

September 2019

The following newsletter has been created to engage with those passionate about Humanitarian Engineering (HE) by providing information and resources to our subscribers. This issue highlights key events, projects, and opportunities for involvement all related to HE at Mines and around the world.

## HE @ Mines

### NEW CLUB: Socially Responsible Scientists and Engineers (SRSE)

When: Mondays, 6-7 PM

Where: Brown Building W210

Are you looking for professional and individual development outside of the classroom in understanding what it means to be a socially responsible scientist and/or engineer? SRSE is focused on just that. With plans to host student and faculty presentations, professional speakers, an annual symposium, and opportunities for networking and attending conferences we can further discuss social responsibility in engineering and how we can encourage it locally, nationally, and worldwide. If you would like the chance to take part in this club or just want to learn more, stop by one of our meetings and engage with one of our guest speakers!

## Upcoming Events

Maya Carrasquillo will be presenting her lecture “*Shifting the Paradigm from Sustainability to Social Justice: A Case Study towards Equitable Decision-making for Stormwater Management in Coastal African American Communities*” as part of the HE Lecture Series **Community Development and Unintended Consequences**

When: Tuesday, October 1st, 5-6 p.m.

Where: Berthoud 243

Please register for the event at

<https://humanitarian.mines.edu/he-events/>

**Dinner will be served!**



You can find out more about Maya Carrasquillo at her website:

<https://www.mayaecarrasquillo.com/>

This event is co-sponsored by Humanitarian Engineering, Environmental Engineering, ReNUWIt, Socially Responsible Scientists and Engineers (SRSE) and Mines Without Borders (MWB).

September 2019

## Interview with Professor Jessica Smith

Alice Wilbur, a Shultz Scholar, recently sat down with Professor Jessica Smith to talk about her sabbatical and her work at Mines. Here are clips from the interview!

**Alice Wilbur (AW):** Thanks for sitting down with me! So to start off, tell me about your sabbatical.

**Jessica Smith (JS):** I wrote a book! I have been spending the last four years interviewing engineers about how social responsibility plays a role in their professional practice and in the way that they think about themselves as engineers. And because Mines is such a wonderful, exciting, busy place, I had no time to write it up. So, I received a fellowship from the British Academy (which is a combination of NSF and National Endowment for the Humanities, rolled up with a royal blessing) to spend a semester at the University of St. Andrews in Scotland, which has an amazing anthropology department. It was the first time I had been with anthropologists since I finished my Ph.D., so it was fun going back to my intellectual roots and bringing back something new to them.

**AW:** What was your process for writing your book? Why did you decide to write it?

**JS:** I spend a good bit of time hanging out with social scientists and humanists, and I always felt very frustrated by either their inattention to engineers and engineering or the really reductive way they would talk about it. So my goal was to tell a better story of engineers and engineering, and their work. I've been really interested in corporations; most engineers in the United States go work for them, even if they don't want to, and the reason I started this whole research project back in the day was to see what role this emerging field of corporate social responsibility (CSR) played in engineering practice. The corporate influence is often viewed as this stultified, tainting influence. And that can definitely happen, but people also have to live inside of these structures and make them livable. So I wanted to tell a more nuanced and meaningful story about what corporate work is like, so we can be a little more thoughtful about how we are preparing students to go out in their careers.

**AW:** How did your sabbatical affect your work at Mines, including teaching, research, and the Master's program?

**JS:** At a very basic level, I got to read books, and because I had time to read, I was able to not just learn for myself, but also to find more updated, more engaging readings for my classes, like Corporate Social responsibility and Engineers Engaging Communities.

September 2019

The other thing that became really clear to me as I was doing all these interviews is that before engineers can think “what is my social responsibility”, they had to figure out “what is my relationship to these companies”. It seemed like the people I met followed three paths: they either stayed in corporations, they became consultants, or they left industry entirely. Those who left tried working professionally for EWB or other NGOs, or they went back to grad school. So I think being able to concretely show how those different institutional positions influence what you can do is really valuable for students to think about as they’re thinking about what kind of career they want, and what kind of decisions they might have to make.

**AW:** Tell me a bit about your research.

**JS:** The idea of this project was that I was going to do all this ethnography, interviewing engineers, and then we were going to integrate that into undergraduate engineering education. Something that I’ve also been doing for four years is giving pre- and post-surveys to thousands of Mines students in classes where we do work that’s a critical take on corporate social responsibility. We are also just now finally getting to analyze the data from all the pre- and post-assessments. I have an undergraduate researcher working this year on studying how these sorts of class experiences affect how students view social responsibility, and its place in their career. Some of our preliminary findings that I shared last summer at our big national engineering education conference were that this sort of instruction broadened the list of who engineering students thought were legitimate stakeholders. This suggests that they’re having a broader view of their impact on society and who has a legitimate stake in having their voice heard.

