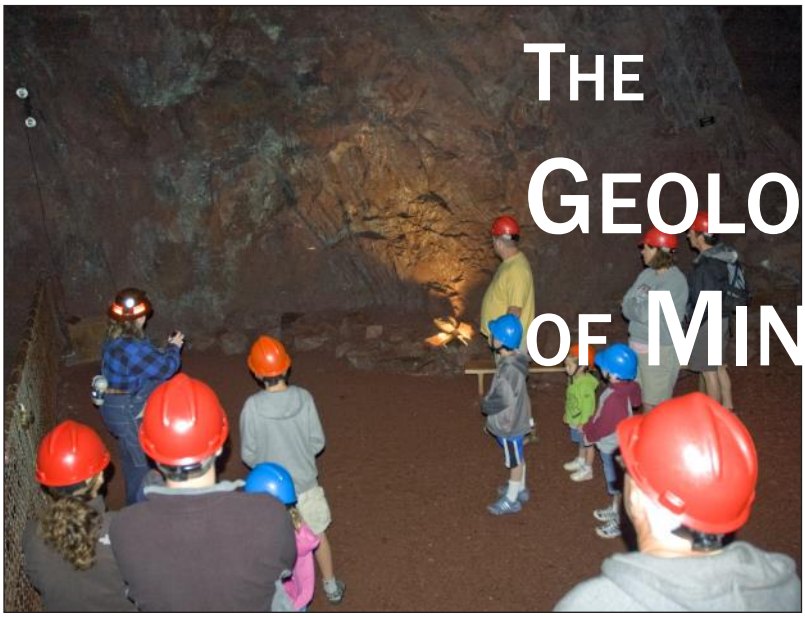
August 2019 Volume 73, No. 3

Promoting public interest and educational support in the geological sciences



The Geological Society of Minnesota News

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

From the President's Desk…

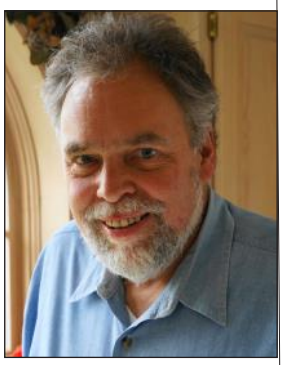
I hope you are enjoying our summer; I am. Although we've had a shortage of field trips this summer, GSM has participated in a few other activities, including a bonus lecture by renowned science journalist **Peter Brannen**; **Raptors! Reptiles! & Rocks!**; and **DinoFest**. Read about these inside. And we have the Sand & Sandstone field trip planned for the weekend following Labor Day.

As every year, August ends with the **Minnesota State Fair**. Thanks to the State Fair Committee, led by **Dan Japuntich**, for preparing our booth in the Education Building and getting it staffed. And thanks to all of you who are volunteering for one or more shifts. The State Fair is one of the main venues through which we attract new members. If you attend the Fair this summer, stop by and say hi to your friends in the booth, and see our great selection of rocks and minerals, especially the stunning ones in the back.

The 2019-2020 lecture program will start with the **Fall Banquet** at U Garden Restaurant on **Monday, September 16** and continue every other Monday until early December, before the year-end break and resumption in early February. As usual, **Steve Erickson** has put together a compelling, varied program. This issue of the Newsletter includes the full schedule, which is also posted on our web site. If you have an idea for a lecture or lab, or know of a possible presenter, contact Steve with the information, or submit it using the contact form on our web site. Steve always appreciates new leads.

Besides great food and our first lecture of the season, the Fall Banquet also includes our **Annual Meeting** of the full membership of GSM. The meeting will start a half hour earlier than in past years, at 6:30. It will be short, as the only order of business is election of two new members to our **Board of Directors** for 2020-2021. These openings occur since two current Board members, **Dick Bottenberg** and **Kate Clover**, have served the maximum of 4 consecutive years. (Our bylaws include this provision so we periodically get the fresh perspectives of new members on the Board.) You can find our bylaws and the duties of Board members on our web site. If you think Board membership is a way you could give back to GSM, please contact me before the banquet.

