Rochester Academy of Science

BULLETIN

"An organization of people in the Natural Sciences"

October 2020 - Vol. 74, #9

President's Message

Although we had been forced to cancel our Fall Scientific Paper Session, we will still hold our annual Larry King Memorial lecture as a Zoom virtual meeting. You may remember that the speaker for our canceled April Annual Meeting was to be Laura Helft, Ph.D. She is one of 11 co-authors of the paper, "Decline of the North American Avifauna," which caused a great stir when published last October. See next month's Bulletin for a weeknight reschedule date when she will share her work concerning the dramatic loss of birds in North America.

I am also pleased to tell you that despite the challenges which local colleges are facing, the Rochester Academy of Science has already announced to the upstate academic community that it will again offer its annual Student Grant Program to support undergraduate scientific research in the natural sciences. I hope that you have enjoyed the Bulletin articles this past year summarizing research projects to which we made supporting grants through this program. We are concluding this with the result from Erika Delles' bird migration study within this issue.

These grants are recognized as particularly important by the students' colleges. As an example, take a look a the Rochester Institute of Technology's publicity promoting the award made to Erika Delles. https://www.rit.edu/spotlights/rit-biology-major-awarded-student-research-grant-rochester-academy-science

Our $500 grant is recognized as a major award. These are cited as accomplishments by colleges demonstrating the quality of their academic offerings and they become a part of the students' résumés in applying for graduate schools. These awards encourage the study of the natural sciences.

I think it is important that you understand that no part of your annual dues is used in making these awards. They are funded by endowment funds donated for this purpose, supplemented by individual one-time donations or by section sponsorships. This limits our budget for these awards. If you agree with me that this program is important, I invite you to join me in making a donation, however small, to the Rochester Academy of Science specifically towards making one additional award this coming year. Please contact Dr. William Hallahan at whallah3@naz.edu to donate.

Yours truly, Michael Grenier
RAS President

***

Undergraduate Student Research

2019-2020 Grant First Place Awardee:

Erica Delles, Rochester Institute of Technology. *Physiological Condition in Relation to Molecular Sex of Thrushes During Migration Stopover*. Sponsor: Susan Smith Pagano, Ph.D.

This past April, we summarized in the Bulletin the top submission for the annual RAS Student Grants. Erica recently submitted her final report to us, and we are pleased to publish the results. The goal of this study was to optimize a working protocol for determining the molecular sex of *Catharus* thrushes, and then explore patterns in stopover physiology, body condition, and chronic stress in these birds during fall migration on the south shore of Lake Ontario.

Erica Delles, RIT

Patterns in Molecular Sex of *Catharus* thrushes at Braddock Bay Bird Observatory

Table 1 below shows the percentages of males compared to females for the two years that samples were collected (2017 and 2018) as well as for the three species sampled. Only Hermit Thrush were analyzed for molecular sex in 2017. The species codes HETH, GCTH, and SWTH correspond to Hermit Thrush, Gray-Cheeked Thrush, and Swainson's Thrush, respectively. The sample size for each year/species combination is noted in parentheses after the percentages.

(Continued on p.2)

(Continued from p.1)

Follow-up analysis of the timing of capture of males and females using two-sample t-tests and Analysis of variance (ANOVA) did not reveal any significant differences in the average capture date between these two groups using the overall data above, or by species. This suggests that this predominately hatching year population of young birds, on their first migration, are not staggered in their timing based on sex, which is important new knowledge for this area.

Patterns in body condition related to molecular sex

Our data indicates that the average body condition index for females as compared to males using the overall data is not significantly different as determined by two-sample t-test. This same pattern was determined when the data was separated by species and analyzed with ANOVA. Thus, it can be assumed that molecular sex and body condition during migration are not necessarily related for the study species.

As shown in Figure 1, there was a trend toward lower average heterophil to lymphocyte ratio in females compared to males, though this was not statistically significant. We also considered possible covariates that may have been influencing H/L, and we corrected for time of capture and handling time with Analysis of Covariance (ANCOVA). However, there were still no significant differences found between the sexes, or among the three species in H/L, suggesting similar levels of stress.

