Rochester Academy of Science

BULLETIN

"An organization of people in the Natural Sciences"

August-September 2020 - Vol. 74, #8

President's Message

On July 17, we held the 140th Annual Meeting of the Rochester Academy of Science with over 40 members attending. The Astronomy Section hosted this web-based meeting.

The Academy has never missed a year holding its Annual Meeting. We were not stopped by WWI or WWII, not by the Great Depression, not by the so-called "Spanish Flu", and not by this COVID-19 pandemic.

Our first order of business was to establish our Board of Directors for 2020-2021. I am gratified that members elected their current serving officers and Board members and added the very well-qualified Dr. Michael Richmond to their governing body. Our complete Board is listed on page 6, as always.

Our second item (and a great pleasure for me) was the induction of Robert McGovern into a fellowship in our Academy. Our Fellows were established in 1889, our ninth year, and redefined in 1946 as our highest honor. Our criteria include significant contributions to one or more sections or to the Academy as a whole and significant scientific publications or work, or significant accomplishments in the presentation of science. The citation put together by a team of people in support the nomination is provided on page 2 as evidence of the deservedness of this honor.

Congratulations, Bob McGovern.

Yours in Science,
Michael Grenier, RAS President

2019-2020 Undergraduate Student Research Grant Awardee:

Joseph Karbosi
(St. John Fisher College)

Joseph Karbosi, St. John Fisher College. *Investigation of a Compound to Potentiate Topoisomerase.*
Sponsors: Jonelle Mattiacio Ph.D. and Jonathan Millen Ph.D.

Topoisomerases are enzymes that function in the unwinding of DNA. The general mechanism involves cleavage of the DNA backbone to relieve tension during replication and subsequent religation of the strands. The function of topoisomerase II is to cause a double-strand break in the DNA using ATP to relieve the strain of DNA supercoils. If the double-strand breaks were left unrepaired, there would be early termination in DNA replication leading to cell death which is the mechanism behind topoisomerase poisons. The inhibition of topoisomerase II is relevant because it is the mechanism used by Doxorubicin, commonly used as a chemotherapeutic drug to cause cell death in cancer cells. Consequently, Doxorubicin is a known Top2 poison that interferes with replication to cause cell death. However, the allowed dosage is limited due to toxic side effects, specifically cardiotoxicity.

We discovered that a compound (Compound X), while non-toxic alone, works to increase the potency of Doxorubicin's cytotoxic effect in cancer cell lines. *In vitro* this compound decreased lifespan and increased the cytotoxicity of Etoposide (another common Top2 poison) in *S. cerevisiae* (yeast). It was determined that increasing concentrations of Compound X in the presence of Doxorubicin, decreases cell viability in a concentration-dependent manner.

The focus of our current research is to further investigate the range of cancer cells sensitive to the Compound X potentiated Doxorubicin. To maximize the potential benefit of Compound X, we will focus on the most common forms of cancer. In this case, we propose that the most common form of non-Hodgkin's lymphoma, diffused large b-cell lymphoma (DLBCL), will be sensitive to the potentiated Doxorubicin. DLBCL is frequently treated with Doxorubicin and if combined with Compound X, the patient will be able to take lower doses of Doxorubicin for longer periods of time. This lower dose with the same potency means that patients should experience fewer side effects and be eligible for continued Doxorubicin treatment in the future.

RAS Grant money is being used to purchase a different cancer cell line to determine if the results are cancer-specific and not cell line-specific.

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ROBERT JAMES McGOVERN
FELLOW
2020

Bob McGovern joined the Astronomy Section of the Rochester Academy of Science in 1998, and since 2005 has served the Academy in the appointed position of Site Manager for the Marian and Max Farash Center for Observational Astronomy. Bob's tenure is marked by expanded facilities and an active, year-round program. He has been the general contractor, master craftsman and labor foreman for most structures on the grounds. Among these building projects are a garage, several observatories, and major renovations of the classroom building. The Ken and Trudy Brown Memorial Deck that he added has become a well-used and favorite gathering place for members.

