Rochester Academy of Science

BULLETIN

"An organization of people in the Natural Sciences"

November 2020 - Vol. 74, #10

President's Message

Dogs or birds—always a tough choice for me. First at the pet store buying dog food, then at The Bird House stocking up on seed and suet.

Well, this time, we miss out on the bird talk I touted last month. The Cornell Ornithology Lab has been shut down and our planned speaker is not able to appear for our annual Larry King Memorial Lecture. We may get her for our Annual Meeting in April, though.

Our able VP, Dan Krisher, instead has secured another speaker on our qualified list: Dr. Abby Grace Drake from the Department of Ecology and Evolutionary Biology at Cornell University. She studies evolution in skull shape in canids, cetaceans (whales & dolphins), and other animals. She worked extensively on dogs and will speak to us on their origins and evolution. Fascinating! This will be on November 24th at 7:30 p.m. More details are within.

We have funds in our budget for three awards in our 2021 annual Student Grant Program. The good news is that with donations from our members, we are well on our way to having the $300 needed to make a deserved fourth award to a student in the natural sciences. If you would like to help, please contact Dr. William Hallahan at whallah3@naz.edu to donate.

No part of our annual dues is used to make these awards. We can only make an additional award with the donations made by members by November 30. I invite you to join me in contributing, however small, to the Rochester Academy of Science towards one more award this coming year.

Yours truly, Michael Grenier
RAS President

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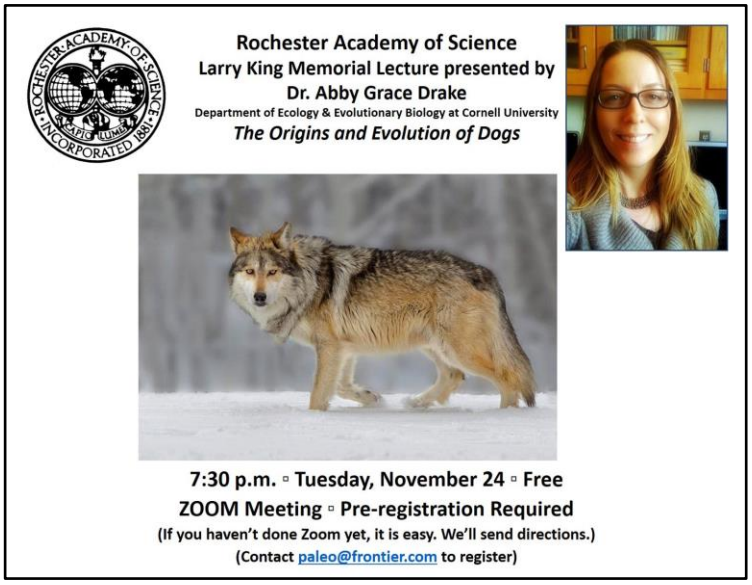

The Newest *Proceedings* of RAS Available

By Jutta Siefert Dudley,
Chair, Publications Committee

After a hiatus of eight years, the latest *Proceedings* of the Rochester Academy of Science was completed in late September. Working with me as editors to accomplish this months' long task were Helen Haller, William Hallahan and Timothy Tatakis. Volume 21 features four articles plus, post 2012, all the abstracts from the annual Fall Scientific Paper Sessions, yearly lists of officers and representatives to the RAS BOD, and Fellow citations.

The articles focus on natural environments in our region: a survey of remnant American chestnut trees in western NY and an update on that topic, a 15-year report of the frog populations in Mendon Ponds Park, and the climatic zones of western NYS. Two of these items were written by RAS members, William Hallahan and Timothy Tatakis. I invite you to read the interesting articles!

You can peruse the new volume on our website, www.rasny.org , where it joins all of the other issues dating back to volume 1 of 1890. The digitized *Proceedings* are also located at New York Heritage website: nyheritage.org/collections/proceedings-rochester-academy-science. At this site you may do advanced searching.

A limited number of paper copies of Volume 21 will be printed. Some will be placed in libraries and the rest are available for purchase. The University of Rochester archives the *Proceedings* and has copies in the Rush Rhees Library stacks. You will also find a collection in the library at the Farash Center for Observational Astronomy.