In Figure 2, the average triglyceride and uric acid values are depicted and compared for females (F) to males (M). These values were transformed by log base 10 to improve normality, and the average value was found, as depicted in the legend "mean (Log(Trig))." The uric acid values were transformed by the cube root of each value to improve normality, then the average value was found, which is depicted in the legend as "mean (CR(Uric Acid))." As shown,

	Year		Species			Overall
Molecular Sex	2017	2018	HETH	GCTH	SWTH	
Male	35.71% (5)	58.62% (15)	50% (12)	66.67% (6)	25% (2)	48.84% (20)
Female	64.28% (9)	41.38% (12)	50% (12)	33.33% (3)	75% (6)	51.16% (21)

Table 1: Patterns in molecular sex of *Catharus* thrushes at Braddock Bay Bird Observatory

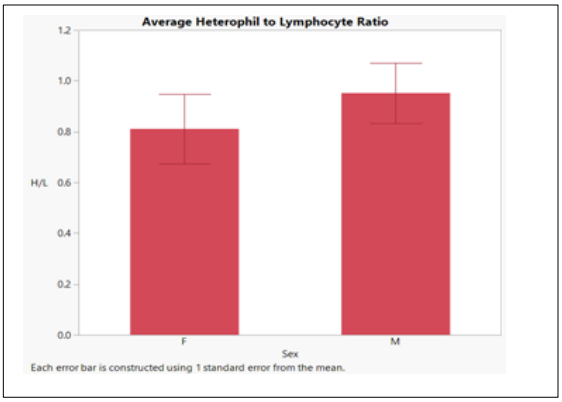

Figure 1: Average heterophil to lymphocyte ratio (H/L) related to molecular sex, where M = male by molecular sex, F = female by molecular sex.

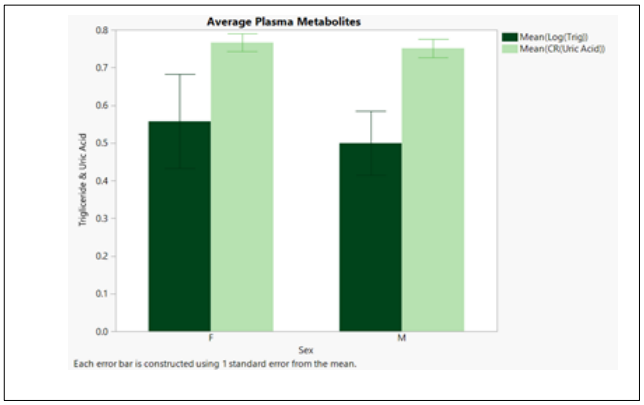

Figure 2: Average plasma triglyceride (mM) and uric acid (mM) concentrations in relation to sex.

there is no significant difference between the uric acid values for females as compared to males. The same is true of the triglyceride values. We also considered important covariates that may influence plasma metabolite concentrations (Guglielmo et al. 2005). After correcting for time of day of capture using ANCOVA, there were still no significant differences between the sexes in plasma triglyceride or uric acid.

Conclusions

There are many factors that contribute to stress and physiological condition of migratory birds like the thrush species studied in this project. It is still unclear whether sex may be a contributing factor to either of these. Based on the data collected, we did not determine a statistically significant difference between males and females for any of the metrics. However, there did seem to be a trend in females having a lower heterophil to lymphocyte ratio. This could indicate that the females were under slightly less stress than the males at the time of sampling. It is crucial for more work to be done in this area especially considering different factors such as including spring migration and birds of different ages. Follow-up work will attempt to increase sample size in order to clarify the trends discovered here, and also extend the work to examine spring migration in hopes of determining whether older birds arriving to breeding grounds have any differences in physiology or stopover behavior that may be related to their sex.

***

Featured Article

July 2020: Three Mars Missions Launched.

by Michael W. Richmond, School of Physics and Astronomy, RIT.

During the month of July 2020, three different countries launched spacecraft toward the Red Planet. I'll take a brief look at each mission: what sort of instruments does it carry, and what questions is it intended to answer? But first, it might seem a bit strange that after a gap of two years since the previous mission (Mars Insight), three rockets should blast off within just a couple of weeks. Coincidence, or was there some reason for this unseemly rush?

The answer is "yes." There *was* a good reason for sending spaceships to Mars in July. Because the Earth and Mars orbit the Sun at different speeds, the Earth is alternately catching up to Mars, and then leaving it behind. You might think that the best time to launch a probe is when the two planets are closest together, as Earth passes Mars, but that fails to account for one factor: **time**. Even at its closest approach, Mars is at least 55 million km from the Earth. Our fastest rockets would take months to make that trip—and during those months, the planets move farther apart.