Bob is the Farash Center's biggest fan and promoter, using the facilities to enrich public awareness and understanding of science. He schedules and hosts monthly Open Houses, holding the September event in conjunction with the Ionia Fall Festival. He plans events that are child-friendly, such as Halloween parties, winter sledding, and RocheStar Fest activities that include fossil digs, birdhouse building, and his famous potato cannon. Bob's participation in Section education programs is exemplified by his leadership in our Summer Science Camp. He shares his knowledge on diverse topics including plate tectonics, constellation mythology, Avogadro's Number, Archimedes' Principle, and aerodynamics. A child at heart, Bob's playfulness and enthusiasm leads to performing exciting experiments and demonstrations that engage the scientific curiosity of young people.

Study of the Sun is a personal passion for Bob. His solar images are fully documented with interesting solar details, image capture techniques, and wavelengths. His solar work led Al Ureles to work with the Farash Foundation to fund construction of a dedicated solar observatory at the Farash Center. Bob used this financial gift to create an observatory with state-of-the-art solar telescopes. He promoted the introduction of Internet access, making it possible for members to transmit live views of the Mercury transit in 2016 and the 2017 solar eclipse. Bob dreams of the day when real-time remote viewing will be available on demand.

In recognition of these outstanding contributions, we welcome Robert J. McGovern as a Fellow of the Rochester Academy of Science.

Robert J. McGovern
Fellow, Rochester Academy of Sciences

Michael R. Grenier
President, RAS

Helen D. Haller
Secretary, RAS

The Earth's Dynamic Magnetic Pole

by Theodore W. Lechman, RAS Bulletin Editor.

The earth's magnetic field is due to the dynamo action of the currents within the liquid conductive outer core. Other planets with liquid cores also have magnetic fields, such as Mercury, Jupiter, and Saturn. Planets with solid or near solid interiors have no magnetic fields, such as Venus, Mars, and the Moon. The magnetic field of the earth forms a magnetosphere that shields the earth from biologically hazardous coronal high energy particles. Therefore, any changes in the magnetosphere has important consequence for life on earth. It has been widely reported that the earth's magnetic poles are shifting in position and magnetic field strength and doing so at historically unprecedented rates.

The common simplified view of the earth's magnetic field is that of a simple bar magnetic, aligned with the spin axis of the earth, with the north magnetic pole over the north rotational spin axis and the southern magnetic pole over the south spin axis. There are numerous problems with this simplified view. The first is that the north magnetic pole is not actually alighted with the spin axis of the earth. As can be seen in figure 1, the earth's magnetic pole is on the move at accelerating rates. Between 1990 and 2005 the north magnetic pole accelerated from its historic speed of 0-15 km/year, to its present speed of 50-60 km/year. This change in magnetic pole position is hypothesized to be a consequence of a jet of molten iron in the outer core. In 2017 the earth's magnetic pole crossed the International Date Line and has departed the Canadian arctic for Siberia. The magnetic north pole is now moving so rapidly that the World Magnetic Model (WMM) had to be urgently updated in 2019. The importance of the WMM is made plain by the fact that NASA and the FAA make use of the model for mapping, satellite tracking and air traffic management. Your cell phone apps, such as compass, maps and GPS, make use of the model. The geographic north pole and the north magnetic pole were not understood to be distinct until 1831.

Another issue is the very name of "north magnetic pole". In an ordinary bar magnet, the magnetic field lines connect the north pole with the south pole, and the convention is that the direction of the magnetic field lines point from the north towards the south. This polarity determines the direction of force a charged particle will experience in the magnetic field. The magnetic field lines of the earth point from the southern magnetic pole towards the northern magnetic pole. Therefore, if you want to picture the earth's magnetic field as a bar magnet, then the south pole of the bar magnetic will be in the north and the north pole of the bar magnetic will be in the south. This is the reason why the north pole of your compass magnet points north. So, by "north magnetic pole" what we are referring to is the magnetic pole near the geographical north of the planet, not the magnetic polarity of the magnetic fields.

