Many of you will recall using a Brunton compass during your time at F&M. The use of a Brunton is, of course, still an essential skill required of all our geoscience majors and the Department has always kept a supply of compasses for students to use in their courses, independent studies, and for field camp. It might come as a surprise, however, that our current Bruntons are the originals purchased in the 1960’s and 1970’s. Over the years we have refurbished and maintained them, but recently Emily Wilson found out that the Brunton company will no longer maintain our Brunton compasses – they are too old!! In light of this situation, we are in the process of replacing these crucial items with new versions. The challenge is the cost – over $600 per Brunton. We would love to avoid dipping too deeply into our operating budget to replace these items! Jim Humphreville ’50 recently donated funds to the Department for the purchase of teaching-related materials and we will use some of those funds to purchase the first of our replacement Bruntons. In recognition of this we will engrave Jim’s name on a new Brunton so that the next generation of F&M geoscientists can appreciate the important role our alumni have in making F&M’s ENE Department the best! If you are interested in funding a new Brunton, please contact Andy de Wet (adewet@fandm.edu) or Chris Williams (cwilliams@fandm.edu). We would be delighted to engrave your name on one of our new Bruntons!
Dear colleagues, alumni and friends,

Fall 2017 has been another productive time for the Department. We welcomed a new faculty member to the department – Assistant Professor of Environmental Studies Eric Hirsch. Eric’s expertise is in the area of environmental anthropology and his research focuses on the relationship between environmental change, economic development, and indigenous livelihoods. He joins two other tenure track faculty in Environmental Studies – Elizabeth De Santo and Eve Bratman.

The Department sponsored Amory Lovins as a Mueller Fellow to the campus in the Fall. Amory visited many classes and gave the Common Hour presentation entitled “Astonishing Energy Futures and the Future of Global Change”. Later in the semester, Assistant Professor of Environmental Studies Elizabeth De Santo was nominated by students to give the first all-campus Common Hour “Now” presentation. The title of her talk was “Unraveling Teddy Roosevelt’s Legacy: America’s National Monuments Under Threat” (see page 8 for more information about these presentations). Roger Thomas, John Williamson Nevin Professor of Geosciences, Emeritus, was recently named as a fellow of the AAAS (see page 12). Well done Roger.

After many years of having the seismometer located on the F&M campus, we relocated it to the F&M - Millport Conservancy property in Lititz (see page 8). The F&M seismometer is part of the Lamont-Doherty Cooperative Seismographic Network (LCSN). The Millport location has much less seismic noise and will enhance the spatial distribution of the LCSN.

The Department has also created a 3D visualization lab that includes computers, drones and 3-D printing capabilities. We recently purchased several drones partly through the support of the Patton Geophysics fund. The facility is available to members of the department for spatial imaging, mapping and 3-D modeling and visualization. Exciting new 3-D visualization techniques are being incorporated into various courses, including GIS and geomorphology.

Bob Walter, with the help of Eric Schwarz (Exelon Corporation), set up a new gamma spectroscopy laboratory in the Department (see page 9 for details). This lab adds to the already excellent analytical capabilities of the Department and allows our students to get additional hands-on laboratory experience as part of course work and their independent research.

The Department has also initiated a major effort to build on its already inclusive environment. Carol de Wet is currently the chair of the GSA Diversity Committee and she organized a Pardee Symposium at the GSA Annual Meeting in October that focused on diversity issues in the Geosciences (see page 8). Carol and Paul Harnik encouraged the Department to think deliberately about staying at the forefront of providing our students, staff and faculty with a welcome and inclusive environment. Paul, with the assistance of Emily Wilson ’11, created an off-campus code-of-conduct document for all members of the Department. We have decided to include the document in all our syllabi and are requiring our students to sign the code for all off-campus activities. The document outlines acceptable and unacceptable behavior and holds our students and all participants to the highest standards of behavior, as well as providing information and resources if a negative situation arises. Tim Bechtel instructed a student Directed Reading course focusing on diversity in the geosciences, and several members of the faculty met with students from the course to discuss ways that we can make sure our department is forward thinking and welcoming to all students. This initial conversation will be expanded in the Spring Semester as we move to implement some of the ideas from the students.

One of the things we have already done is to increase financial assistance to our majors to cover the cost of attending a geology field course. With an increasingly diverse student body, and the significant increase in field camp tuition, we recognize that if we maintain our field camp requirement for the Geoscience major we need to ease the burden of this additional expense for our students. The Department discussed dropping this requirement but we firmly believe that there is great value for our students to go to field camp. The increase in financial support has been achieved through a combination of departmental funds and the generous support of the Geoscience Founders Society. We are extremely grateful to all alumni who have given so generously to the Founders Society and the Department over the years. This support has made a huge difference in what we can achieve in the Department and we encourage everyone to give whatever they feel comfortable sharing to keep F&M’s Department of Earth and Environment vibrant and strong!

As always, we encourage our alums to visit the Department at any time and to share their experiences and interact with the members of the Department. Have a wonderful 2018!