September is the start of our new fiscal year, and your continuing memberships are up for renewal. The easiest way to renew is at the Fall Banquet or one of our lectures, when Membership Chair **Joanie Furlong** and Treasurer **Dave Kelso** will accept new and renewing memberships. To speed the process, print a membership form from our web site beforehand. This year you will see a new multi-year option: you can renew



GSM President, Dave Wilhelm

Upper photograph: Mark Ryan

Inside this issue:

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from the GSM archives:
Red granite in dry river bed Jim Falls, Chippewa Falls, Wi, GSM, 1939

individual and family memberships for 1, 2, or 3 years. The Board decided to provide this as an option for those who prefer not to be bothered with renewing every year. Be sure to enter your e-mail address exactly right, as e-mail is our primary means to reach you. Of course, we also accept memberships sent by U. S. mail. Your membership fees are what keep our organization going fiscally; without that support we could not provide the fine speakers who share their research and experiences with us each year.

Dave Wilhelm

GSM

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The Geological Society of Minnesota is a 501(c)3 nonprofit organization. The purpose of this newsletter is to inform members and friends of activities of interest to the Geological Society of Minnesota.

Please note the GSM change of 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 dues are: $10 Full-time students; $20 Individuals; $30 Families GSM News is published four times a Year during the months of February, May, August and November. Deadline for article submission is the first of the month, before the date of publication. Newsletter contributions welcomed.

Newsletter contributions welcomed

Of interest to our GSM enthusiasts: While out and about enjoying your vacation time – when you visit a site that you find interesting, please consider sharing your experiences with us by writing up a few words and sending it to Theresa Tweet at phoenix8185@gmail.com. Thank you in advance!

New GSM Members!

Catherine Cody, Mt. Iron
Mark Scipioni, St Paul
Robert Palmer, St Paul
Bruce Henke, Duluth
Tom & Carla Johnson, Brooklyn Park

GSM Board Membership

The GSM Board consists of members who have a special interest in advancing the goals of our society, including lectures, field trips, and community outreach. The Board currently has nine members. Our bylaws limit the terms of Board members to four years, to encourage a turnover of perspectives and ideas. The Board typically meets quarterly, on the second Thursdays of February, May, August, and November, or a different date if conflicts arise. We typically meet from 7 to 9 PM at the Minnesota Geological Survey at 2609 W Territorial Rd, St. Paul MN 55114.

Board meetings are open to all members of GSM. So, whether you are a new member of GSM or have been a member for many years, if Board membership is something that might interest you, or you are just curious to see what our Board does and how it works, we encourage you to attend a meeting. And, if you have a topic you would like the Board to consider, please contact Theresa Tweet at phoenix8185@gmail.com.

Mark your calendars for September 16, 2019

Join us for the **GSM Fall Banquet and Annual Meeting** and the first lecture of our 2019-2020 series, presented by Randy Strobel, Ph.D., Associate Prof., Metro State U. Randy's talk is on **"The Geology of the Bakken Formation, North Dakota."**

The Banquet will begin at 5:00 PM, September 16 with the Annual Mtg at 6:30 PM and the Lecture beginning about 6:45 PM.

The location will be at the U Garden Restaurant, 2725 University Ave. SE, Minneapolis; see the map on the GSM web site if needed.

Memoriam– Rita Childs

It is with deep regret that GSM reports the passing of Rita Childs. Rita taught science at Mahtomedi High School and her passion for teaching and science was just one of her defining characteristics. Rita had been a GSM member for over 30 years and she loved geology - this was very well known by all of her family and friends. In 2017 Rita attended a GSM field-trip to Kearney NE, and together with her husband, brother and sister-in-law was able to view a total solar eclipse – that was exciting for her (and for all of us)! Rita was also featured in the "GSM Member Spotlight" in the Fall, 2016 edition. Recently, Rita's husband Richard told a story of him having to carry out the large pieces of Morton Gneiss from their visit to a quarry in Morton, Minnesota while she recalled the geological significance of that formation. As was her wish, Rita's grave marker will be made from Morton Gneiss.

