



President's Message

The principal purpose of the RAS Bulletin is to communicate events to our members. We wrap engaging articles around that to make the publication more interesting and to expose you to various fields within the natural sciences. Alas! There are far fewer events to report than we usually have. Rather than serve up thin content, we have decided to combine our December and January editions into one issue to cover the next two months. January program detail and additions, if any, will be sent to you by email by your section contact. The next Bulletin issue, then, will be February 2021.

*

Although we could not have the annual RAS Scientific Papers Session this year, we did hold the Larry King Memorial Lecture that is normally part of that session. I hope you were part of our audience. We had over 60 in attendance, including several RIT students for extra credit in their evolution class this semester. Cornell Lecturer Dr. Abby Grace Drake delivered the address. She discussed the Origin and Evolution of Dogs. Using the morphology (shape) of skulls, she has demonstrated that some "dog" fossils used in studies are actually wolves, while showing the morphology changes that occurred early in dogs. She also covered the differences among various breeds.

*

Nominations for RAS Board of Directors Now Open

The Nominations Committee (Tim Tatakis, Tony Golumbeck, and Dan Krisher) will present a slate of candidates for office at the January 20, 2021 Directors meeting. If you are interested in running for a position and

not already on the slate endorsed by the committee, the Bylaws allow you to be placed on the ballot by submitting a petition signed by ten endorsing members, and sending the petition to Secretary Helen Haller by February 1. Include a brief sketch of your qualifications and desire to serve.

All officer positions (1-year term) and two directorships (3-year terms) are up for election each year. A ballot will be provided in the March RAS Bulletin, a month prior to the Annual Meeting, when ballots will be tabulated, and the results announced.

*

I am thrilled to report that thanks to the generosity of a few members, we have raised \$250 and we will be able to make a deserved fourth award to a student in the Natural Sciences in our annual Student Grants program. If you would like to help increase this amount, please contact Dr. William Hallahan at whallah3@naz.edu to donate.

*

Where will you be in the evening of December 21? I will be watching the sunset (clears skies, please!) and awaiting the view of the Great Conjunction of 2021. Whenever there is an astronomical event, everyone seems to want to know how special it is. Many of us are attracted to rare celestial events and this is one of the rarest. This closest approach of Jupiter and Saturn to each other occurs only once every twenty years. So there are likely to be only three or four in your lifetime, maybe five if you are lucky. Conjunctions typically are about 1°15' apart or less. Really close conjunctions are very rare. In this year's, at their closest, they'll be about 0.1° apart, only 6'. That's just

1/5 the diameter of a full moon. You are likely to see news reports that this conjunction is the closest since July 16, 1623. While technically true, the fact is that no one saw that one, as the planets were in the glare of the sun. The last time you could have seen a conjunction this close was on the morning of *March 4, 1226!* . . . over 794 years ago. Now, that is RARE.

For this conjunction, both planets will be visible in the same field of view in most small telescopes, along with some of Jupiter's and Saturn's moons. In fact, they will be so close it may be a challenge to separate them with the unaided eye for many people.

With sunset at 4:38 pm, twilight in Upstate NY ends at 5:11 pm. That is the time to start looking, just slightly south of the point that the sun sets and about 15° above the horizon. With houses and trees about, your view might be obscured, so find a clear spot. I wish you good viewing!

*

Unless you are a Life Member, note that your membership will expire on December 31, 2020. Please renew your membership at your earliest convenience. A membership form is included inside this Bulletin on page 3 or you can get it at rasny.org/mbform.pdf.



Best wishes for an active and happy 2021!

Michael Grenier, RAS President

Featured Article

Mineral Evolution

By Theodore W. Lechman,
RAS Bulletin Editor

Traditionally, the field of mineralogy has been the study of naturally occurring inorganic solids that have a definite chemical composition and an ordered internal structure. Geologists are able to identify minerals because they have characteristic physical properties that can be determined by chemical, mechanical, and crystallographic means. Minerals are important economically, as most industrially useful metals are found naturally in mineral deposits.