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Featured Article

Change Ringing: Music, Science, and Mathematics

By Helen Haller, RAS Secretary, and Chris Haller

Don't let the title put you off. Change ringers do not need to be talented musicians, scientists, mathematicians, or athletes! They are ordinary people who enjoy climbing tower stairs, working as a team, and pulling ropes to produce a distinctive, rich cascade of sound.

When hearing the sounds of bells ringing from a tower, the casual listener immediately recognizes that some bells play hymns and songs with melodies. Those bells are in what are called *carillons* or *chimes*. The bells do not swing, and their striking is controlled by one or two people, the carillonneurs or chimers. In contrast, bells hung for *full-circle change ringing* produce no recognizable tunes. Yet they are rung in disciplined and orderly sequences.

Change ringing requires special bells, special "music," and people who have been taught to ring. The human ingredient is critical because change ringing is very different from playing a carillon. It bears no resemblance to a single person at a keyboard. No computers or electronic devices do the ringing — change ringing depends on real bells, each swung in a complete circle by a single person: six bells — six people, eight bells — eight people, usually standing in a circle. This six-minute video showing our good friend Tom Farthing in the bell tower on the campus of the University of Chicago, is a delightful introduction to the basics of bells and the appeal they hold for many.

A Brief History

Chiming bells mounted on bearings (swinging them through a short arc using a rope and lever) goes well back into the Middle Ages, but it was not until the late 16th century that ringers developed the full wheel, which allowed enough control for orderly ringing. In 1668 Fabian Stedman published *Tintinnalogia: Or, The Art of Ringing*, containing the then available information on systematic ringing. The theory of change ringing set forth by Stedman has been refined in later years but remains essentially unchanged today. The British Isles have more than 5,000 such towers, and more than 40,000 ringers. Bells are very much a part of English life and culture, as you can see and hear in such videos as the BBC's "Bells on Sunday".

The British brought change ringing to the American colonies, installing rings of bells in Boston, Charleston, New York, and Philadelphia in the 18th century. Paul Revere joined the band of ringers at Old North Church when he was 15 years old. His familiarity with the tower and his association with its keeper later enabled him to use the tower for the lantern signals that directed his famous midnight ride. And here is a seven-minute video of the bells at Old North Church in Boston being rung a few years ago; Chris is on Bell #6.

After the Revolution, change ringing began to fade away in the United States. Throughout the nineteenth century new rings of bells were installed at scattered locations, but interest waned. A weak revival occurred around 1900 with several additional new rings. By mid-twentieth century only a few towers with rings of bells had active change-ringing *bands* (that is, people who could ring them). Two new rings in Canada in the 1950s and the ten-bell ring at Washington National Cathedral in 1964 sparked a revival that gathered momentum, and there are now over 50 operable rings in North America, most associated with churches. Over half have been installed since 1960. The one at the Church of the Ascension on the north side of Rochester, installed in 2015, is the most recent.

A 26-minute video of a tour of 15 bell towers in the northeastern USA was made by our friend Kemp Brinson just before we got our bells in Rochester. It introduces a lot of information about change ringing, as well as giving lovely looks at the 15 towers.

There are over 500 ringers in North America. Most belong to the North American Guild of Change Ringers (NAGCR, fondly called the NAG), which just held its 49th Annual General Meeting (virtually) in mid-October. The NAG website, www.nagcr.org, has much information, alas, some rather outdated. A new website should be unveiled by year's end.

The Bells

A *ring* of bells consists of three to twelve or more bronze bells. They are typically large, ranging in weight from a few hundred pounds to several tons. They are hung in stout frames that allow the bells to swing through 360°. Each bell/headstock combination is attached to a wooden wheel that has a handmade rope around its circumference; there is also a stay, below in the photo of Figure 1, that is part of the mechanism that prevents the bells from going "over the balance", that is, swinging through more than 360°. The mechanism achieves such exquisite balance that ten-year-olds and octogenarians can control even quite large bells easily. Each swinging bell requires one ringer's full attention.