Robert Evan Sloan 1929-2019

Professor of Paleontology, U of Mn

Robert E. Sloan was born in Champaign, Illinois on July 17, 1929. After leaving public high school at the end of his sophomore year, he immediately entered the University of Chicago, receiving his Ph.D. in June 1953. He was then hired by the University of Minnesota and stayed until retirement in 1997. Of the 84 faculty in the history of the department, he served with all but 11. He was given an Institute of Technology Distinguished Teaching Award in 1967 and in 1997 received the University College Distinguished Teaching Award.

His research was directed at finding concrete examples of theoretical concepts in paleontology, with specific work on both an Ordovician extinction and the terminal Cretaceous extinction, the evolution and ecology of trilobites, dinosaurs, multituberculate mammals, and the adaptive radiation of placental mammals after the final extinction of dinosaurs. A paper he wrote on the extinction of multituberculates was rated as one of the 22 best papers of all time in vertebrate paleontology, putting him in the same company as Cope, Marsh and Cuvier. Dr. Sloan discovered the oldest primate in the world in the basement of Pillsbury Hall, from a concentrate collected in Montana. He discovered the oldest hoofed mammal, contemporary with the last dinosaurs and ancestral to horses, cows, elephants and whales, in an anthill in Montana.

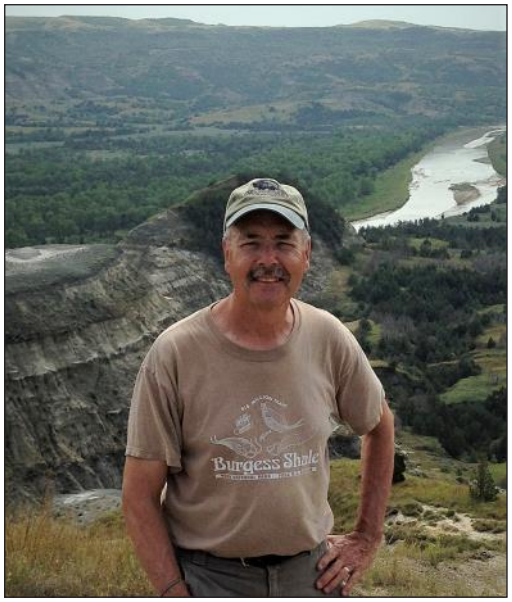
(Adapted from a description of his life and career written for the department newsletter at the time of his retirement in 1997)

Lifetime GSM member - Doug Zbikowski

Recently a Lifetime membership was awarded to Doug Zbikowski, longtime member, past President, Vice President, and co-founder of our current "Marker Program." Doug also helped found the Student OutReach program that teamed up with Carleton and Macalester colleges to offer Geological Classroom Presentations for schools and organizations. The program now offers the expertise of graduate students from just Macalester. Doug also gathered and sorted rock samples for the rock boxes the GSM supplied to teachers when they requested a presentation. They were also sold singly to members at a discount. These rock boxes were assembled at fun "Rock Parties" held in Doug's garage. Doug has also been a regular volunteer at the Minnesota State Fair booth and has donated many items for the Silent Auction. Doug is just that kind of creative, caring, and helpful person.

Theresa Tweet

GSM Member Spotlight
Dan Japuntich



1. **How long have you been a GSM member?**
Almost 20 years

2. **How did you get interested in geology?**

I collected rocks when I first walked and collected my first fossil in 2nd grade in 1953 (I still have it: probably a sponge in NE Illinois Silurian limestone). I majored in Mining Engineering for a time before switching to Mechanical and Chemical Engineering when I decided I liked working indoors better.

3. **What do you dig about the GSM?**
The lectures that Steve E. organizes are superb, the field trips get me outdoors (I used to backpack) and the members are especially bright, energetic and friendly. And, of course, we have cookies at the break!