Andy de Wet, Chair of the Department

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**ENE Alumni Happy Hour in DC**

In December 2017, Prof. De Santo met up with a few ENE alumni in Washington DC for an impromptu happy hour. In attendance were Julia Fiala ’13, Evan Frye ’09, Larissa Kehne ’16, Ben Martin ’16, Emi Okikawa ’17, and Matt Steinwurtzel ’16. Unfortunately, due to the weather and conflicts with other holiday events, a few people couldn’t make it at the last minute, but we hope that this group will grow and continue to meet. If you are in the DC area and would like to join the email list, please contact Prof. De Santo (edesanto@fandm.edu); she’ll be happy to put you in touch with other alumni. We’ll do one in Philadelphia soon, too! In the meantime, if you’re on LinkedIn, please join our group “F&M Earth and Environment Alumni and Friends” for networking and so we can see where you all are!
Tim Bechtel (Director of F&M Science Outreach and Adjunct Asst. Professor of Geosciences)

Summer involved co-teaching karst hydrogeology field camp in the Allgäu Alps with friends from Karlsruhe Institute of Technology, and meetings in Eastern Ukraine to advance our NATO Science for Peace and Security sponsored humanitarian de-mining project. I am delighted that F&M Physics and Astronomy Professor Froncy Crawford and his student Gabriella Sallai are joining this research team. A late August research expedition into the Mammoth Cave system put us right on the path of totality for the 2017 total eclipse. Felicia recorded a spectacular time lapse image through a homemade solar filter on a 700 mm lens with doubler. From late summer through fall, Kevin Cerna ‘18 and Ryan Ulrich ‘18 have been working with me on high resolution microgravity measurements, and Morgan Torstenson ‘18 has been compiling a global mapping of submarine groundwater discharge vents. We are grateful to all the F&M alums who have provided locations and contacts to assist her effort. I am especially proud of a group of senior science majors (including Danielle Sang, Shelby Sawyer, and Morgan Torstenson from Earth & Environment) who spent the fall looking at ways to enhance diversity and inclusivity in the Natural Sciences. With Kevin Cerna, they will continue to work on this by participating in the Department Working Group.

Eve Bratman

My 2017 teaching highlights included the Senior Seminar in Environmental Studies and Sciences, where I developed community-engaged research projects for teams of students to gain hands-on experience with data collection and analysis while furthering the work of several local organizations, including the Common Wheel, Assets-PA, Lancaster Solid Waste Management Authority, Wittel Farm, and Stroud Water Research Center. Many of those projects and partnerships will continue when I teach the course again in the Spring of 2018, including a new project involving student research and the City of Lancaster’s greenhouse gas emissions inventory. My summer Hackman fellow Stephanie Schick (‘17) helped along my book manuscript, Governing the Rainforest: Sustainable development in the Brazilian Amazon, which is under review with Oxford University Press. Additional publications include a book chapter on the contemporary environmental legacy of the Latin American “new left” leadership, and an article on environmental impact assessments in Brazil. I was an academic advisor for a Council on Foreign Relations InfoGuide on deforestation in the Amazon, which won several awards, including an Emmy! Now in my second year at F&M, my husband and I are nicely settled into Lancaster life. We are enjoying getting to know the region through local hikes, mushroom foraging, long bike rides, and cultivating a bounteous garden.

Elizabeth De Santo

I was on junior faculty research leave last spring (2017), which allowed me some time to catch up on writing and research. In February 2017, I presented two papers at the International Studies Association (ISA) conference in Baltimore, MD, one of which examined the role of science in UK marine protected area (MPA) planning and was subsequently published in the journal Environmental Science and Policy. The second paper I presented focused on MPAs on the high seas and in the Arctic, and is currently under review as chapter for a book on “Governing Across the Waves” with University of Chicago Press. This book is an output from a US Coast Guard workshop on Arctic governance held at Bowdoin College, in which I participated last fall. During my leave, I also travelled to Bonn, Germany, with my research student Lea Senft ’17, where we participated on the IUCN delegation to the fifth plenary meeting of the Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services (IPBES). It was a wonderful opportunity for Lea to see what she had been researching “in the real world” and I made valuable contacts for future research, as the project develops. I am in the process of writing up my research on Militarized MPAs, which examines the pluses and minuses of establishing parks surrounding military bases in remote island locations. I am continuing to teach ENE 216 Environmental Policy and ENE 405 Marine Protected Areas, and next semester I will offer a new Connections Course on “The Whale”, which will take an interdisciplinary approach to examining human interactions with nature, from direct and indirect use, to cultural and artistic inspiration. This autumn I got back out on the Chesapeake a few times, and earned my Coastal Cruising certification with the American Sailing Association.
Faculty News Updates

**Andy de Wet**
This is my second year as department Chair. I am enjoying teaching GIS in the fall and will be teaching two Mars related courses in the spring – one introductory course called “Life on Mars?” and a more advanced half-credit course focused on remote sensing and planetary evolution with a special focus on Mars. During spring break I will be leading a Department field trip to New Mexico and Arizona where we will examine volcanoes (Zuni-Bandera Volcanic Field in the El Malpais National Monument and the San Francisco Volcanic Field outside Flagstaff), impacts (Meteor Crater) and canyons (the Grand Canyon)! Two students are doing independent research with me this semester – Jared Brush ’18 is characterizing various watersheds and associated lakes at the Eastern Norse Settlement in Greenland based on remote sensing and data we collected over the summer of 2016 and Aidan Malloy ’18 is doing an environmental assessment of a site associated with F&M in Somerset County, PA.