A new understanding of minerals that contextualizes them within the planetary history of the solar system was initiated in a 2008 paper by [Robert Hazen of Carnegie-Mellon University](#). This new understanding is referred to as “Mineral Evolution”, where minerals are understood to be the fossilized remains of planetary geological processes that dramatically change over time. Although the analogy is not perfect between biological and mineral evolution, much like the biological conditions of the Earth’s past is encoded in the paleontological fossil record, so too is the history of changing geophysical planetary conditions encoded in the earth’s mineral record. So as geophysical conditions have changed on planet earth, the result has been the formation of new mineral species resulting in the net increase of existing minerals and mineral types.

This new paradigm of Mineral Evolution was brought to the attention of the Rochester Academy of Sciences by a presentation to the Mineral Section on the subject by [Dr. Dori Farthing of the Geology Department of SUNY Geneseo](#) on October 20, 2020. A copy of her presentation can be found on the

RAS website here:
<https://www.rasny.org/Publications/Bulletins/mineral%20evolution-handouts.pdf>.

Mineral Evolution Eras

The current model of mineral evolution consist of three major eras comprising a total of ten stages (see Table 1 below).

The starting point of mineral evolution predates the formation of the solar system. This is when the solar system was still a diffuse nebula of “star dust” consisting of light gases and the ejecta of previous supernovae and other cataclysmic stellar events. The chemistry of this period is sometimes referred to as [dark chemistry](#) due to the lack of sunlight or planetary pressures and temperatures. This is the **Era of Prenebular Ur-Minerals**.

The first major planetary geological era is called the **Era of Planetary Accretion** which coincides with the accretion of the planetary nebula into the planet Earth (*Theia?*) and where the primary geophysical process are collision and bombardment.

The second major mineral era is known as **the Era of Crust and Mantle Reworking**. This includes [igneous rock](#)

evolution, [granite](#) and [pegmatite](#) formation, and [plate tectonics](#).

The last and present mineral era is the **Era of Biologically Mediated Mineralogy**, where the evolution of life on earth changed the atmosphere from nitrogen/ carbon dioxide/ inert gases to an oxygen rich atmosphere due to cyanobacteria and photosynthesizing organisms and the subsequent establishment of the carbon cycle, known as [the Great Oxidation Event](#). Also involved were the creation of intermediate oceans, the events associated with [Snowball Earth](#), and [biomineralization](#) during the **Phanerozoic Era**.

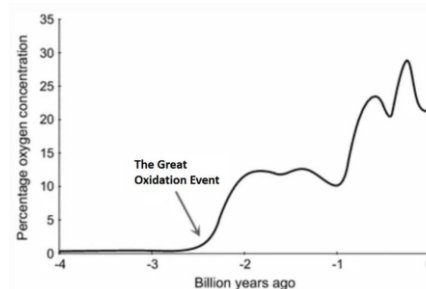


Figure 1: Oxygen Content of the Earth’s Atmosphere over the last 4 billion years ([Martin, 2017](#))

Era/Stage	Age (Ga)	Cumulative no. of species
Prenebular “Ur-Minerals”	>4.6	12
Era of Planetary Accretion (>4.55 Ga)		
1. Primary chondrite minerals	>4.56 Ga	60
2. Achondrite and planetesimal alteration	>4.56 to 4.55 Ga	250
Era of Crust and Mantle Reworking (4.55 to 2.5 Ga)		
3. Igneous rock evolution	4.55 to 4.0 Ga	350 to 500*
4. Granite and pegmatite formation	4.0 to 3.5 Ga	1000
5. Plate tectonics	>3.0 Ga	1500
Era of Biologically Mediated Mineralogy (>2.5 Ga to Present)		
6. Anoxic biological world	3.9 to 2.5 Ga	1500
7. Great Oxidation Event	2.5 to 1.9 Ga	>4000
8. Intermediate ocean	1.9 to 1.0 Ga	>4000
9. Snowball Earth events	1.0 to 0.542 Ga	>4000
10. Phanerozoic era of biomineralization	0.542 Ga to present	4400+