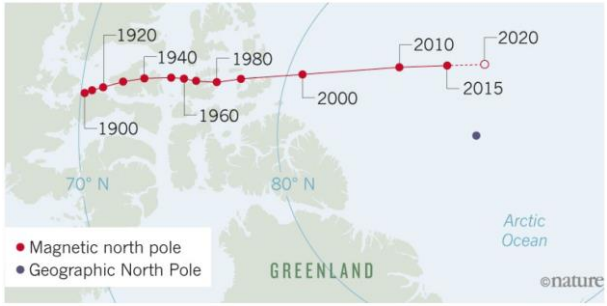

Figure 1: Movement of the Northern Magnetic Pole
(World Data Center for Geomagnetism/Kyoto Univ)

Fossilized Magnetic Fields

Whereas the earth's liquid outer conducting core acts as a dynamo generating earth's magnetic fields, the viscous (over geological time) semiconducting mantle, especially the upper mantle known as the asthenosphere, enables the earth's crust to move in large plates described as plate tectonics. Where continental plates diverge, there is an upwelling of lava from the asthenosphere to the crust's surface, where it hardens as solid rock. As this rock hardens, the metals in the rock retain the same magnetic polarization that the magma experienced when it formed. As the new oceanic crust is formed at divergent plate boundaries, new rock spreads out in conveyor-belt fashion, each section retaining the magnetic polarization of the earth's magnetic field at the time of cooling, thus creating a fossil record of the history of the earth's magnetic field. Figure 2 on page 4 illustrates how tectonic divergent rifts encodes the history of the earth's magnetic field.

The present magnetic polarity epoch, known as the Brunhes Chron, named after the pioneer of paleomagnetism, has lasted in its present magnetic field orientation for the past 0.76 million years (0.76 Ma). Prior to that, the earth's magnetic field was reversed from what it is today for 0.12 Ma. Figure 3 on page 4 shows the earth's geomagnetic polarity since the middle Jurassic. Dark areas denote periods where the polarity matches today's polarity, while light areas denote periods where that polarity is reversed. The term "chron" represents a period in geologic history when the earth's magnetic field was in a predominantly "normal" or "reversed" position. A chron is a time equivalent of a geological region of the same magnetic polarity, known as a chronozone. A chron whose polarity lasts less than 200,000 years is known as a "polarity subchron", whereas as polarity interval lasting >10 Ma is known as a "polarity superchron".

(Continued on p.4)

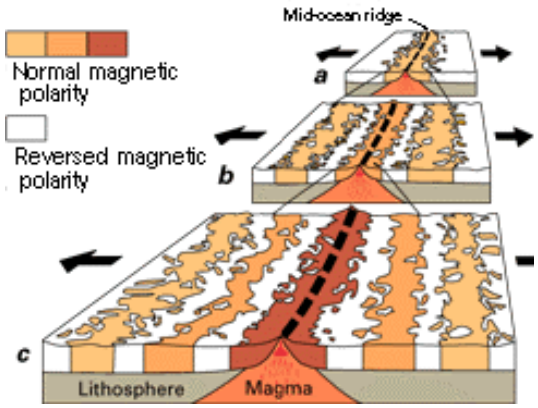

Figure 2: Ocean Floor Magnetic Striping
(Commons.Wikipedia.org)

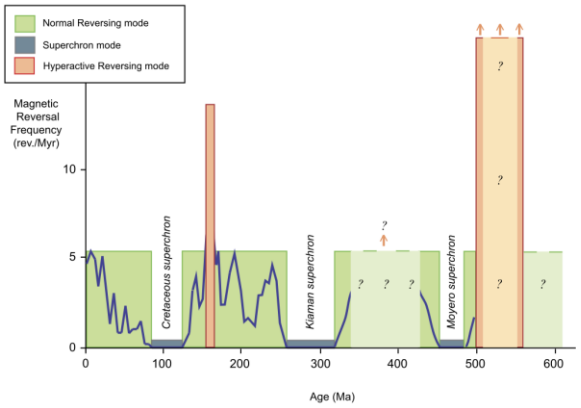

Figure 4: Frequency of Magnetic Pole Reversal
(Gallat, Pavlov, Korovnikov, 2019)

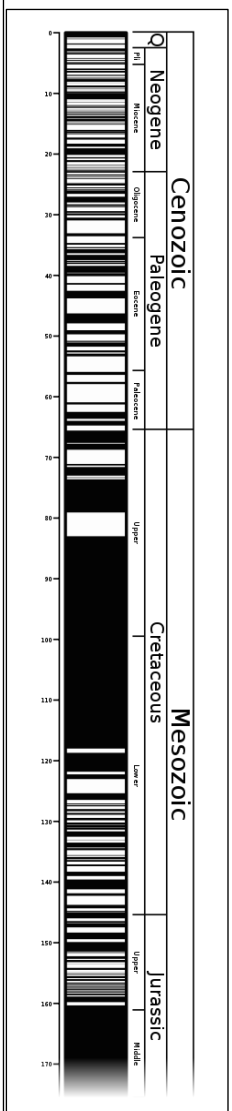

Figure 3: Geomagnetic Polarity since the Middle Jurassic
(Wiki Commons)