**Carol de Wet**
I enjoyed teaching in F&M’s summer program for diverse and academically high achieving high school juniors, College Prep, in July. The students will be their family’s first generation college students and College Prep gives them an intensive pre-college experience, including taking two courses, providing a sense of what college academics will be like. They were a great group! I continue to collaborate on freshwater limestone projects from Olduvai Gorge, Tanzania and carbonate lake deposits from the Atacama Desert, Chile. F&M students have been actively involved in both projects and will be co-authors on forthcoming papers. It was satisfying to get the last of the York County Ledger Fm. microbial carbonates papers out this year. F&M former student co-authors Phil Dinterman ’98 and Monica Arienzo ’08 were very patient while we pulled their senior thesis work together for the manuscript! I co-convened a Pardee Symposium on Diversity and Inclusivity in the Geosciences at the Geological Society of America meeting in Seattle and enjoyed seeing so many Geo-Diplomat alumni at the meeting!

**Paul Harnik**
It has been wonderful this Fall to return from my research leave and jump back into the classroom. Over the past year I have continued my investigations into the historical ecology of marine communities in the northern Gulf of Mexico. In May, I conducted fieldwork in coastal Louisiana with five students and am now working with Morgan Torstenson ’18 to gather data from our new samples to compare with ones that we collected previously offshore Alabama. This summer I was awarded an early career research fellowship from the National Academies of Sciences, Engineering, and Medicine which will support additional fieldwork in the Gulf as well as radiocarbon dating and isotopic analyses of mollusk shells. The first paper on my Gulf research is currently in press in Palaios and focuses on recent shifts in marine bivalve life histories in response to anthropogenic eutrophication. This paper is co-authored with two F&M students, Mario Williams ’16 and Morgan Torstenson ’18. At the GSA national conference this fall, two former Keck students (Anik Regan from Macalester, and Luke Grimmelbein from Beloit) presented posters on our research and I also gave a talk on scallop evolution in a session that I co-convened on biodiversity response to environmental change. In an effort to foster a safe and inclusive educational environment for all participants in our department’s educational programs, this year I drafted a code of conduct policy with my colleagues that outlines expected behavior for all participants in our off-campus educational offerings and provides resources in the event of sexual harassment and/or assault, or other forms of harassment. Starting this spring semester, the policy will be implemented in all of the courses in our department.

**Eric Hirsch**
Prof. Hirsch completed his Ph.D. in sociocultural anthropology at the University of Chicago, and spent last year as a Postdoctoral Fellow in Global Governance at McGill University’s Institute for the Study of International Development. His research focuses on the relationship between environmental change, economic development, and indigenous livelihoods. His current research project, Investing in Indigeneity, explores small-scale development interventions focused on cultural entrepreneurship and ecological expertise in Andean Peru. A second project he has initiated, After Development, will examine the local implications of global climate change in the highlands of Latin America and islands of South Asia. At F&M, he is also launching the “Ecological Migration Lab”. This data generating lab will involve students in pairing life history interviews with mapping tools to follow the journeys people take when they migrate due to environmental change.
Faculty News Updates

**Zeshan Ismat**
I’m on sabbatical this year. I’m living in Brooklyn and doing some research at Columbia University.

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**Diane Kadyk (Academic Department Coordinator)**
It’s hard to believe I’ve been behind the desk in the Earth & Environment office for ten academic years now - longer than any of the last three coordinators! Granted, I did get a beautiful new desk a few years ago, but I still miss that old one from circa 1957! So many changes through the decade, both within the department and at F&M as a whole: the variety and constant flow of new technology, updated procedures, scientific discoveries, and the growth of the department. It all keeps me coming back year after year. When not behind the desk, I can be found tending my vegetable garden or playing harp and concertina at Irish music sessions. I’m currently at work recording my 2nd CD of traditional Irish harp music.

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**Dorothy Merritts**
This year I passed the 30-year mark, but find it hard to believe that so many years have passed. One of the best parts of those years has been collaborating with our students even after they graduate, and forging bonds between them and current students. Recently I began to collaborate on research with Su Fuertsch (now Fanok, ’90) at The Nature Conservancy. Together with our research crew we are evaluating the presence and impact of historic sediment from old millponds in PA State Parks. Mike Rahnis (’92) has been a leading member of our crew for a decade now, and this year began using two rounds of lidar data in Pennsylvania to calculate volumes and rates of erosion of historic sediment from breached millpond reservoirs. He’s been training our newest research associate, Evan Lewis (’16), who in turn has been training many current students working on various projects in our group. These students include Alec Snyder-Fair (’18), Logan Lewis (’18), Jon Meissner (’17), Yuning Bai (’18), Dori Coplan (’19), and Diane Wagner (’20). With all our current students we’ve been having a great time exploring Earth’s surface processes with drones, lidar, and of course a lot of field work. Come spring a large group of us is heading to NE GSA in Vermont to present on this work, and we hope to see some of you there.