Table 1: Three Eras and Ten Stages of Earth's Mineral Evolution ([Hazen, 2018](#))

(Continued on p.3)

Mineral Evolution

(Continued from p. 2)

Jumps in Cumulative Number of Mineral Species with Supercontinent Formation

In a 2019 paper by Robert Hazen and his colleagues, data mining techniques were used on the International Mineralogical Association database to discover that not only are increases in mineral species diversity and complexity not uniform, but are correlated with the formation of supercontinents, in which geological pressures and stresses are especially large. Figure 2 shows how jumps in mineral species formation are correlated with the [Kenorland](#) supercontinent of 3 billion years ago, the [Nuna](#) of 2.2 billion years ago, the [Rodinia](#) of 1.7 billion years ago, the [Pannotia](#) of 1 billion years ago, and [Pangea supercontinent](#) of 400 million years ago. [Current research](#) points to current formation of a new supercontinent called [Amasia](#), which is anticipated to generate the next group of mineral species.

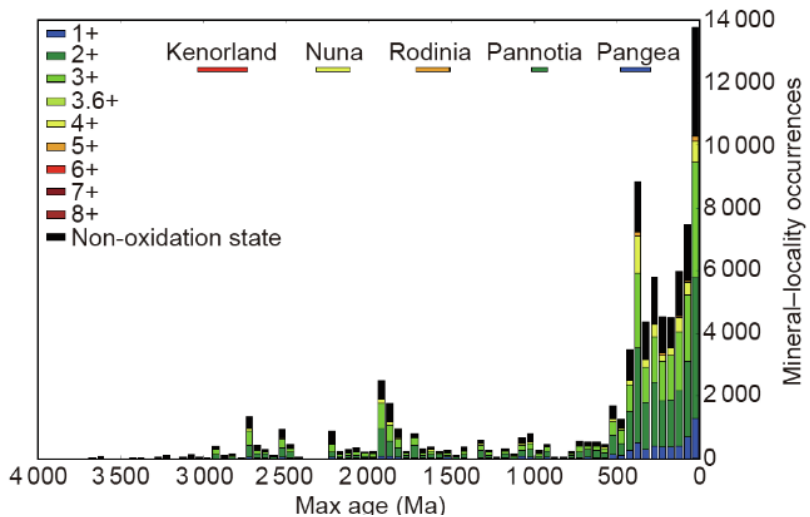


Figure 2: Record of Earth's Mineralization over Time
(Hazen, 2019)

Big Data and Citizen Science

There are a number of Mineralogical databases to which the amateur can contribute data as well as perform data analysis. They include the following links:

- Mindat.org
- Earthchem.org
- Macrostrat.org
- [The Paleobiology Database](http://ThePaleobiologyDatabase.org)
- [IMA Database](http://IMA Database.org)

In particular, Dr. Hazen is encouraging participation in the [Deep Carbon Observatory](#) which is a project to understand the quantities, movements, forms, and origins of carbon on earth, as well as the many ways deep carbon impacts the oceans, atmosphere, and life at the earth's surface.

2021 Rochester Academy of Science, Inc.

Membership Form

Mail to:

R.A.S. c/o
William L. Hallahan
6658 North Avon Rd.
Honeoye Falls, NY 14472

- [] New
[] Renewal

Name _____ E-mail _____

Street _____ Phone _____

City _____ State _____ Zip _____

For your convenience, please pay your dues to the R.A.S. and its sections with a single check. **Make check payable to: Rochester Academy of Science**
CIRCLE the amount you are paying for an Academy category (shaded column) and for the Section(s) in which you wish membership.