Notes from the Past

GSM News Winter 1987-1988

Frank Gohlke, Landscape Photographer, was featured in the Sunday, October 4, 1987 issue of the Star Tribune's Arts and Entertainment section. A three-page spread described Frank's work here in the Twin Cities, the Midwest, the United States – especially Mount St. Helens, and most recently in France. A book of his classic photographs of Midwestern grain elevators is to be published next year. He returned this fall from France where he photographed the countryside on a French government grant. Frank says that he is going to miss Minnesota much. We remember Frank for his Mount St. Helens presentation at our 1985 GSM Spring Banquet. Frank's wife, Lucy, was recently named assistant director of the Wellesley College Art Museum in Massachusetts. We'll miss you too, Frank.

GSM 2019 Spring Banquet

For those of you who missed the GSM Spring Banquet on Monday, May 6, here is a brief recap of the event: Dan Japuntich was still looking to fill a couple more time slots at the GSM Minnesota State Fair booth. The time goes by quickly as you talk to other geology enthusiasts about GSM membership, geology markers across the state, our Minnesota rock and mineral collection, recent GSM field trips, the large assortment of rock and mineral samples on-loan from the Minnesota Geological Survey, and many other geology subjects. Much of the information is provided to you in the booth.

Steve Erickson gave an update to the 2019-2020 Lecture series. This seasons Lecture topics will be jumping all over the board with something for every interest in the field of geology – check out the updated schedule here: http://gsmmn.mngeology.net/content/2019-2020-seminars-and-labs

The Banquet Lecture was **Fossils on the Iron Range**," given by our guest speaker John Westgaard, B.A. and director of the Hill Annex Paleontology Project. The Project is currently based in the Minnesota Discovery Center: The Museum of the Iron Range. The Science Museum of Minnesota, in St. Paul, was the original home for the project which began in 2014 under the tutelage of Bruce Erickson. The organization is volunteer driven; a non-profit group that presents at conferences, supports teachers, paleontological science education, and educational workshops. The Project helps to update scientific and geological information about the area. It also strives to preserve the mining history of the Mesabi Range over the last century including archiving of some of the sites that are no longer accessible.

John talked about the Coleraine Formation, a large deposit of marine rocks with fossils dating back to the Cretaceous Period that is found only in the state of Minnesota. This area was once part of an ancient river system and one of the creators of Minnesota's last ocean shorelines that extended over the Dakotas, northwards into Canada, and south into the Gulf of Mexico.

Through geologic time, different varieties of marine creatures lived and died on the Iron Range. Buried under gravel, mud, sand and silt, it wasn't until

mining began in the area that the fossil remains were uncovered. These include dozens of different species of ammonites, an index fossil that with origins back to the Mesozoic era.

To add further depth to the talk, John brought with him several examples of the fossilized remains of marine organisms: bone fragments of early reptiles, shark teeth, and crustaceans, (crab exoskeletons and parts, mussels, and fish vertebrae).

The food was great, the conversation light and enjoyable, and the talk – fantastic! Thank you for joining us John, and thank you to Steve for another terrific series of Lectures.

Additionally, to see more pictures of the different fossils found in the Coleraine Formation by volunteers of the Hill Annex Paleontology Project, checkout this site by Rylan Bachman: http://rylanbachman.com/hillannex/

Also, a recent note from John Westgaard states: I would like to reiterate to all GSM members that there are a variety of opportunities to participate in Hill Annex Paleontology Project efforts. With our work occurring throughout the year, there are many facets in which volunteers participate. There are field work sessions from spring through fall. Over the winter, we typically do lab work in Chisholm, MN. Then, all through the year, we also engage in a wide selection of outreach and community engagement events. Anyone whom is interested need only reach out to connect with our team.