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**Karen Mertzman ’96 (Laboratory Technician)**
Another year of sports, music and fun has passed. I am still chronically busy running samples from all over the world. I got to go to a seminar to learn more about Rietveld, Crystallinity and cluster analyses of minerals using the X-ray diffraction. Personally, we are in the early stages of a college search for our oldest son. Princeton and Columbia are the frontrunners, but we still have a year to make any final decisions. Now that he is driving, I get to spend a little less time as a taxi driver. We have a trip to Europe scheduled for 2018 and I always look forward to whatever challenges a new year (and new students) bring to the lab.

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**Stan Mertzman**
I am on sabbatical leave for the 2017–2018 academic year. Next fall I will return to the classroom to teach the Mineralogy course and a section of the Dynamic Earth introductory geology course, as well as the Petrology course in the Spring Semester 2019. I spent nearly two weeks doing field work on the western periphery of Mount Shasta in northern most California during late September. What a beautiful time to be in the field with day time temperatures between 70 and 80F and 25 to 35F at night with a few clouds scattered about. Interested in what I’ve been doing in terms of research? See volume 260 of Lithos for an article concerning Cambrian flood basalts in Oklahoma; see volume 282-283 of Lithos 2017 for an Ethiopian basalts article; see an issue of Icarus 2018 for a paper concerning garnet and remote sensing detection; see an issue of American Mineralogist 2018 for an article focused on products of hydrothermal alteration associated with Kilauea volcano in Hawaii. My family is well, all doing fine; I’m still at 11 grandchildren, no new additions.
Faculty News Updates

Jim Strick
Jim Strick taught his course on Nuclear Weapons, Power and Waste Disposal again this year. In addition to visiting the Limerick Nuclear Power Station in Pottstown, PA for an all day field trip (photo at left), the class has had numerous high profile guest speakers this fall. These included renowned expert on efficiency and renewable energy Dr. Amory Lovins, author Naomi Klein, geophysicist Howard Patton (who worked on verification of the Comprehensive Test Ban Treaty), historian Vincent Intondi (author of *African Americans Against the Bomb*, Stanford U. Press, 2015), and lawyer/historian Dr. Mary Mitchell of Purdue University (who talked with the class about the Price-Anderson Act). The class also includes a film series, with documentaries about accidents at Browns Ferry, Three Mile Island, Chernobyl and Fukushima; also about Atomic Spies and the Race for the Hydrogen Bomb. There are also dramatic films such as Fail Safe and On the Beach, and black comedies such as Atomic Cafe and Dr. Strangelove.

Bob Walter ’75
This Fall I taught one section of GEO (now ENE) 110 and this Spring I look forward to teaching Senior Seminar (ENE 480), the capstone of the Geoscience major. We have a great crop of senior GEO students, and I’m excited to get to know them even better. I just completed my first semester as a member the college Professional Standards Committee. I am advising Yuning Bai ’17 on his senior thesis project involving an analysis of the carbon and nutrient content of sediment deposited on the newly formed floodplain at the Big Spring Run (BSR) restoration site. Dorothy and I continue to lead the multi-disciplinary investigations at BSR (http://www.bsr-project.org). Also, we are in the last year of an NSF-funded collaboration with Noah Snyder at Boston College to study the impact of legacy sediments in the glaciated terrain of New England in comparison with the Mid-Atlantic Piedmont (http://www.anthropocenestreams.org/). This past summer, Tim Bechtel, our student Jake Longenecker ’17, and I published a paper in Geophysical Research Letters that proposed a novel way to determine groundwater recharge. Jake, the senior author on this paper, won the Young Investigator Award at the International Association of Hydrogeologists conference in Croatia! http://onlinelibrary.wiley.com/doi/10.1002/2017GL073790/abstract I am fortunate to be working with Eric Schwarz on setting up our new NSF-funded gamma spectroscopy lab. Eric, a radiochemist with Excelon Corporation and an expert in gamma spectroscopy has been instrumental in getting this lab up and running. Thank you Eric! The detectors are named Lucy and Lily, after my two granddaughters – an honor that is completely lost on them!

Chris Williams
I’m on sabbatical leave for the academic year. I’ve been enjoying this break from teaching and focusing on research and revising my courses. My main focus over the summer and the fall has been on wrapping up some loose ends related to research projects on Quaternary peat deposits. I’m also focused on completing a review study of pre-Quaternary peatlands in the geologic record. For fun, this past summer I had a nice two-week vacation in a very peaty place, the United Kingdom. My wife and my 7-year-old son travelled with me through Scotland, Wales and England where we returned to some places we had visited in the past and to some places new to us including an incredible Bronze-age copper mine on the Great Orme in Llandudno, Wales. My son Ben was interested in seeing Ben Nevis the highest mountain in Scotland. I look forward to some more writing in the winter and spring and then fieldwork next summer.