Membership Categories

R.A.S. dues are a prerequisite for section membership

	Rochester Academy of Science	Anthropology Section	Astronomy Section	Life Sciences Section	Fossil Section	Mineral Section	Total
Member (Individual over age 18)	\$10.00	\$2.00	\$25.00	\$2.00	\$10.00	\$5.00	
Family (Including students to age 18)	\$15.00	\$3.00	\$30.00	\$3.00	\$10.00	\$6.00	
Student (Through full-time undergrad.)	\$5.00	\$1.00	\$5.00	\$1.00	\$5.00	\$2.00	
Supporting (Individual or family)	\$20.00	*****	\$40.00	\$10.00	\$20.00	\$10.00	
Patron (Individual or family)	\$30.00	*****	\$50.00	\$20.00	\$30.00	\$20.00	
Life (Individual only)	\$200.00	*****	\$300.00	\$40.00	*****	*****	
Gift (Thank you!) Fill in amount ⇨							
<i>If you are away part of the year, please indicate the months:</i>							

Citizen Science

2020 – A Good Year for Supernova Observers

By David Bishop, Vice President
ASRAS

For most things, 2020 has not been a good year. However, the universe keeps on going regardless of what is happening down here. Last year, we had a record number (15,914) of supernovae discoveries, but it was quantity, not quality. We had two objects which became bright enough to see with amateur telescopes ($> 13^{\text{th}}$ magnitude). This year so far, we have had 11, including some nice bright Mag 11 objects! We are also going to have another record number of discoveries (16,711 as of mid-November).

A supernova is an exploding star in another galaxy. These events happened millions of years ago, and we are just now seeing the results. These explosions are some of the most energetic events noticed by humans. For a matter of weeks a supernova can be as bright as the host galaxy it comes from.

I have made the cataloging of supernovae (plural of supernova) a study of mine. A quarter of a century ago (yes that does make me feel old) I began making a list of the currently observable supernovae. The list was designed so that people could easily see what objects were visible. My web page is the only source of supernova reference images on the web. See <http://www.RochesterAstronomy.org/snimages>. It has been cited in many technical papers.

Our brightest object of the year was discovered early on in the year. Supernova SN2020ue (Figure 1) is in a galaxy named NGC 4636 (a galaxy in the constellation Virgo). Fifteen days after discovery it got up to magnitude 11.8, and dimmed down to 18^{th} magnitude by June.

Happening at the same time, and very close to the core of the galaxy



Figure 1: Supernova SN2020ue
(Image: Robert Ligustri)

was Supernova SN2020oi (Figure 2) in M100 (a galaxy in Ursa Major). It only got to 12^{th} magnitude, but a supernova in a Messier galaxy is a rare thing.

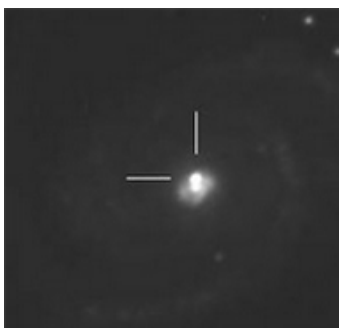


Figure 2: Supernova SN2020oi in
M100 (Image: Paolo Campaner)

Next, Supernova SN2020ftl (Figure 3) went off in a little galaxy called NGC 4277 (next to NGC 4273) once again in the constellation Virgo. This one only getting to 13^{th} magnitude, but it made a good picture.



Figure 3: Supernova SN2020ftl
(Image: Sergio Bove)

When COVID-19 was making us stay at home, a new flurry of supernovae started up. It began with Supernova SN2020jtfo (Figure 4) in M61 (also in the constellation Virgo). This one was a [Type II supernova](#), (a rapid collapse and explosion of a massive

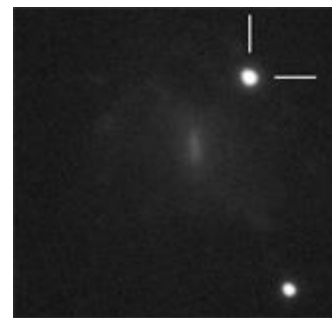


Figure 4: Supernova SN2020jtfo
(Image: Maciek Jarmoc)

star), but it was in an easy to see galaxy.

Next was Supernova SN2020hvf (Figure 5) in NGC 3643. The host galaxy was a very dim galaxy in the constellation of Leo the Lion. This supernova became so bright (Mag 12) that it outshone its host galaxy.