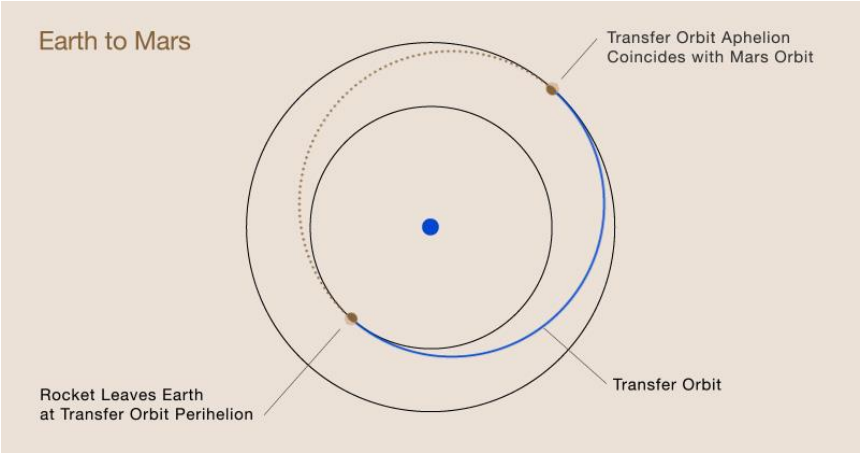

Figure 1: Hohmann Transfer Orbit
(NASA)

It turns out that the most fuel-efficient way to send a spaceship from one planet to another is to use what is known as a **Hohmann transfer orbit.** The idea is to launch forward from Earth into a gently curving trajectory which will move outward from the Sun, but slow down as it approaches the distance of Mars; slow down just enough so that its aphelion (most distant portion of its orbit from the Sun) occurs at exactly the distance of Mars' orbit. If one chooses the launch time just right, then at the moment that the spaceship reaches Mars' orbit, Mars will be right there, waiting for it. (See Figure 1, above).

So this "Hohmann transfer orbit" is a very special ellipse: its innermost point (perihelion) has the same distance from the Sun as the Earth's orbit, and its outermost point (aphelion) has the same distance from the Sun as Mars' orbit. One of the great things about this orbit is that when the ship reaches Mars, it will be travelling at the same speed as Mars, and in the same direction. That means the ship will require only a small amount of fuel to put itself into an orbit around Mars.

This Hohmann transfer orbit from Earth to Mars takes about 258 days. There are only certain moments when the two planets are located in just the right positions of their orbits that a trip of this duration will leave one and reach the other. These "launch windows" occur at roughly two-year intervals. The last one occurred in May 2018, when NASA launched the Mars Insight mission; and the current one has just ended. Now, let's examine each of the three missions in turn.

HOPE (United Arab Emirates)

The first mission to be launched this year was based in the United Arab Emirates; it is the first interplanetary probe for this country. The mission is quite an international collaboration: the United Arab Emirates Space Agency, the University of Colorado at Boulder, and the University of California at Berkeley constructed the spacecraft and its instruments, while the Japanese Space Agency provided the booster rocket which lifted it off the Earth on July 19, 2020. (See Figure 2 at left).

Figure 2: HOPE
(UAE Space Agency)

(Continued on p.4)

(Continued from p.3)

This probe is the simplest of the bunch launched in July. It consists of a single craft which will remain in orbit around Mars. The orbiter carries three main instruments, which will study properties of the Martian atmosphere:

EMIRS, an infrared spectrometer, which will concentrate on the surface and lower atmosphere of Mars. It will measure dust and water vapor in the atmosphere, as well as the temperature and thermal emission from the surface. It measures light with wavelengths between 6 and 40 microns.

EXI, an optical imaging camera, takes pictures in the near-ultraviolet and optical, at wavelengths between 220 and 635 nanometers. Its goals are to monitor dust, water-ice clouds, and ozone over the full seasonal cycle of the Martian year. Its images won't provide particular high spatial resolution, as each pixel will cover roughly 2.3 km on a side.

EMUS, an ultraviolet spectrometer, dedicated to the upper reaches of the Martian atmosphere. It will measure absorption and emission lines at wavelengths between 100 and 170 nm, including features due to hydrogen, carbon, argon, oxygen, and carbon monoxide.