Figure 1: Bell/Headstock Combination *(Helen Haller)*

(Continued on p. 3)

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Change Ringing

(Continued from p. 2)

The bells are arranged in a frame so their ropes hang in a circle in the ringing chamber below (see Figure 2 at right). Into each rope is woven a long tuft of brightly colored wool (called a *sally*), which marks where the ringer must catch the rope while ringing. (For the Rochester tower, we had the sallies made in the colors typical of lilacs, as befits our city.)

Bells are rung from the "up" position. With a pull of the rope, the bell comes off the balance, swings through a full circle, and stops at the balance in the up position again, but on the other side. With the next pull it swings back to the first position.

The Science

Bells are in effect pendulums, and the physics of such swinging objects governs their motion. Ringers must absorb the practical laws of momentum of bells and of rapidly rising and falling ropes into their muscles and bones. It takes about two seconds for a bell to travel from mouth up one way to mouth up the other way, which is why they cannot be used to play ordinary "melodic" music. But they can be made to follow one another in order, each ringing once before the first one rings again. Ringing bells in a precise relationship to one another is the essence of change ringing. Rung in order from the lightest, highest-pitched bell to the heaviest, lowest-pitched one, the bells strike in the sequence known as *rounds*, which ringers denote by a row of numbers:

1 2 3 4 5 6 7 8

To produce pleasing variations in the sound, bells are made to change places with adjacent bells in the row. Here is a simple example with which many *methods* begin:

1 2 3 4 5 6 7 8
2 1 4 3 6 5 8 7
2 4 1 6 3 8 5 7

These rows of numbers are the musical notation of change ringing. No bell moves more than one place from one row to the next, although more than one pair may change in the same row.

The Music

In order for ringing to be pleasant to listen to, and for ringers to be able to memorize and follow along in what they are doing (they do not read anything while ringing), ringers have a number of rules, which are strictly enforced in friendly cooperation.

First, the rhythm should not vary from row to row. The rhythm provides the steady framework within which the complex changes can be heard. Listen for two rows rung in precise tempo, followed by two more rows, and so on. The tiny pause between each pair of rows will help you determine which bell rings first, and no other pausing or substitution of ringers is allowed.

Second, listen for the bell that strikes the lowest note. This is called the *tenor* bell. In some methods it always strikes last, even when other bells are changing their position in the order. Listen for the highest bell, the *treble*, as it makes its way through the rows. Listen also for rows in which large bells alternate with small bells throughout the row. These are considered particularly musical, and composers strive to include as many such rows as possible.

Method Ringing

Ringers begin in *round*s, ring changes according to a plan, and return to rounds without repeating any row along the way. In order to ring a different row or change with each pull of the rope, ringers devised sequences of patterns called *methods*, orderly systems of changing pairs. These changes of place produce musical patterns, with the sounds of the bells weaving in and out as if they are folk dancing with each other. The pattern called *Plain Hunt Minor*, shown in Figure 3 on page 4, is a simple regular weave, and is the basis for many methods. Follow the path of any bell: you will notice that it moves one place at a time until it gets to one end of a row; it rings a second time in that first or last place and then moves in the other direction, one step at a time. After it has thus rung in both the *front* (leading) and the *back* (ringing last), it is back where it started, and you hear rounds again.

Figure 2: St. Mary's Church, Whitby UK

Plain Hunt Minor

Looking at the example in Figure 3, notice that the second row switches every pair of bells from rounds, all four pairs in the eight-bell example. If we applied the same transformation rule (**all pairs change**) again, we would be back in rounds, so we need another rule. The one shown is **middle pairs change**. We can apply these alternately until in a short time we return to rounds, but to continue beyond this simple weaving pattern, we need more rules for transformation. To keep the number of rules to a minimum, ringers allow only two more rules at most, specific to the method being rung, which are called ***bob*** and ***single***. With these tools, a plain hunt on any number of bells can be extended to cover all possible rows. But how many rows are possible? The greater the number of bells ringing, the longer they can ring without repeating a row. Consider the *permutations* of the number of bells ringing.