Emily Wilson ’11 (Research Lab Manager & Technician)
The past year has been exciting and busy both in Hackman and outside. Along with some tremendous help from our summer student workers, we schlepped no less than 300 boxes of rocks and fossils from the paleontology classroom to a temporary storage location in Hackman. After renovations were complete, we hauled roughly 200 of those boxes back into that classroom, and the remaining boxes were relocated to other places in the department. The updated classroom looks wonderful! In August, I coordinated the installation of a new seismic station at Millport Conservancy in Lititz, PA (more information elsewhere in the newsletter). Other than the poison ivy rash I developed on my arms, it was a splendid experience. This lab rat always enjoys a couple of field days under the sun! Outside of work, I spent much of my time in my garden, in the woods, or on a bike saddle. The highlight of my summer travels was a solo five day 300 mile bike tour around the Pennsylvania Wilds region. Everyday when I woke up, all I had to do was bike! It was blissful.
Happy 2018 from the Geoscience Founders Society!

Thanks to the generosity of alumni and friends of the Society we had an excellent 2017. First and foremost, individual gifts to the Society continue to supplement the annual funds derived from the Founders Society Endowment. Your annual dues and extra gifts are deeply appreciated. Taken together, your gifts have enabled the Department to do that “little bit extra” to support our students and faculty and enrich the student experience in the Department. Students were aided directly with funds to support their field camp expenses, and with funds to support student-faculty research projects that provide practical experience and develop important skills for life-long learning. Your generosity makes this possible!

The Franklin and Marshall Geoscience Founders Society was established to connect the Department with the work experience of its alumni and friends, to rekindle the camaraderie and spirit of its alumni, and to provide support and encouragement to the faculty and students as they continue the long tradition of excellence in Franklin and Marshall geology and the study of the environment. The Founders Society celebrates our history and supports the continued success of the Department.

We are putting your generous donations to work in ways that directly impact our students. Gifts of all sizes are meaningful and I encourage you to join your fellow alumni and make a donation today. You will find an envelope do so in this newsletter!

Here are other examples of how gifts to the Founders Society support the Department:

• Research Grants for majors. We are able to offer up to $1,500 a year to assist students conducting independent research with faculty.
• Student Awards ($500 each): the Founders Society provides select student awards. These include: Wise-Beutner Structural Geology Award, the Geology Award, and The Richard A. Sheppard ’56 Award
• The Founders Society provides funding for several $1,000 field camp scholarships to help students offset the cost of attending a field camp like YBRA to meet the requirements of the major.
• Grants to fund student participation at professional conferences (e.g., GSA, AGU) are provided by the Society.
• Faculty Research Grants: Faculty may each use up to $650 a year to help pay research-related costs (e.g., analytical fees, thin-section prep, travel costs).
• Field excursions such as the recent “Denver Energy Trip” that provide our majors rich and immersive experiences alongside practicing professionals.
• The Founders Society pays for two annual newsletters and production of the annual Department calendar.

Sincerely,
Chris Williams, Director
F&M Geoscientists at the Geological Society of America Annual Meeting

The Geological Society of America Annual Meeting was October 22-25, 2018 in Seattle. Carol de Wet and Barb Nash (Univ of Utah) co-convened a Pardee Symposium, “The Changing Face of Geoscience in the 21st Century: Increasing Diversity and Inclusion to Solve Complex Problems”. GSA President Isabel Montanez opened the session, highlighting the importance of broadening participation within the Geosciences to GSA, and to the discipline in general. The symposium was organized around two themes, “Why Diversity?” and “How Diversity?” The “Why Diversity?” keynote speaker, Dr. Dorceta Taylor, University of Michigan, spoke about the importance of moving beyond stereotypes to understand inclusivity as broadly as possible and how this benefitted society. Her remarks were followed by a panel discussion, moderated by Dr. Samuel Mukasa (Univ. of Minn., GSA Fellow). Panelists Dr. Aradhna Tripati (winner of the GSA 2017 Bromery Award, UCLA), Dr. Wes Ward (GSA Foundation Trustee), and Orla McLaughlin (ExxonMobil). Questions from the audience were submitted using Slido technology, a system that allows participants to enter questions using their smart phone, laptop or tablet. The questions appear on the screen and can be “liked” by other audience members, indicating which ones resonate with them and they would like to be addressed by the panelists. Lively discussion ensued.

The second part of the symposium, “How Diversity?” opened with a keynote address by Dr. Alexander Gates, winner of the GSA 2017 Public Service Award. He described the program he has built up at Rutgers University, Newark campus, where college students work with high schoolers in a protégé model to recruit and retain local students in the Geosciences. F&M Geology alumna Marilyn Suiter ’78 (NSF) moderated the panel following Gate’s keynote. Panelists included Dr. Suzanne O’Connell (Wesleyan Univ), Dr. Lisa White (Berkeley) and Dr. Christopher Atchison (Univ of Cincinnati). Slido again prompted good dialog and conversation.