For more information about these and other opportunities contact John at jwestgaard@smm.org

Theresa Tweet

Bonus Lecture: Mass Extinctions in the Geological Record

On May 20, an eager audience at Tate Hall on the University of Minnesota campus was treated to **Peter Brannen**'s lecture "**Mass Extinctions in the Geological Record**". Peter is a science journalist and recent author of 'The Ends of the World'. Around 220 were in attendance, about half of whom were not GSM members. The audience size was handily a record for a GSM lecture. Peter was introduced by **Don Shelby**, former news anchor at WCCO-TV, who has a strong interest in climate change and other environmental concerns.

Peter's lecture concentrated on the last half billion years of Earth's history, that period when large life forms were extant. During that time, the geological record shows five mass extinctions. Most of us were familiar with the most recent of these, which occurred 66 million years ago and ended the Cretaceous period, that brought all non-avian dinosaurs to extinction. Peter also described the four mass extinction events which preceded that, including the most severe of all, the Permian–Triassic, which occurred 251 million years ago and wiped out over 90% of all multi-cellular species. Peter's lecture included artist's reconstructions of many long-gone species, including a crocodilian species that walked on two legs. Peter concluded his lecture with a discussion of whether or not we are in the midst of a sixth mass extinction. His conclusion is

that we are not, based on the great biodiversity still on Earth. However, most extinction events of the past involved rapid changes in carbon dioxide levels, causing rapid temperature changes, so it is not wise to ignore that great changes that we are causing to our atmosphere.

Following the one-hour lecture, Peter answered thoughtful questions from audience members of all ages, including a few of school age. As with most GSM lectures, the question-and-answer period was as interesting as the lecture itself. At the end of the evening, Peter signed copies of his book for audience members.

This lecture was co-sponsored by **Don Shelby**, **GSM**, **MN350**, and **Climate Generation: A Will Steger Legacy**. Two other individuals made this evening possible: **Carrie Jennings** of the Freshwater Society became aware in February that Peter would be in the Twin Cities and suggested that GSM might extend our lecture schedule to include a talk by Peter. **Mary Ludington** was of invaluable assistance helping to organize, find sponsors, and publicize this event.

Dave Wilhelm

Raptors! Reptiles! & Rocks!

On Thursday afternoon, May 30, St. Mark's School in St. Paul organized a unique event for students and the public: **Raptors! Reptiles! & Rocks! Theresa Tweet** and I handled the "Rocks!" portion of this event, using rock specimens and other materials from GSM's State Fair display. The Raptor Center and the Minnesota Herpetological Society provided the creatures and expertise for the other two legs of this alliterative triangle.

GSM and make you own dinosaur display

Background: This event was originally scheduled for April 26, when **Dan Japuntich** and I were planning to do the Rocks portion. One day before, we got an e-mail from the organizer saying that the event was cancelled due to an administrative announcement. When we heard on news media that weekend that St. Mark's would be closing its doors after over 100 years in operation, we understood why the event was cancelled. We were surprised a few weeks later when resilient St. Mark's decided to reschedule the event in spite of their upcoming closure. We of course were happy to do our part to show support. Since Dan was unavailable on the rescheduled date, Theresa stepped up to be our other presenter.

The event was a great success, with many students, parents, and members of the public (including a few GSMers) enjoying a raptor show, marveling at the snakes and other reptiles, handling GSM's Minnesota rocks, and (for the younger ones) "making" their own dinosaurs in our booth. For me, while I certainly enjoyed seeing the snakes, eagle, and owl, the highlight was touching a live alligator, which I had never done before. The alligator had been rescued years ago as a baby in a St. Paul neighborhood, and has since been trained to signal its owners when it is hungry.

Largest non-mammal at Raptors! Reptiles! Rocks!

Dave Wilhelm

GSM at First Ever Dino Fest!

On July 13th, the Science Museum of MN (SMM) held its first annual Dino Fest, and GSM was there! This unique opportunity for public outreach was opened by Steve Erickson's connection with SMM's new Chair of Paleontology, and Dino Fest founder Alex Hastings


Steve Erickson manning the GSM table

(who is also GSM's Oct. 28 speaker). Theresa Tweet supplied a collection of terrific dinosaur fossil casts to serve as the foundation for the GSM display. Several items from the State Fair materials (display trays, lecture/Geo-marker brochures, some graphics) were included, along with a couple books, a few paleogeography maps, and simple signage, and the table was set. GSM was represented by the aforementioned Mr. Erickson, and this article's author.