Figure 3: Tianwen-1
(CGTN)

If all goes well, HOPE will arrive at Mars in February 2021.

Tianwen-1 (China)

On July 21, 2020, four days after the UAE launched HOPE, the China National Space Agency (CNSA) sent its own interplanetary probe into space. Tianwen-1 is an ambitious project, especially for China's first attempt at reaching Mars. The craft consists of both an orbiter and a lander, each of which contain a number of scientific instruments. (See Figure 3 above).

The orbiting unit has a wide variety of instruments: two cameras for imaging the surface, one with a resolution as fine as 2 meters per pixel; a magnetometer, spectrometer and surface radar, to investigate surface properties in other ways; and a pair of instruments to study the particles and magnetic fields sharing the craft's orbit around the planet.

The lander will detach from the orbiter and head to the surface, using three different methods to slow its fall. First, as it enters the atmosphere, a heat shield will slow its progress and protect the rest of the probe from high temperatures. Second, a parachute will pop open in the upper atmosphere, further slowing the descent to about 95 meters per second. Finally, a set of retrorockets will fire to slow the ship further, avoid hazards on the ground (if necessary), and lower the craft to the ground.

The target area is a region known as "Utopia Planitia" which lies within an ancient and very large impact crater. The American Viking-2 craft landed there back in 1976 and sent back a picture showing a very thin coating of water ice covering the ground early one morning. Will Tianwen-1 find hoarfrost, too?

If all goes well, a small rover will roll out of the spaceship and travel across the surface.

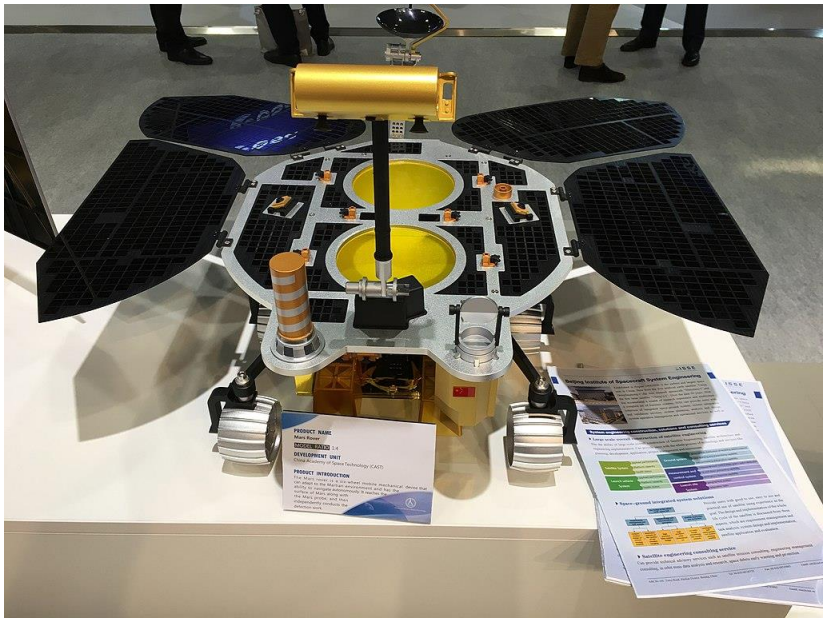

Figure 4: Tianwen-1's Rover Mockup
(Wikimedia and Pablo de Leon)

(Continued on p.5)