F&M Geoscience was well represented in the audience with Marty Gilmore ’91, Christine Burns Bradford ’92, Shondrika Burrell ’95, and Jory Lerback ’13, in attendance. It was wonderful to see alumni Holli Frey ’99, Phil Dinterman ’98, Monica Arienzo ’08, as well as many others at the Alumni Reception the next evening.

Paul Harnik also attended the meeting where he gave a presentation on the Neogene evolution of scallops in the neotropics as part of a session he co-chaired on biotic response to environmental change. Two of Paul’s former Keck Geology students presented posters on their collaborative research in the Gulf of Mexico. Paul and Carol served as mentors in GSA’s “On to the Future” program and Paul represented the department at the Keck Geology Consortium Meeting on Saturday evening.

ENE prominent at two F&M Common Hours

Assistant Professor of Environmental Studies Elizabeth De Santo discussed “Unraveling Teddy Roosevelt’s Legacy: America’s National Monuments Under Threat” at the College’s Nov. 30 Common Hour, a community conversation scheduled every Thursday classes are in session. Elizabeth has been a member of the Department of Earth & Environment since 2013 and was nominated by one of her students and selected by the Common Hour Committee to give the first of the student-proposed NOW Hour events. This was a great honor for Elizabeth and the Department. Elizabeth has been working in the field of marine conservation for nearly 20 years and has published articles on marine preserves, but noted that many of the same principles of conservation apply to continental spaces as well. She presented evidence in her Common Hour talk showing the value in conserving land areas, but also noting that there are numerous perspectives on what conservation entails.

The Department also co-sponsored the Common Hour presentation by Amory Lovins, environmental scientist, physicist, author, and co-founder and chief scientist of the Rocky Mountain Institute. Introduced by Professor Dorothy Merritts, Amory gave a hopeful talk titled, “Astonishing Energy Futures and the Future of Global Change” and commented that “The Model T got 62 percent cheaper in 15 years. Solar just got 80 percent cheaper in five years.” “Focusing on outcomes, not motives, can turn gridlock into a solution.”
New Seismic Station Installed at Millport

For over 20 years, the Earth and Environment Department housed a seismometer in a grassy patch near the north-eastern corner of Hackman Physical Science Laboratories, coordinated with Columbia University’s Lamont-Doherty Cooperative Seismographic Network. LCSN handles the maintenance and data processing of over 40 seismometers in the northeast United States. Within the past year, LCSN approached ENE about the possibility of moving our seismometer to a new location. Millersville University has a seismic station located about 4 miles southwest of F&M campus. If ENE could move our seismic station north of campus, it would improve the seismic network by having seismometers spaced further from each other. We were also interested in finding a quieter site; the grassy patch near Hackman, while great for classroom demonstrations, tended to pick up ‘earthquakes’ when students walked to class, when the grassy patch was mowed, or when large groups of people would gather on Hartman Green. ENE began looking for possible sites north of campus and finally decided to install a new seismic station at Millport Conservancy located in Lititz, PA. F&M maintains a partnership with the Conservancy and caretakers Lynn and Logan Myers worked very closely with ENE in planning the seismometer installation. Professor Tim Bechtel, Lab Manager Emily Wilson ’11, and students Danielle Maloney ’18 and Kevin Cerna ’18 ran several seismic lines to find the location with the shallowest bedrock - the best location to install a seismic station. Once the best site was determined, ENE had to coordinate with LCSN, Millport Conservancy, F&M’s Department of Facilities and Operations, power and internet providers, and independent contractors!

The project came together August 16th and 17th. Power and internet had been trenched over 200 feet to the new seismic vault location and the contractor had dug a hole four by four feet wide and 2 feet deep to bedrock. The crew of F&M students, staff, and LCSN scientists labored to widen the hole so that a hand-made cast could rest directly on bedrock. Our students carried 80 pound concrete bags to the vault location so that the crew could mix each bag of concrete individually, then pour it into the cast. Once the concrete had set, the crew placed the seismometer and all related equipment inside the vault and weather-proofed as best as possible. Several days later, the seismometer recorded a 0.4 magnitude earthquake near Mount Joy, PA. The instrument has recorded larger earthquakes (i.e., magnitude 6.0 and greater) from locations such as Mexico and South America.

- Emily Wilson ’11

New Gamma Spectroscopy Laboratory at ENE

Over the past year, with funds from the National Science Foundation, the Environmental Protection Agency, and the PA Department of Environmental Protection, I began working with Eric Schwarz to set up a new gamma spectroscopy laboratory in ENE. I purchased two high-precision Canberra Broad Energy Germanium (BEGe) gamma ray detectors and digital analyzers. Eric, a radiochemist with Exelon Corporation and an expert gamma spectroscopist, is volunteering in our lab for the pure joy of the enterprise! Under Eric’s expert guidance, we calibrated the instruments and began analyzing unknowns in a fraction of the time it would have taken me to do this on my own. Kudos and thanks to Eric!