No doubt the stars of the show were the fossil casts, being both rich in minute detail, and also (as replicas) a hands-on experience. The Velociraptor and T-Rex claws were the most popular (especially the 'raptor claws, which could be "worn" between fingers of a fist), followed by the serrated Carcharodontosaurus tooth. Well over 100 kids (plus their parents) stopped by the GSM booth, and with Steve making a couple future speaker connections, and SMM asking GSM back to the museum for October 19's Fossil Day, the outing was a great success! (Thanks, Theresa! And for the rest, a Fossil Day update with any opportunities for participation may well be part of announcements at September's lectures, so stay tuned!)

Patrick Pfundstein

Putting a date to a lava flow

On a recent visit to the islands of Oahu and Hawaii, I was able to see firsthand how the various flows of lava could be distinguished by the rustic colors of the landscape, rich in ebony, brown, watered gray and burnt sienna.

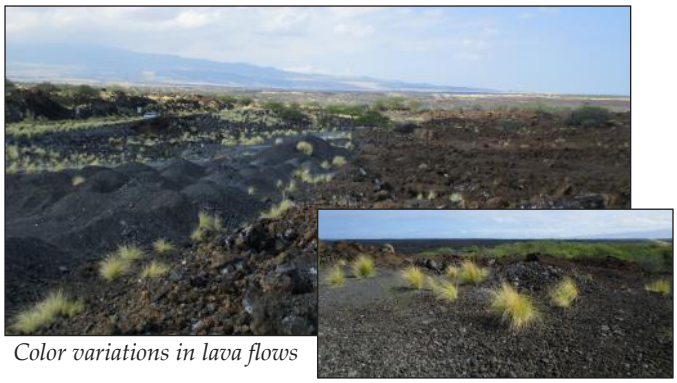
These islands were formed in stages, from the oldest of Kauai, to the youngest of Hawaii, all related to the Hawaiian-Emperor Seamount chain and a hot spot deep within the earth. Here are a few of my favorite environments:

Desert: On the west side of the Big Island (Hawaii) sits Ka'ū. Due to the rain shadow effect of giant volcanoes, acid rain, and the gases emitted from Kilauea, the land is shy of vegetation. The lava is seen as it was deposited; each flow eroding in place, creating its own beauty.

Newer islands: On Hawaii, near the summit of Mauna Kea, is Lake Wai-au. At one time Lake Wai-au was tropical, but during the Pleistocene, glaciers existed on the high peaks and left remnants in the form of permafrost. Today, heat from the sun melts the permafrost, feeding the lakes and ponds at the top of the summit.

Older islands: these are smaller because as the Pacific Plate move away from the hot spot, the supply of magma is cut off and the islands begin eroding and sink.

To sort out these transitions, geologists use various methods to decode and date the different flows and


Color variations in lava flows

environments. The most common method is the Potassium-Argon (K-Ar) dating. This method measures the formation of Argon gas relative to Potassium-40 in the rock. The crystallization of the minerals starts the radioactive clock; provided the minerals were not reheated to reset the "clock" the age of the flow can be determined. Another form of dating is surface exposure age. This method relies on a surface being exposed to cosmic rays which produce isotopes in the upper meter of material, isotopes that don't form in other ways, and the quantity of which is proportional to the exposure time. For younger material, radiocarbon (C14) dating is used if organic material, such as charcoal, is found in a flow. Such a date would be indirect for the lava flow as the flow should be younger than the organic material. C14 is incorporated from the atmosphere when an organism is alive. The C14 decays at a known rate after the organism dies and the amount of C14 measured relative to a known or calculated atmospheric concentration is a measure of the age.