(Continued on p. 4)

Change Ringing

(Continued from p. 3)

Two bells can ring only two changes: 1,2 and 2,1 (1 x 2 = 2); three bells can ring 1,2,3; 1,3,2; 2,1,3; 2,3,1; 3,2,1, and 3,1,2 – which is six changes (since 1 x 2 x 3 = 6). Extending, five bells allow 120 different rows (1 x 2 x 3 x 4 x 5). The numbers increase rapidly. Six bells yield 720 different changes (1 x 2 x 3 x 4 x 5 x 6), seven bells 5,040. Your mathematical self may have noticed that the number of possible changes is equal to the factorial of the number of bells rung. Eight bells can be rung through 8!=40,320 changes, which has been accomplished less than a handful of times on light, fast bells with heroic volunteers willing to stand and ring for nearly 24 hours without a pause, as the rules require ringing from start to finish with no visible music, no row repeated, no rest breaks, and no substitutions.

How is this even possible for ordinary people to manage? To explain, we must delve further into finite mathematics, especially group theory. For centuries ringers aspired without success to ring all the possible changes on seven bells according to the rules, to perform a "*full peal*." Many times they failed because of faulty plans which were later discovered to be "false" because they repeated some of the rows. They puzzled out how to prove that so many changes could be rung "true," without repetition, and gradually developed a practical system of sets of changes "true and complete" within themselves and distinct from other such sets. This "*Q set*" theory became one of the real-world foundations of what is now called *group theory*. The set of changes possible after a bob is called cannot mathematically repeat any rows rung before the bob but is a nonoverlapping set.

Here is an 18-minute video that goes somewhat deeper into the mathematics and group theory, featuring Emily Russell, whom we have known since she was a child.

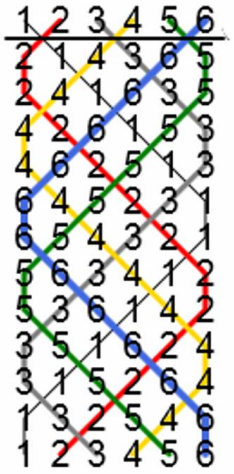

Figure 3: Plain Hunt Minor

But ringers calling the local congregation to Church on a Sunday morning did not usually need to think about such things. Many village bands could ring nothing but rounds, or (at most) "*call changes*" when each pair-change was shouted by a ringing master, and the rhythm had then to settle down before the next pair-change was called. Call changes developed into high art in the southwest corner of England, with careful plans and training resulting in delightfully steady and musical ringing performances. The rest of the change ringing world pursued "*scientific" ringing* as described above, but for the individual ringer it may be described as "*hunting a path*" among the other bells, based upon the Plain Hunt, and thinking at any given moment perhaps little more than "third place, second place, now lead and slow down, lead again and slow further, wait for someone to take you off lead and ring after them…."

This 6 ½-minute video, made at Washington National Cathedral, is a summary "crash course" in most of what we have said here, and includes some nifty visuals. As an aside, all the people shown are acquaintances or friends of ours; the ringing community is close-knit and very welcoming. You can explore further by looking at many YouTube videos on change ringing, by delving into areas of www.cccbr.org, the website of the overall body that governs change ringing, the Central Council of Church Bell Ringers, or by talking with one of us. When this unfortunate COVID-19 is no longer such a threat, we will be resuming ringing at Church of the Ascension. Visitors are always welcome at our practices, and Chris is willing to teach anybody who wants to learn.

To dig deeper into the mathematics of change ringing, see:

Change Ringing: A Connection Between Mathematics and Music, by Danica A. Nowosielski, Pi Mu Epsilon Journal, Vol 10, No. 7, (Fall 1997), pp. 532-539 .

Figure 4: Members of the Ancient Society of College Youths, London, ringing changes at the dedication of the bell tower of the National Cathedral, Washington, D.C., 1964.
(Stewart Brothers Photographers, Inc.)

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Events for November 2020

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

NOT MEETING IN NOVEMBER *Life Science, Field Trips, Herbarium Group, Astronomy Star Parties, Strasenburgh Observatory*

6 Fri: Astronomy Section Meeting

7:30 p.m. Speaker: Larry McHenry, member Kiski Astronomers of Pittsburg and Oil Regional Astronomical Society. Topic: The Herschels and Their Catalog: A review of William and Caroline Herschel's life, and their survey of deep-sky objects. Larry has successfully observed the Herschel-400, along with several hundred additional Herschel objects. He will share what he has learned regarding the Herschels, their accomplishments, and their classification system, along with Larry's personal observations of selected objects from all eight Herschel classes. Meeting held remotely via BigBlueButton. Meeting details will be shared via email. Contact: Mark Minarich at mminaric@rochester.rr.com.