We will use these instruments to determine the activities of the radioisotopes of $^{210}$Pb, $^{137}$Cs and $^7$Be in soils, sediment, air and water. These isotopes, which have very different production pathways and half-lives, are all deposited on surface soils from the atmosphere, and are used as isotopic tracers to detect change and mobility of surface soils. We can use these isotopes, for example, to quantify soil erosion rates, deposition rates of sediment in reservoirs and to fingerprint sediment sources in the suspended sediment loads of streams. So far, our students and I have focused on $^{137}$Cs.

Over the next year we will develop a collaboration with the USGS on testing the application of $^7$Be to soil erosion studies. Stay tuned.

- Bob Walter ’75
Department News: Conservation Paleobiology

Conservation Paleobiology:
Putting the Dead to Work to Assess Human Impacts on Coastal Ecosystems
Paul Harnik, Assistant Professor of Geosciences

It was once commonly assumed that marine ecosystems were less vulnerable to the impacts of human activities than terrestrial ecosystems because they are vast, seemingly inaccessible, and because the unique life histories of many marine species result in broad geographic ranges and large populations which may act as buffers to environmental change. Recent studies have overturned this view, documenting the fingerprint of humans on ocean chemistry, habitat quality, and the population sizes of exploited species. However the impacts of anthropogenic environmental change on most marine species remain poorly understood due to a lack of long-term biomonitoring. The developing field of conservation paleobiology addresses this knowledge gap by using the skeletal remains of historical populations to establish pre-impact baselines that serve as reference points for studying present-day populations. Since joining the F&M faculty in 2013, my students and I have been “putting the dead to work” to investigate the impacts of human activities, and specifically eutrophication, on coastal ecosystems in the northern Gulf of Mexico.

The Mississippi River watershed drains 40% of the continental United States and is home to approximately 70 million people. The river’s delivery of nutrients has supported tremendous primary production in the marine ecosystems of the northern Gulf of Mexico for millennia; evident today by the network of offshore oil and gas wells that mine the region’s hydrocarbon-rich sedimentary deposits. Farming and other human activities have enhanced delivery of nitrogen and phosphorous to Gulf ecosystems, further spurring primary production and leading to the development of one of the largest oxygen-limited, ‘dead zones’ in the world. How has anthropogenic eutrophication affected communities of marine organisms in the Gulf? Answering this question requires a historical perspective that existing biomonitoring data cannot provide because biomonitoring efforts in the region are quite limited in their temporal and spatial extent. Mollusks (snails and clams) are diverse and abundant today in coastal environments throughout the Gulf of Mexico. Given the durability of their shells, their biomineralized remains can also persist in sediments on the seafloor for millennia. The extent to which present-day marine communities differ from those that occurred in the region before various human activities can be determined by comparing samples of live and dead mollusks (i.e., live-dead analysis). Samples of old dead shells offer unique windows into the marine communities of the past, valuable reference points for determining the natural range of variability in marine ecosystems in the absence of current environmental change, and baselines that can be used in environmental management and restoration.

This area of research is highly interdisciplinary. The questions my students and I ask lie at the intersection of marine ecology and environmental management. For example, how have organisms adapted to anthropogenic nutrient enrichment? Have increases in primary production resulting from changing land-use practices favored some species over others? Have the hypoxic (low oxygen) conditions frequently associated with eutrophication caused some species to decline in abundance, or go locally or regionally extinct? Answering these questions requires the skills and perspective of a paleontologist. To generate pre-impact baselines for coastal communities, one must be adept with reconstructing and analyzing long-term historical records while always accounting for the variety of preservational filters that act upon biological remains after death. I teach an upper-level elective course on Conservation Paleobiology every autumn, in which students develop these skills through the collection and analysis of modern and ancient biodiversity data. Conservation Paleobiology students come from a variety of majors, including geoscience, environmental science, environmental studies, biology, and anthropology.

Over the past three summers, I have collected live-dead samples on the continental shelf offshore Louisiana, Alabama, and Florida with teams of students (eleven in total since the start of this project). Our fieldwork is conducted in partnership with several marine labs in the Gulf, and occurs early in the summer when seas are relatively calm. Our days on the water are spent wet sieving and picking through tremendous quantities of sediment re-
covered in numerous box cores. Back on campus, independent research students and teams of student volunteers have helped to sort through these samples, separating out specimens of different species for further study. Volunteers meet weekly in my lab and participate in regularly scheduled “Pizza and Paleontology” gatherings that are open to the entire F&M community. Most of my summer research students have been supported through the F&M Hackman Summer Scholars program and Earth and Environment endowed funds for student-faculty research. During the 2016-17 academic year, I also directed a Keck Geology Consortium project that involved students from F&M, Macalester, and Beloit colleges.