The Hawaiian Islands were not built in a day, but have been renewing themselves over several million years (roughly 80 million years for the whole chain). Unlike the explosive eruptions of andesitic magma, the magma of the Hawaiian Island chain is a more fluid basalt, that oozes up through the ocean floor and islands. The resulting beautiful lands contains lava tubes, steep cliffs, lava lakes, waterfalls and much more, all destined to eventually return to the ocean bottom.

Interested in reading more?

http://www.pbs.org/wgbh/nova/education/earth/dating-lava-flows.html

http://www.talkorigins.org/faqs/dalrymple/radiometric_dating.html

http://archserve.id.ucsb.edu/courses/anth/fagan/anth3/Courseware/Chronology/09_Potassium_Argon_Dating.html

Theresa Tweet

Dikelocephalus minnesotensis

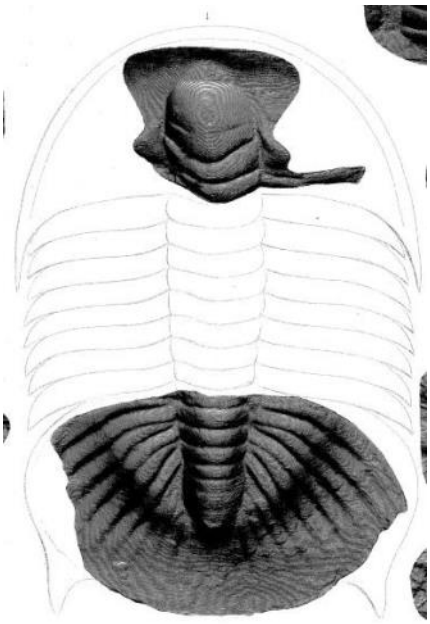
Justin Tweet, adapted from Equatorial Minnesota blog post of the same name, June 25, 2017: (https://equatorialminnesota.blogspot.com/2017/06/dikelocephalus-minnesotensis.html)

Investigating the rocks of Saint Croix National Scenic Riverway (SACN) is a tougher nut than working in Mississippi National River and Recreation Area (MNRRA). Most of the area where rocks are exposed in MNRRA is part of some kind of park (city, state, regional, county, etc.) and generally accessible to the public. Much of the area with outcrops on the St. Croix is private land, and many of the key localities in the literature are now overgrown, destroyed by construction, or are roadcuts next to busy highways. Determining where you are in the strat column is also more difficult. In MNRRA, it's hard to get mixed up if you can tell sandstone from limestone/dolomite and shale. In SACN, you're dealing with several quartz-rich medium to coarse sandstones that tend to look the same, with some intervening shaly, dolomitic, or finer-grained sandy formations, and in the literature practically every investigator had their own preferred system of names right up until the 1960s. Finally, in MNRRA there are abundant and diverse fossils in the Platteville and Decorah, while in SACN the special of the day is the BLT (burrows, lophophorates [brachiopods and hyoliths], and trilobites) with a side order of mystery snails, and you have to work for everything but the B.

Nevertheless, the St. Croix Valley contains about a dozen fossil-producing areas of Late Cambrian age that have received significant attention in the literature, from Afton up to St. Croix Falls, and it is due to the historic investigations that the uppermost Cambrian of North America is sometimes known as the Croixan or St. Croixan. Several dozen species, mostly brachiopods and trilobites, have been named from these sites. One of the best known of these is the trilobite *Dikelocephalus minnesotensis*. *D. minnesotensis* is among the first fossil species described from Minnesota, in the batch out of David Dale Owen's expedition (Owen 1852). By pride of page priority, it gets to be the type species of the trilobite *Dikelocephalus*. Owen did not designate type specimens, so the illustrated fossils have come to be regarded as the type material. They include a partial head (cranidium) (USNM 447020) and tail (pygidium) (USNM 17863), which have fortunately survived all these years in the collections of the Smithsonian. According to Owen, these specimens came from near Stillwater: "This species was first found, and is most common, in a dark gray, argillo [clayey]-calcareous [limy] bed intercalated in member d of F. 1, ninety or one hundred feet below the base of the Lower Magnesian Limestone [Prairie du Chien Group], near the margin of Lake St. Croix, above Stillwater".