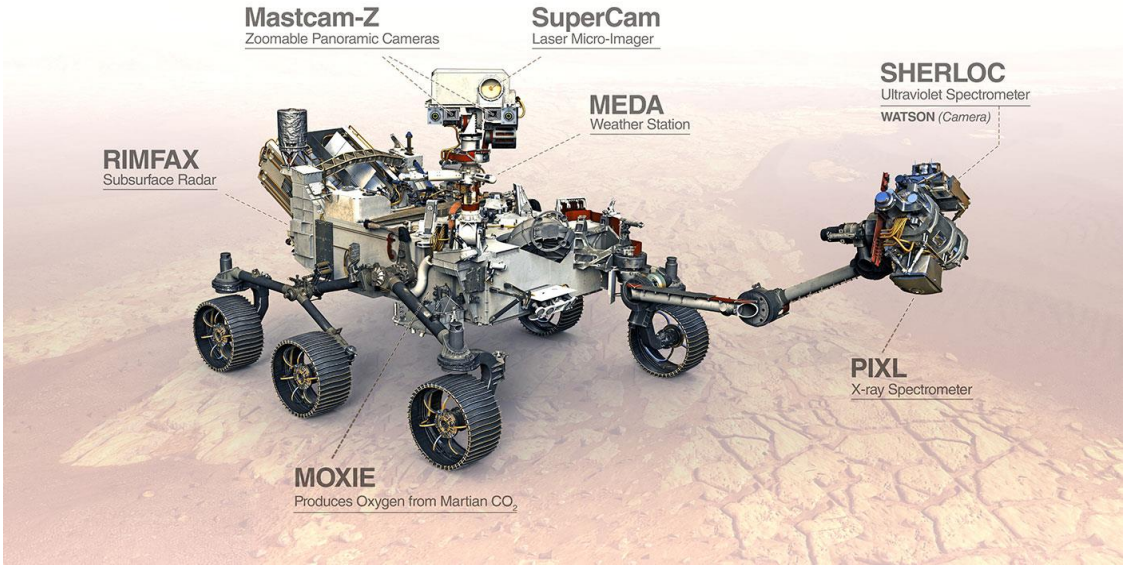

Figure 5: Perseverance Rover
(NASA)

(Continued from p.4)

Note the solar panels in Figure 4, on the bottom of page 4, which supply all its power.

The rover is equipped with several cameras, ground-penetrating radar which can reach 100 meters below the surface, meteorological instruments, and a magnetometer.

The baseline lifetime of the rover is 90 days, but the orbiter should last much longer.

Mars 2020 (USA)

The final entry in the Mars sweepstakes is NASA's "Mars 2020" mission, which was shot off the Earth by an Atlas V rocket on July 30. Like Tianwen-1, this project will send a rover to the surface of Mars; but unlike Tianwen-1, it has no accompanying orbiter—just the rover.

In order to bring the unit safely down to the surface, NASA is returning to the "skycrane" method it used successfully a decade ago in the Mars Science Laboratory (Curiosity) mission. The Perseverance rover is powered by a Multi-Mission Radioisotope Thermoelectric Generator (MMRTG), which employs the temperature difference between a warm chunk of plutonium dioxide and the cold outside air to generate electricity. The radioactive decay should produce enough power to keep the rover going for more than ten years.

Perseverance carries a large suite of scientific instruments. In addition to several cameras and a subsurface radar unit, there are an X-ray spectrometer and an ultraviolet spectrometer which can reveal the elemental composition of rocks and dust on the surface.

One of the most intriguing features of Mars 2020 is its helicopter. This is the first time NASA has sent an aircraft to fly in the atmosphere of another planet. Its battery can only hold enough energy to power a single flight, lasting up to 90 seconds, each day, but that should be enough to send it several hundred meters each time.

What sort of features will it find?

For further information contact Michael Richmond's Website at: http://spiff.rit.edu/richmond/asras/mars_probes/mars_probes.html

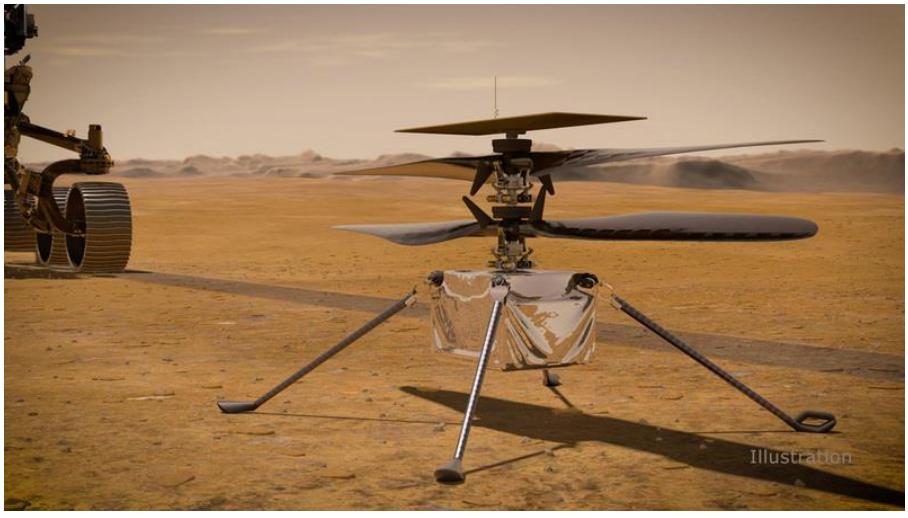

Figure 6: Mars Helicopter
(NASA/JPL-Caltech)