(Continued from p. 3)

A striking feature of the chron history of the earth, as shown in Figure 3, is the broad epoch of constant magnetic polarity. The Cretaceous Superchron (also known as the Cretaceous Normal), is visible as the broad, uninterrupted black band near the middle of figure 3, lasted for almost 40 million years, from about 120 to 83 million years ago, including stages of the Cretaceous period from the Aptian through the Santonian. The frequency of magnetic reversals steadily decreased prior to the period, reaching its low point (no reversals) during the period. Between the Cretaceous Normal and the present, the frequency has generally increased slowly. It is hypothesized that the magnetic stability of the Cretaceous Superchron helps to explain the diversity of the Cretaceous, in which a stable protective magnetosphere helped protect the life on earth from Solar high energy particles, much like it has been doing recently since *Homo heidelbergensis*, during the present Brunhes Chron.

Figure 4 above show the chron timeline of figure 3 but in terms of frequency of magnetic reversals. Superchrons operate in a mode in which polarity reversal is rare and the magnetic strength and polarity is extremely stable. During "normal" polarity reversing modes, magnetic polarity reverses at a rate of 5 reversals per Ma, max. There are also periods of hyperactive reversals when the magnetic polarity reverses at a rate of >25/ Ma. It is hypothesized that during hyperactive reversal periods, the average strength of the magnetic field is reduced, on account of not only reversals, but also magnetic "excursions", in which the magnetic field strength declines as in a reversal, but rather then reversing, the magnetic polarity re-establishes itself.

The Earth's Magnetic Field Today

Since 1850, the strength of the earth's magnetic field has fallen by 9.4%. This trend indicates that the earth's field strength may reach zero in 1,600 years. This is the reason why some believe the earth is in the early stages of a reversal. Simulations show (Figure 5) that during a reversal, the unified field breaks up into many separate poles before reforming either into a reversed pole or reforming back into the pole's original magnetic orientation; that is, an excursion.

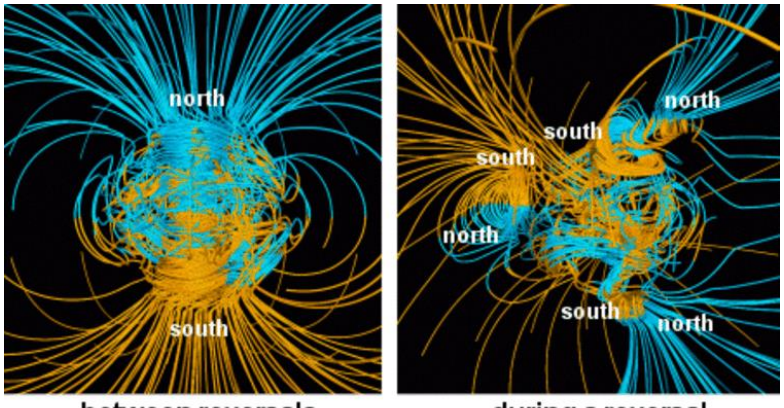

Figure 5: Earth's Magnetic Fields Prior to and During a Reversal
(NASA / Gary Glatzmaier / Phil Plait)

References:
Yves Gallet, Vladimir Pavlov, Igor Korovnikov. Extreme geomagnetic reversal frequency during the Middle Cambrian as revealed by the magnetostratigraphy of the Khorbusuonka section (northeastern Siberia) Earth and Planetary Science Letters 528 (2019) 115823

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Events for August-September 2020

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 AUGUST OR SEPTEMBER

Anthropology Field Trips
Life Sciences Field Trips
Herbarium Group
Astronomy Star Parties
Strasenburgh Observatory
Summer Friday Science Club
Ionia Fall Fest

AUGUST EVENTS

7 Fri: Astronomy Section Meeting

7:30 p.m. Meeting held remotely via BigBlueButton. Matthew East of L3Harris will speak on "Current and Future L3Harris Space Missions." Meeting details will be shared via email. Contact: Mark Minarich at mminaric@rochester.rr.com.