**AW:** How can Mines students get involved with your research?

**JS:** I would love for them to be research assistants! It’s a lot of tedious Excel work, but then it turns into magic when you start being able to see what’s been happening and you can compare Student A before and after, Student B before and after, and then look at that collectively to see what’s happening – over a course or the entire project. So there’s a wonderful payoff, but it takes a lot of persistence.

**AW:** Tell me about the new Master’s program

**JS:** We are launching a Master’s program in Humanitarian Engineering and Science. The way that it’s structured is that there will always be that HE core, and then we are developing specialties. Our first specialty is geophysics, and now we’re trying to figure out the next ones. This would be what we think is the first Humanitarian Geophysics graduate degree available, so it’s nice to be at the front of that movement. This degree is not just for geophysics students, but for anyone with a

September 2019

background in quantitative geosciences. You can do really cool stuff as it comes to hazard mitigation, groundwater, seismicity, even applications to cultural heritage and agriculture. There's a lot you can do with geophysics tools to make the world a more equitable, just, and sustainable place. That's going to be starting next fall.

**AW:** How can Mines students get involved with that?

**JS:** Apply! And come talk to us [Jessica Smith or Juan Lucena]. Mines undergrads can double count up to 6 credits. So if students are already at Mines – whether or not they have completed the whole HE minor -- they'll be a leg up and they can finish the Master's degree more quickly.

**AW:** Do you think this program would be more aligned with the Leadership and Social Responsibility minor or the Engineering for Community Development minor?

**JS:** If you look at the classes, there are things that are common to both minors: working with communities, thinking about how engineering can contribute to sustainable development, etc. The new Master's program does include an advanced version of Professor Juan Lucena's class, Engineering for Sustainable Community Development, for students who want to take their learning in that area to the next level.

**AW:** If you could require me to read one thing before I graduate, what would it be and why?

**JS:** I'm going to go with Fabiana Li's book, *Unearthing Conflict*. And even though it's about mining controversies in Peru, I think some of her main insights hold for people no matter what. These mining controversies were all about water, and whether these big mines were taking too much, if they were changing the quality, etc. What she does really beautifully is that she shows how people have different understandings of things that we call resources. So what engineers see as water, something that can be treated, something that can be measured, something for which health and safety can be quantitatively determined, *campesinos* (local Peruvian farmers) understand the health of water by how it looks, by how it smells, by how it tastes, by the film that it leaves on their crops, etc. So a lot of the controversies happened because of these two different understandings of what good water was. I think that basic insight goes a long way for anyone who works with resources or with people who have very different lives than their own. And that wouldn't just have to be with *campesinos* in Peru, it could be that communities here in Denver have very different understandings of what good water is.

**AW:** Thanks for sitting down to talk with us, Professor Smith!

September 2019

Here are some links to resources she mentioned:

#### Humanitarian Geophysics:

Broadly defined, *Humanitarian Geophysics* focuses on applying the principles of geophysics to improve the lives of disadvantaged communities and the natural environments in which they live.

Humanitarian Geophysics spans a wide range of topics including:

- Locating new groundwater resources
- Groundwater/aquifer management
- Environmental remediation and monitoring
- Natural hazards posed by earthquakes, volcanoes and landslides
- Agriculture development, management and optimization
- Securing cultural heritage

Practitioners work on developing sustainable socio-technical solutions to these challenges in collaboration with local scientists, communities and government stakeholders.

More information about the Master's program: <https://gradprograms.mines.edu/edns/>

*Unearthing Conflict*, by Fabiana Li on Amazon:

<https://www.amazon.com/Unearthing-Conflict-Corporate-Activism-Expertise/dp/082235831X>

## Summer Trips

Over the summer HE faculty and students ventured out of Golden to various parts of the country and world to employ HE mindsets and techniques in real-life situations. The following segments will describe the trips they took and some of the knowledge and experiences they gained along the way.

### **Colombia, South America**

#### ***Cassidy Grady, Seamus Millett, Franco Pilone***

As part of the National Science Foundation (NSF) funded PIRE project, Responsible Mining and Resilient Communities, a team of faculty and graduate and undergraduate students took their studies to the field in the Antioquia department of Colombia, South America. The multi-disciplinary team consisted of four faculty, four graduate students, and six undergraduate students from CSM. This team was joined by a plethora of other students and faculty representing institutions like the University of Colorado Boulder, The United States Air Force Academy, The University of Texas Arlington, The Universidad Nacional de Colombia, and Uniminuto. The trip consisted of a week of classes, activities, meetings, panels and cultural activities in Colombia's second-largest city, Medellin, before the students spent the second week in the field surrounding Andes, Antioquia. The graduate students on the trip had the opportunity to spend much more time in the country

September 2019

beyond the two weeks spent there by many of the faculty and undergraduate students; however, each of the students on the project had ample time and opportunity to spend in the field engaging with the Colombian communities and miners. The following sections are various aspects of the trips and pieces of knowledge that the CSM students wanted to share with everyone.

