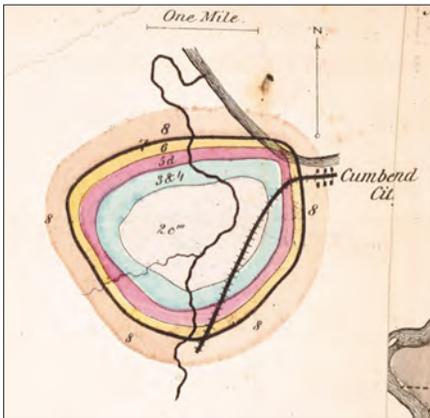


Blue and green slag and crinoid segments found at Wells Creek, Tennessee. Scale bar represents 2 mm.

the economic panic of 1857. The new "Age of Steel" doomed the charcoal iron industry. However, the stacks, buildings, cemeteries, and slag piles remain as evidence of this industry.

3) The crinoids: The rings in this sample are fossil crinoids. Some have a small opening in their centers, others are solid. These are marine organisms that lived in ancient seas that covered much of North America including the Tennessee/Kentucky region about 320 million years ago during the Devonian.

4) The meteorite impact site: When work on the railroad started in 1854 around Wells Creek, engineers and surveyors noted the area's strange twisted rocks and tilted bedding planes which stood in contrast to the usual flat landscape of the area. They notified the state geologist, who roughly sketched the site; he inset a map into the 1869 Tennessee map, but he did not include suggestions about its origins. Farmers also noticed the soil was different. But the origin of the structure was controversial. In 1874, one geologist suggested the "evidence hints at a terrible subterranean convulsion at one time." In the 1930s, suggestions for its origin included a "crypto-volcanic" or "crypto-explosive" (meteorite impact) origin.



An enlargement of the small map inset on Safford's 1869 Geological Map of Tennessee (Source: Library of Congress)

Fast forward to the 1960s and in preparation for the first lunar landing, detailed studies of the Wells Creek site were done as NASA scientists wanted to learn whether lunar craters were related to those on earth. After lots more research, scientists came to prefer the meteorite impact hypothesis to explain the origin

of the Wells Creek site. Now, after 150 years of controversy and study, geologists finally agreed that the seven-mile (11.3 km) diameter basin surrounded by ridges was an impact crater site. It is estimated the impact occurred between 100 and 300 million years ago.



Shatter cones, Well Creek Impact Crater Site, Tennessee. Photo by Lori Carter

Geology and rock enthusiasts are drawn to explore the center of the crater. It contains some excellent shatter cones - conical rock fragments formed from the high pressure of the impact. They range from 1/4" to 2.5" (.6 - 6.3 cm) across.

If you visit, check out the Wells Creek impact crater site and the Iron Furnace Trail to learn more about the crater and the historic iron industry in middle Tennessee.

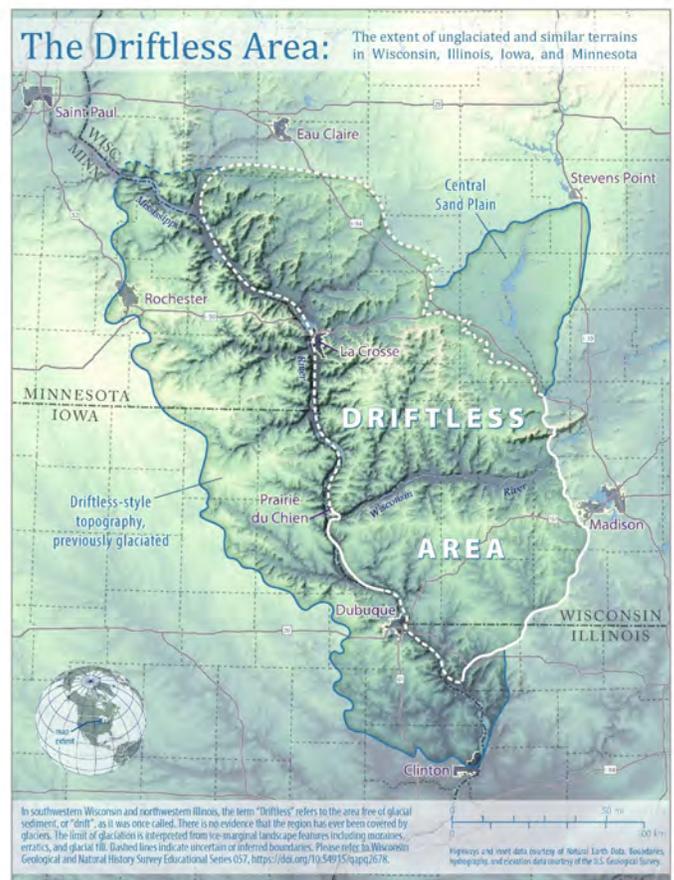
Reprinted with permission from the Sand Paper, the International Sand Collectors' Society Newsletter, May 2023.

Kate Clover, Photos by Leo Kenney

The Driftless Area: extent of unglaciated and similar terrains in Wisconsin, Illinois, Iowa, and Minnesota

<https://wgnhs.wisc.edu/catalog/publication/000997>

This summer, the Wisconsin Geological and Natural History Survey released a pamphlet, Educational Series 057, on behalf of the four relevant state geological surveys, to explain the driftless area of southwestern Wisconsin and northwestern Illinois that has never been glaciated, and the driftless-style topography of adjacent southeastern Minnesota and northeastern Iowa that has only been glaciated in the distant past, unlike the recent glaciation that affected the Twin Cities, for example, so the effects of glaciation in that area are faint due to the passage of time.



In southwestern Wisconsin and northwestern Illinois, the term "Driftless" refers to the area free of glacial sediment, or "drift," as it was once called. There is no evidence that the region has ever been covered by glaciers. The limit of glaciation is interpreted from ice-marginal landscape features including moraines, erratics, and glacial till. Dashed lines indicate uncertain or inferred boundaries. Please refer to Wisconsin Geological and Natural History Survey Educational Series 057, <https://doi.org/10.54915/wgnhs057>. Topography and more data courtesy of National Earth Data, Sandboxes, hydrography, and elevation data courtesy of the U.S. Geological Survey.

GSM Membership Application/Renewal 2023-2024

Membership year begins September 1

Questions? Click the Contact tab on the GSM home page

Name _____ Phone (H) _____
Address _____ Phone (C) _____
City _____ State _____ Zip _____
Email Address(es) _____

Where did you learn about GSM? What stimulated you to join?

Membership: Please make check payable to: **GSM Please mail to:**

Geological Society of Minnesota

P.O. Box 141065

Minneapolis, MN 55414-6055

Membership Levels:

- Student _____ \$10
- Individual _____ \$20; \$40 (2 years); \$60 (3 years)
- Family _____ \$30; \$60 (2 years); \$90 (3 years)
- Sustaining _____ \$50
- Supporting _____ \$100
- Guarantor _____ \$250

_____ Membership fee (from above)

_____ Media-library membership--add \$15 one-time fee

_____ Tax-deductible contribution (GSM is a 501(c)3 nonprofit educational organization)

_____ Check here if you want a contribution receipt for tax-filing purposes.

_____ Total included



P.O. Box 141065, Minneapolis, MN
55414-6065

FIRST CLASS MAIL