One of the primary projects in my lab focuses on life history adaptation in the northern Gulf. Evolutionary theory predicts that increased resource availability relaxes life history trade-offs, giving individuals that produce many small eggs a fitness advantage over those that invest equivalent energy in fewer, larger eggs, leading to a reduction in mean egg size over time. Anthropogenic eutrophication results in increased phytoplankton production which, all else being equal, would increase food supply for basal consumers in aquatic food webs such as marine bivalves. The size of the earliest larval shell of marine bivalves is correlated with egg size and previous studies have shown that larval shell size can track variation in primary production over millennia. In collaboration with Mario Williams (’16) and Morgan Torstenson (’18), I gathered and analyzed data on live and dead larval shell size to test the hypothesis that populations in the northern Gulf today have smaller larval shells than historical populations. We use the scanning electron microscope in Hackman to make all of our larval shell measurements. We have found that the larval shells of one species in coastal Alabama are smaller today than they were in the past. By radiocarbon dating a subset of these shells, we were able to determine that this life history shift occurred relatively recently (post-1950s) and did not reflect a long-term trend. I am working with Morgan Torstenson this year to gather comparable data from coastal Louisiana, to test the hypothesis that the magnitude of live-dead difference in larval shell size is greater in coastal environments adjacent to the Mississippi River that have experienced more pronounced anthropogenic eutrophication.

In addition, I have been investigating changes in the composition and relative abundance of bivalve species in live-dead samples from across the northern Gulf. Previous work found that live-dead agreement can break down in regions affected by anthropogenic eutrophication in part because of the enrichment of organic-loving species in the living community relative to the associated death assemblage. With Keck student Luke Grimmelbein (Beloit ’17), I gathered and analyzed live-dead data for bivalve species offshore Louisiana and Alabama, and found that the live community in both regions was dominated by organic-lovers. Our data indicate that live communities in coastal Alabama are enriched in organic-lovers compared to historical baselines, consistent with recent community-level changes in response to eutrophication.

Although differences between life and death assemblages can reflect recent changes in marine communities in response to human activities, post-mortem processes such as shell dissolution and fragmentation can also result in live-dead disagreement. Understanding the nature of these post-mortem filters, and specifically how they differ among depositional environments, is essential for interpreting the ecological information recorded by death assemblages. With another Keck student, Anik Regan (Macalester ’17), I examined taphonomic variation in death assemblages from across the northern and eastern Gulf of Mexico. Previous work on tropical marine environments found that the condition of molluscan remains varied markedly between carbonate and siliciclastic depositional settings. Regan gathered data on the taphonomic grades of bivalve shells from multiple localities across the Gulf and found similar differences between carbonate and siliciclastic settings in these higher latitude, subtropical shelf environments.

These projects have resulted in presentations by me and my students at the national Geological Society of America meetings (Williams & Harnik 2015; Harnik et al. 2016; Grimmelbein & Harnik 2017; Regan & Harnik 2017), and a paper co-authored with two students (Harnik et al. 2017). Based on this research, I was awarded an early career research fellowship this year from the Gulf Research Program of the National Academies of Sciences, Engineering, and Medicine. I plan to use these funds over the next two years to expand the scope of my live-dead sampling in the northern Gulf, generate additional age constraints on Gulf death assemblages using radiocarbon dating, and measure spatiotemporal variation in temperature and nutrients using the isotopic composition of mollusk shells.

As the footprint of human activities on Gulf marine ecosystems continues to increase, biological baselines that pre-date these activities become more critical. Biological baselines are needed to evaluate the impacts of anthropogenic eutrophication, industrial fishing, and other stressors on marine benthos, and to establish meaningful targets for ecosystem restoration following environmental disasters. Molluscan death assemblages can provide such baselines provided that potential taphonomic biases are taken into account. I feel incredibly fortunate to work on these and related research topics with my students, and can’t wait to see what we find in the coming years.

The American Association for the Advancement of Science has named Franklin & Marshall’s Roger D. K. Thomas as one of its Fellows. Roger, the John Williamson Nevin Professor of Geosciences, Emeritus, joined F&M’s faculty in 1975. He is already a longtime fellow of the Geological Society of America and of the Paleontological Society, where he served for six years as Secretary and subsequently received an award for distinguished service. However, the AAAS honor was particularly meaningful. “To be recognized in this way... was unexpected and a very nice surprise!” he said.

In bestowing the honor, the AAAS cited Roger’s “distinguished contributions to the science of paleontology through undergraduate education, research on the growth and form of animal skeletons, and for service to professional societies.” AAAS Fellows were formally announced Nov. 24 in the AAAS News & Notes section of the journal Science. The organization, founded in 1848, is the world’s largest general scientific society. It embraces nearly 250 affiliated societies and academies that serve 10 million individuals, and publishes several prestigious journals. The AAAS has been designating fellows for more than a century.

Recently retired, Roger is still very active in the Department and is working on several papers focused on his ongoing research activities including some amazing fossil discoveries from the Kinzers Formation.

Congratulations Roger!

(Source: modified from Peter Durantine, F&M)