10 Tue: Fossil Section Meeting

7:30 p.m. This meeting is on the ***SECOND Tuesday*** due to election on November 3. The meeting will feature a presentation by Danielle Dufault, research associate and in-house scientific illustrator at the Royal Ontario Museum, Toronto. She will discuss ROM finds in the world-famous Middle Cambrian Burgess Shale and her illustrations both of specimens and life restorations working directly with the scientists researching these creatures, as well as other fossils on which she has worked. Meeting will be held remotely via ZOOM and is open to RAS Members and guests. For meeting details and logon info contact Michael Grenier at paleo@frontier.com

11 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.

14 Sat: Astronomy Section Open House and Member Viewing at the Farash Center Observatory

Noon till 4 or later observing if clear skies. 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.

17 Tue: Mineral Virtual Meeting

7:00 p.m. ZOOM meeting. Speaker is Geologist Dr. Karen Harpp of Colgate University. Topic: the evolution of the Galapagos Islands. Members will receive information by email. Contact: J. Dudley at juttasd@aol.com.

18 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.

24 Tuesday: RAS Larry King Memorial Lecture

7:30 p.m. Speaker: Dr. Abby Grace Drake from the Department of Ecology and Evolutionary Biology at Cornell University. Topic: The Origins and Evolution of Dogs. 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.

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Watercolor tracing made by archaeologist Henri Breuil from a cave painting of a wolf-like canid, Font-de-Gaume, France dated 19,000 years ago. *(Wiki – Megafaunal Wolf)*

This Thanksgiving, Thursday November 26th, let's offer thanks to the Aztecs for giving the world one of its favorite fowl.

Aztec Illustration from the Florentine Codex featuring a Turkey

Rochester Area Research in Review

Oct 15, 2020 UR Quantum engines? Entanglement as fuel?

Oct 7, 2020 UB Why some friends make you feel more supported than others

Oct 7, 2020 Cornell Data tool helps users manage water resources, protect infrastructure

Oct 5, 2020 URMC Nobel Prize in Physiology or Medicine 2020: Discovery of Hepatitis C virus

Oct 1, 2020 URMC Cells sacrifice themselves to boost immune response to viruses

Sept 30, 2020 UB Greenland is on track to lose ice faster than in any century over 12,000 years

Sept 30, Binghamton Screen time can change visual perception -- and that's not necessarily bad

Sept 29, 2020 URMC Can the common cold help protect you from COVID-19?

Sept 17, 2020 Cornell Algorithm boosts efficiency, nutrition for food bank ops

Sept 16, 2020 Binghamton Better material for wearable biosensors

Sept 10, 2020 Cornell Vibration device makes homes 'smart' by tracking appliances

Sept 10, 2020 URMC Researchers draw more links between vaping, smoking, young people, and coronavirus

Sept 8, 2020 Cornell Lost frogs rediscovered with environmental DNA

Citizen-Science Opportunities in the Rochester Area

SUNY Empire State College Citizen Science

Citizen Science with WXXI

Rochester Daytripper Citizen Science

Seneca Park Zoo: Biosurveys and Citizen Science

Zooniverse Etch a Cell Project

ROC March for Science - Citizen Science

Rochester Museum and Science Scenter - Citizen Scientist programs

NYSERDA Climate Change Citizen Science

Helmer Nature Center- Virtual Earth Day Citizen Science

43-Year Backyard Bird Citizen Science Project

Audubon Society Christmas Bird Count

National Girls Cooperative Project - Science Action

Rochester Academy of Science Fossil Section—An Example of Citizen Scientists and Their Role in Paleontology

Strengthening citizen science as a tool against invasive species in the New York Finger Lakes Region

RIT Hackathon - Space Apps Challange

The Big Butterfly Count is an annual citizen science survey organised by Butterfly Conservation

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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