***

Professional-Amateur Collaboration

Spectroscopy at the Al Ureles Observatory

by Leo Kellett RAS, ASRAS
2018 Astronomer of the Year

Members of the Astronomy Section have been participating in data collection and submission to Professional and Amateur astronomy organizations for several years. Images tracking comet morphology and photometry of variable stars were some early activities. Recently the group has installed Leo Kellett's spectroscope onto the Ureles Observatory's Meade LX-200 12 in. Schmidt-Cassegrain telescope on Dave Vogel's mount, and has begun to collect spectroscopic data for stars 28 Cygni and P Cygni in the constellation Cygnus.

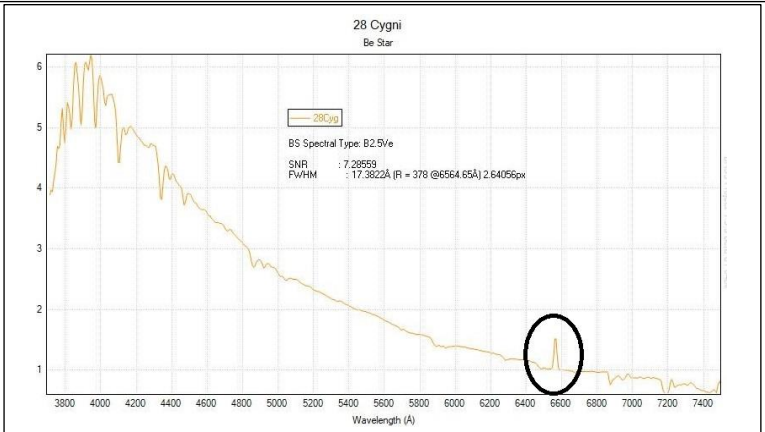

Figure 2: Spectrum of 28 Cygni using Alpy 600

The Alpy is a transmission grating with 600 lines/mm. It is a slit based instrument, but its low-res grating limits its resolution.

Figure 2 above show the spectrograph of 28 Cygni using the Alpy 600 spectroscope. While this showed the star has an emission line at the H-alpha location the resolution is not high enough to see any detail.

The next step was to set up the JTW Spectro L200 which has a reflection grating at 1800 lines/mm. The results are much more revealing, as can be seen by the results in Figure 3, which clearly shows the two emission peaks superimposed on the absorption line at H-alpha. The peaks are caused by doppler shift of the emission from ionized Hydrogen atoms in the disk surrounding the star. The published rotational velocity of 28 Cygni is 320 km/s (Ref 1). The dip and its depth are caused by the inclination of the system to the line of sight exposing the absorption at the star's photosphere. The resolution and signal to noise are within a range suitable for submission to the Be Star Database for possible use by other researchers studying this star's behavior. The submission to this data base is grouped into resolution levels and the resolution of this result is roughly R=3000 which would be at the low-resolution end of the submissions.

Another spectrum recorded the next night is of the luminous blue variable star P-Cygni, which gives its name to a type of spectroscopic feature called a P Cygni profile, where the presence of both absorption and emission in the

(Continued on p.8)

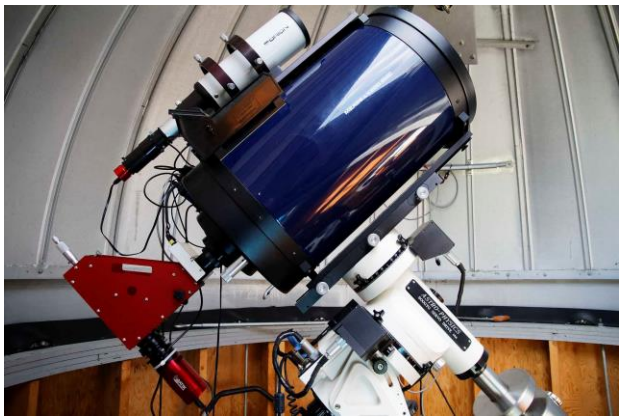
Figure 1: Ureles Observatory telescope outfitted with L200 Littrow Spectroscope (Leo Kellett), Astrophysics AP 900 GE Mount (Dave Vogel) and ASRAS Orion ST80 spotter scope.