12 Wed: Astronomy Board Meeting

6:00 p.m. Meeting an hour earlier due to Perseid meteor shower. Meeting to be held remotely via BigBlueButton. Meeting details will be shared via email. Contact: Mark Minarich at mminaric@rochester.rr.com.

12 Wed: Astronomy Perseid Meteor Shower Watch

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

15 Sat: Fossil Field Trip

Rescheduled from July 18th. This is a tentative date. 10:00 a.m. all attendees to meetup at Pompey Center site. Collecting field trip to Pompey Center Road cut southeast of Syracuse and to the Swamp Roadcut near Morrisville. For final details, including date and precautions to be taken, contact Dan Krisher at DLKFossil@gmail.com.

19 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.

Perseid Meteor Shower. Best viewing: after midnight, Wednesday morning, August 12th.
(Rafael Schmall/Universities Space Research Association)

SEPTEMBER EVENTS

9 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.

11 Fri: Astronomy Section Meeting

7:30 p.m. Meeting held remotely via BigBlueButton. Topic and speaker to be determined. Meeting details will be shared via email. Contact: Mark Minarich at mminaric@rochester.rr.com.

15 Tue: Mineral Virtual Meeting

7:00 p.m. 7 p.m. Zoom meeting. David K. Joyce will talk about the Sudbury Basin, a rich deposit of metals in northern Ontario. Members will receive information in Sept. Contact: J. Dudley, juttasd@aol.com.

16 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.

19 Sat: Observing at the Farash Center Observatory

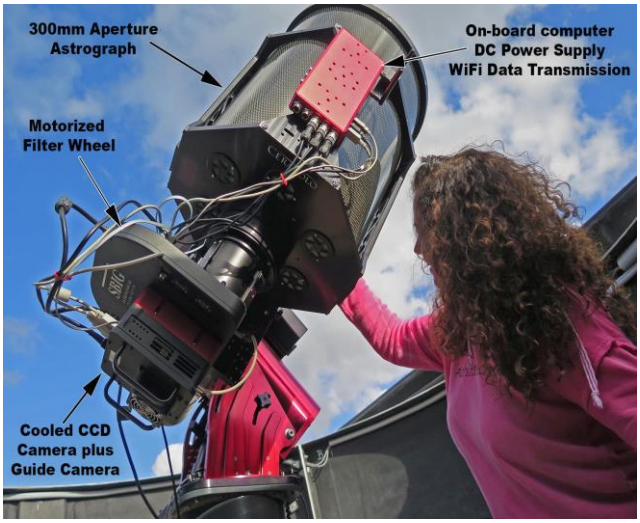
Dusk until? Outdoors only. Observing social distancing and masks as appropriate. Specific rules for bathroom are posted at the facility. Members may bring guests, but all must sign in at Wolk Building to facilitate contact tracing. Contact: Mark Minarich at mminaric@rochester.rr.com.

Oriental Tree Lily, 6', Native to Japan. Planted in Brighton by Squirrels.
(Laura A. Cushman)

Comet Neowise *by Rick Albrecht, Life Member ASRAS*

This image of Comet Neowise, bottom left, was taken the morning of July 8th from the backyard observatory of Peter and Debra Ceravolo in Osoyoos, BC Canada (49-degree latitude). Debra used a 300mm aperture Astrograph to capture this image. Operating the Astrograph at f/9, she took 160, one second images with a SBIG 8050SC one shot color camera, seen bottom right. The field of view in that image is about 20x17 arc minutes. Because the comet was so low on the horizon you can see a little bit of atmospheric refraction (red fringe on the bottom of the nucleus).

Editor's Note: Rick Albrecht has been active in both the ASRAS and RAS since 1969. In 1995 he moved south to Cumming GA but is still active in astronomy and stays in touch with members of ASRAS. Rick has been designing a 36-inch telescope for Peter and Debra Ceravolo for a few years and they share a number of their activities with each other. Visit Rick at: https://www.rickalbrechtphoto.com/.



(Debra Ceravolo)

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.

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