The sweet siren song of the Franconian trilobite

Although the geology is reasonably precise for 1852, the geography is vague. Winchell (1888) noted that the horizon in which the first specimens were found was the St. Lawrence Formation. (This publication is also useful for documenting a mastodon or mammoth from Stillwater.) Nelson (1949), gave the type locality as Fairy Glen, just north of Stillwater, which was followed by Hughes (1993) and Labandeira and Hughes (1994). I am not sure if this is because Nelson had some information I don't, or if it was just based on the fact that Fairy Glen is historically the place you would go to find the St. Lawrence Formation near Stillwater. At any rate, you can visit Fairy Glen, because it's now a small park, but don't expect to be seeing hordes of trilobites; Hughes (1993) reported that the productive section was "no longer exposed", and having wandered around there for a while I don't doubt it. You can see plenty of the overlying Jordan Sandstone, though, and Fairy Falls.



Dikelocephalus minnesotensis, Owen (1852), Table 1, figure 1. The original caption is: "*Dikelocephalus Minnesotensis* (N.S.) from the fifth Trilobite-bed of F.1, on the banks of the St. Croix, at Stillwater, Minnesota. Restored outline, in dim contour."

Dikelocephalus as a genus had a fairly quiet existence in the literature (perhaps because nobody could spell it) until the early 20th century. Charles Walcott, as part of his work on the Cambrian, added some species and put others in

new genera in 1914. Matters rested for a few years, then got weird. What happened was that *Dikelocephalus* fell under the attention of Edward Oscar Ulrich and Charles Resser, who were, how shall we put it, prolific multipliers of species (Sundberg 2007). Their natural tendencies, when combined with what is now known to have been a highly variable trilobite, produced wonders (Ulrich and Resser 1930). Nobody expressed their dismay at the situation quite like Gilbert Raasch, who wrote "By 1933, Ulrich and Resser had multiplied this...to the astounding total of 123 species and varieties. They simultaneously succeeded in rendering the Dikelocephalidae useless for purposes either of

Fairy Falls, rolling over the Jordan Sandstone in Fairy Glen, Stillwater, MN

biostratigraphy or phylogeny, and this important fossil group has subsequently been shunned by paleontologists and stratigraphers" (Raasch 1951). He then devoted several pages to documenting their sins and finished by chopping 123 to 41. Some parts are difficult to follow, though, because of some lithological/biostratigraphic issues as detailed in Nelson (1953). Raasch was in a position to complain, having collected trilobites for Ulrich and Resser and being a leading expert on the rocks in question (Mikulic and Kluessendorf 2001). The problem wasn't completely solved until the work of Nigel Hughes and Conrad Labandeira (Labandeira 1983; Hughes 1991, 1993, 1994; Labandeira and Hughes 1994; Hughes and Labandeira 1995). In these works, which came to incorporate more than 2750 specimens (Hughes 1994), they came to the conclusion that except for a possibly distinct species in the underlying Tunnel City Group (a.k.a. the Franconia Formation), *Dikelocephalus* was just *D. minnesotensis*, and it was super-variable (Hughes 1994). This may be an example of Rosa's rule, which documents the tendency for more primitive members of a lineage to be much more variable than more advanced members.

Having thought about the subject of a state fossil for Minnesota occasionally, I think that *Dikelocephalus minnesotensis* would make a good candidate. It's definitely Minnesotan (says so right there in the species name), it's got a historical hook, it's reasonably well-known, it's not teeny-tiny like most of Minnesota's fossil invertebrates (*D. minnesotensis* is downright big for a trilobite, topping out longer than 12 in/30 cm), and trilobites are pretty charismatic as fossils. Another point of interest: although a couple of other states have trilobites as state fossils, *D. minnesotensis* would be the only Cambrian state fossil.

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