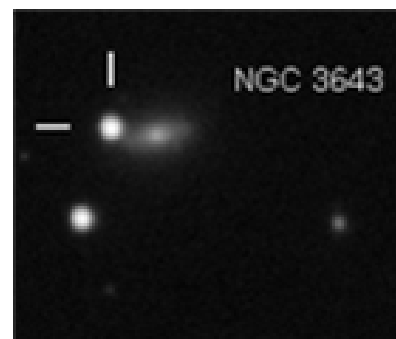


Figure 5: Supernova SN2020hvf in
NGC 3643 (Image: Gerhard Dangl)

Supernova SN2020rcq (Figure 6) was in a very faint galaxy named UGC 6930 (a mag 12.6 galaxy). This supernova got as bright as Mag 11.8 (almost a full magnitude brighter than its host galaxy!).



Figure 6: Supernova SN2020rcq
(Image: Gregor Krannich)

(Continued on p. 6)

Events for December 2020 – January 2021

For updates to events, check the Academy website <http://www.rasny.org> and section websites.

Due to COVID-19 government-advised social distancing precautions, RAS public meetings are being replaced by virtual meetings. Stay tuned to RAS and sectional emails and websites for updates.

NOT MEETING IN DECEMBER OR JANUARY

Life Science Field Trips
Astronomy Star Parties
Anthropology Field Trips

Herbarium Group
Strasburgh Observatory
RAS Winterfest Activities

DECEMBER EVENTS

NOT MEETING IN DECEMBER

RAS Board
Mineral Section

1 Tue: Fossil Section Meeting

7:30 p.m. The meeting will feature a presentation by Dr. D. Jeffrey Over of SUNY Geneseo on “[Devonian Mass Extinctions in New York](#).” Of the five major mass extinctions in the past 540 million years, that of the Devonian is the most prominent in New York's rocks. The Devonian strata in New York actually contain evidence of two other significant mass extinctions. Meeting will be held remotely via ZOOM and is open to RAS Members and guests. Contact: Michael Grenier at paleo@frontier.com for meeting details and logon info.

4 Fri: Astronomy Section Meeting

7:30 p.m. Meeting held remotely via [BigBlueButton](#). Speaker: Kelly Douglass, Visiting Assistant Professor of Physics and Astronomy at the University of Rochester. Topic: “Mapping the Universe with [The Dark Energy Spectroscopic Instrument \(DESI\)](#)”. Meeting details will be shared via email. Contact: Mark Minarich at mminaric@rochester.rr.com.

9 Wed: Astronomy Board Meeting

7:00 p.m. Ionia. Meeting to be held remotely via [BigBlueButton](#). Meeting details will be shared via email. Contact: Mark Minarich at mminaric@rochester.rr.com.

13 Sun: Astronomy Geminid Meteor Shower Observing

Observing from dusk till ?. Observing social distancing and masks. Specific rules for bathroom use are posted at the facility. Members may bring guests, but all must sign in at the Wolk Building to facilitate contact tracing. Contact: Mark Minarich at mminaric@rochester.rr.com.

19 Sun: Astronomy Public Open House

12:00 p.m. - 4:00 p.m. (or later, if skies are clear). Observing from dusk till ?. Outdoors only. Observing social distancing and masks as appropriate. Specific rules for bathroom are posted at the facility. Members may bring guests, but all must sign in at [Wolk Building](#) to facilitate contact tracing. Farash Center for Observational Astronomy, 8355 County Road 14 Ionia, NY 14475. Sledding, weather permitting. For weather related cancellations or changes contact Mark Minarich: (585) 257-6042 or see www.rochesterastronomy.org/calendar-of-events.

JANUARY EVENTS

NOT MEETING IN JANUARY

Fossil Section

8 Fri: Astronomy Section Meeting

7:30 p.m. Meeting held remotely via [BigBlueButton](#). Speaker: Ranga Dias, Professor of Physics and Mechanical Engineering at the University of Rochester. Topic: “[Finally, the First Room Temperature Superconductor](#).” Meeting details will be shared via email. Contact: Mark Minarich at mminaric@rochester.rr.com.