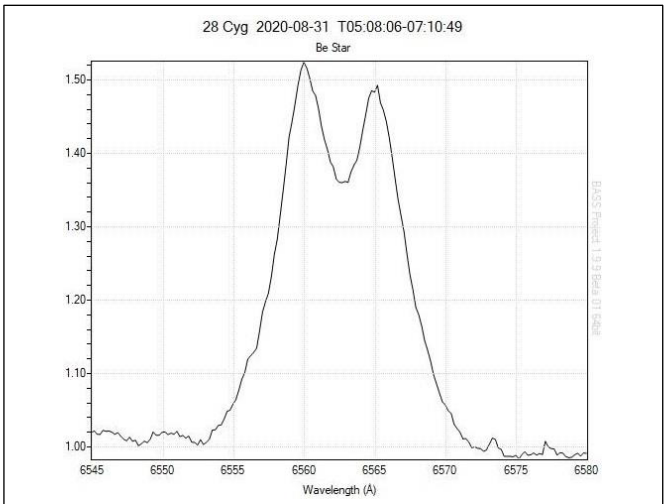

Figure 3: Spectrum of 28 Cygni using Spectro L200

Figure 1 shows the equipment setup of the Ureles Observatory outfitted for astronomical spectroscopy. What spectroscopy adds to a telescope is the ability to measure chemical composition, temperature, density, mass, distance, luminosity, and relative motion using Doppler shift.

ASRAS Spectroscopy efforts began with data collected on the Be star 28 Cygni using a low-resolution spectroscope, the Sheylak Alpy 600.

Events for October 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 OCTOBER

Life Science Field Trips
Herbarium Group
Astronomy Star Parties
Strasenburgh Observatory

2 Fri: Astronomy Section Meeting

7:30 p.m. Meeting held remotely via BigBlueButton. Speaker: Scott Keyon of the Harvard Center for Astrophysics. Topic: "Pluto Strikes Back!" Meeting details will be shared via email. Contact: Mark Minarich at mminaric@rochester.rr.com.

6 Tue: Fossil Section Meeting

7:00 p.m. The meeting will feature a presentation by Bill and Kris Parsons on their work over the past 25 years in the Early Cretaceous of Montana. Besides dinosaurs, recent finds have included turtles, crocodiles, and mammals. Meeting will be held remotely via ZOOM. RAS Members must register for the meeting with Michael Grenier at paleo@frontier.com. Meeting details will be shared only to registered attendees via email. More information will be in the October issue of the Fossil Section Newsletter *Fossiletter*, which will be sent on request to any RAS member.

7 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.

17 Sat: Astronomy Section Open House 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 Sat: Anthropology Section Field Trip

11:00 a.m. -3:00 p.m. The Anthropology Section will be celebrating International Archaeology Day at the RMSC. Fun for the whole family with giveaways, activities, and scavenger hunts. Contact Alex Smith at archaeologyrocheter@gmail.com.

18 Sun: Anthropology Section Field Trip

9:00 a.m. - 5:45 p.m. Family Archaeology Day at the Cumming Nature Center. Join a real excavation of 19th century life! Slots are limited. Contact Alex Smith at archaeologyrochester@gmail.com or go to https://rmsc.org/cumming-nature-center/nature-center-programs-and-events.

20 Tue: Mineral Virtual Meeting

7 p.m. ZOOM meeting. Dr. Dori Farthing will introduce us to mineral evolution, a new hypothesis that proposes minerals increased in number and complexity as the Earth changed over time. Members will receive information by email.
Contact: J. Dudley at jutasd@aol.com.

21 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.

Cucurbita pepo aka pumpkins
(Photo credit: visitrochester.com)

***

Australian 2020 Citizen Science Stamps

(Lynn's Stamp News)

According to the Australian Citizen Science Association, "Citizen science involves public participation and collaboration in scientific research with the aim to increase scientific knowledge."

With the help of that association, Australia Post selected the four projects to be represented on the stamps: QuestaGame, Ngukurr Wi Stadi Bla Kantri (We Study the Country), Butterflies Australia, and Zika Mozzie Seeker.