JANUARY EVENTS

(Continued)

13 Wed: Astronomy Board Meeting

7:00 p.m. Meeting to be held remotely via [BigBlueButton](#). Meeting details will be shared via email. Contact: Mark Minarich at mminaric@rochester.rr.com.

19 Tue: Mineral Virtual Meeting

7:00 p.m. [ZOOM](#) meeting. Members will receive information by email. Contact: J. Dudley at juttasd@aol.com.

20 Wed: RAS Board Meeting

7:00 p.m. Meeting to be held remotely via [ZOOM](#). Meeting details will be shared via email. Contact: Michael Grenier at mgrenier@frontiernet.net.

23 Sat: Astronomy Public Open House

12:00 p.m. - 4:00 p.m. Observing from dusk till ?. Outdoors only. Observing social distancing and masks as appropriate. Specific rules for bathroom are posted at the facility. Members may bring guests, but all must sign in at [Wolk Building](#) to facilitate contact tracing. Farash Center for Observational Astronomy, 8355 County Road 14 Ionia, NY 14475. Sledding, weather permitting. For weather related cancellations or changes contact Mark Minarich: (585) 257-6042 or see www.rochesterastronomy.org/calendar-of-events.



[NASA Snowflake](#)

A Good Year for Supernova Observers

(Continued from p. 4)

Next Supernova SN2020uxz (Figure 7) in NGC 514 (constellation Pisces) went off. Also outshining its host.

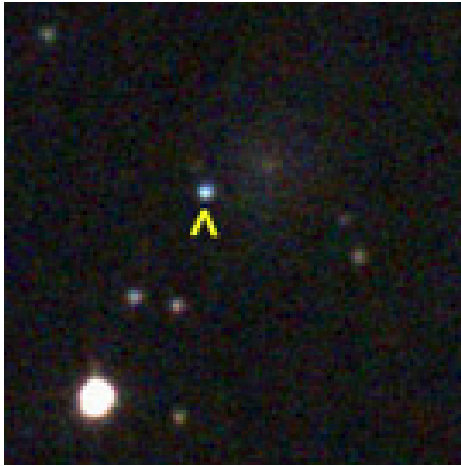


Figure 7 - Supernova SN2020uxz

(Image: J.C. Merlin)

I continue to work on this project about an hour every night, and hope to for years into the future.

Editor's Note: you can find links to various supernovae, including those discussed here at: <http://www.rochesterastronomy.org/sn2020/index.html>

Rochester Research in Review

[Nov 20, 2020 UR Memories create 'fingerprints' that reveal how the brain is organized](#)

[Nov 20, 2020 Cornell Field geology at Mars' equator points to ancient megaflood](#)

[Nov 20, 2020 RIT Hidden 15th-century text on medieval manuscripts](#)

[Nov 12, 2020 Cornell Stretchable 'skin' sensor gives robots human sensation](#)

[Nov 8, 2020 RIT New black hole merger simulations could help power next-gen gravitational wave detectors](#)

[Nov 3, 2020 UR Building a quantum network one node at a time](#)

[Oct 14, 2020 UR Finally, The First Room-Temperature Superconductor](#)



Neptune and three of its moons as captured on the evening of November 9, and presented in a Virtual Star party on November 20, 2020 (Mark Minarich)

ABOUT THE ACADEMY

The Rochester Academy of Science, Inc. is an organization that has been promoting interest in the natural sciences since 1881, with special focus on the western New York state region. Membership is open to anyone with an interest in science. Dues are minimal for the Academy and are listed in the membership application online. Each Section also sets dues to cover Section-related publications and mailings. We are recognized as a 501(c) 3 organization.

For information, contact President Michael Grenier at (585) 671-8738 or by e-mail paleo@frontier.com.

The Academy Internet website is <http://www.rasny.org> or see us on Facebook at <https://www.facebook.com/Rochester-Academy-of-Science-792700687474549>.

This "BULLETIN" is produced monthly, except July and September, by the Astronomy Section, Rochester Academy of Science. Submissions are due by the 10th of the month and may be emailed to editor@rasny.org.

The Academy postal address is P.O. Box 92642, Rochester NY 14692-0642.

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