Election Results of July 17, 2020

President: Michael Grenier
Vice President: Daniel Krisher
Secretary: Helen Haller, Ph.D.
Treasurer: William Hallahan, Ph.D.
Director 3-year term: Karen Wolf
Director 3-year term: Douglas Kostyk
Director 1-year term: Michael Richmond, Ph.D.

Positions begin immediately.

Spectroscopy at the Al Ureles Observatory

(Continued from p. 6)

profile of the same spectral line indicates the existence of a gaseous envelope expanding away from the star. The emission line arises from a dense stellar wind near to the star, while the blueshifted absorption lobe is created where the radiation passes through circumstellar material rapidly expanding in the direction of the observer.

This is as far as we have gotten with the activity. Planned future work will be aimed at increased resolution and improving the signal to noise ratio of our measurements, which would allow ASRAS to be contributors to the American Association of Variable Star Observers (AAVSO) as well as to the Be Star Spectra Database Catalog of spectra obtained by professional and amateur astronomers of Be, Ae/Be stars, and B[e] supergiants, maintained by the LESIA laboratory of the Observatoire de Paris-Meudon.

References:

Baade, D.; et al. (March 2018), "Short-term variability and mass loss in Be stars. III. BRITE and SMEI satellite photometry of 28 Cygni", Astronomy & Astrophysics, **610.**

***

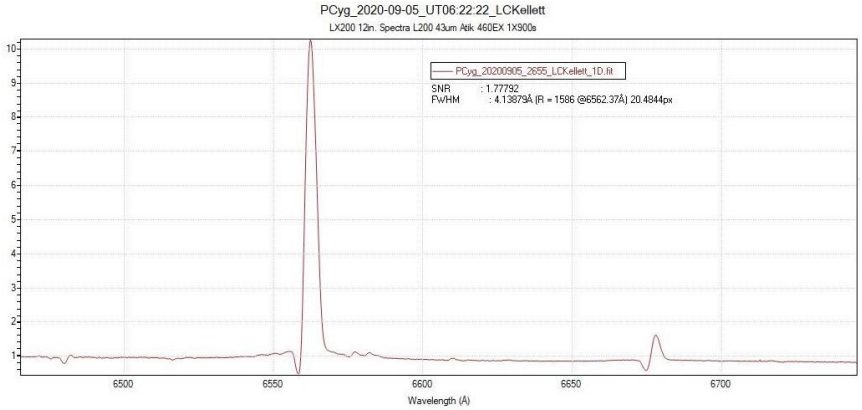

Figure 3: Spectrum of P Cygni using Spectro L200

Rochester Research in Review

Sept 10, 2020 RIT How deaf and hearing people watch sign language...

Sept 3, 2020 RIT New mathematical method shows how climate change led to fall of ancient civilization

Sept 2, 2020 URMC Circadian rhythms help guide waste from brain

Aug 28, 2020 Fossil trees on Peru's Central Andean Plateau tell a tale of dramatic environmental change

Aug 10, 2020 URMC Biology blurs line between sexes, behaviors

July 24, 2020 UR Project creates more powerful, versatile ultrafast laser pulse

June 18, 2020 Joel Kastner RIT. Hubble provides holistic view of stars gone haywire

June 18, 2020 URMC COVID-19 toll in nursing homes linked to staffing levels and quality

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.

ROCHESTER ACADEMY OF SCIENCE CONTACTS

		(585) home // work
Michael Grenier	President	671-8738
Dan Krisher	VP & Fossil	698-3147 (c)
Jutta Dudley	Past President	385-2368
Helen D. Haller	Secretary	387-9570
William Hallahan	Treasurer	624-1628
Alex Smith	Anthropology	750-3329 (c)
David Bishop	Astronomy	329-8831
Lawrence Hirsch	Life Sciences	429-6199
Stephen Busschaert	Mineral	351-7633 (c)
Michael Richmond	Director '21	586-7432
Tim Tatakis	Director '21	292-2332 (w)
Tony Golumbeck	Director '22	(315) 789-4374
Jeff Gutterman	Director '22	392-8299// 748-2272 (c)
Douglas Kostyk	Director '23	943-3419
Karen Wolf	Director '23	670-9709// 273-4500 (w)
Elizabeth Pixley	Herbarium	334-0977
Jutta Dudley	Publications	385-2368
Ted Lechman	Bulletin Editor	490-1132
William Hallahan	Student Grants	624-1628
Paul Dudley	Website	385-2368