### Mining Safety



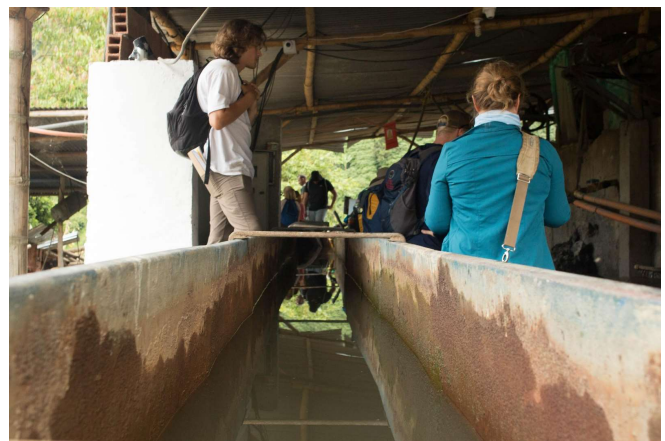
Small-scale mine entrance in Antioquia, Colombia  
Photo credit: Nicolas Mantilla

Small-scale miners in Colombia are often referred to as “artisanal” or “traditional” miners because of the traditional, minimal technology methods they use to mine their ore. Much of the mining that is done in the region surrounding Andes is of the hard rock or underground form of mining. This is where miners are following the twisting vein of gold-containing rock deep into the mountains, sometimes even 400-500 feet below the surface. In large-scale mines of similar type in countries such as the US or Canada, the mine shaft traveling underground would be hundreds of feet wide, fully illuminated and ventilated. This is far from the case in Colombia, where mine shafts are barely bigger than a man, with little to no supports, illumination and ventilation in the mines. The miners also use traditional drilling and blasting methods for extracting the ore and transportation of the ore to the surface is all up to the strong backs and nimble feet of the

miners as they navigate their way across slippery ladders and tight passageways. For many of the miners, not a moment passes in the mines where they are not at risk of something happening. Many of the miners that the students talked to identified the main areas of risk to be rock falls, falling off ladders, explosive malfunctions, and poor ventilation in the mines. Many of the miners also state that due to all the risks they would gladly leave mining for another profession if they had any other option due to all of the present risks; but, there is not much else for many of these miners in this region.

### Ore Processing and Tailings Remediation

Typically the final piece of the mining process before the gold is sold to be further refined and used in anything from jewelry, electronics or banking is the processing of the ore. Ore processing begins with the preliminary crushing of ore to quarter-sized pieces before entering other crushers that crush the ore down to a fine powder mixed with water. Then using various and/or chemical-based processes the gold is separated from the ore to then be burned and purified. Up until 2013 in Colombia, the primary chemical used



Members of the Mines PIRE team observe operations at a processing plant in Colombia - Photo credit: Jake Marquis

September 2019

in ore separation was mercury. However, this all changed when Colombia signed the Minamata Convention, outlawing mercury use in ore processing. Therefore, to abide by current regulations many ore processors switch to cyanidation processes for processing ore. Despite this change in regulation, mercury is still a big issue in Colombia, due to either the illegal use of mercury or previous mercury contamination from historic mining practices. One ore processor in particular in the Andes region, Edilber, is suffering from the effects of these historic mining efforts. His ore processing plant has been a site for gold processing for hundreds of years and there are large piles of mercury-contaminated tailings littering his site, despite his current mercury free practices. Due to these contaminated tailings, Edilber has been suffering punishment from the local environmental regulator, Core Antioquia, even though much of the problem is not his fault. To help Edilber with his dilemma a chemical engineering senior design team and now a current interdisciplinary senior design team are working with Edilber to develop a process to remediate these contaminated tailings so they may be repurposed for use in construction materials. This process would be a huge step in the right direction for a historically environmentally harmful mining industry and can help eliminate mercury contamination across the country.

### Excursions

Although the project is focused on small-scale mining, it is important to not forget about the large scale mining companies as both small and large scale are intertwined with each other. Students on this trip were able to meet with speakers from Mineros SA (a large scale mining company) at their headquarters in Medellin and talk to their company representatives on their perspective of ASGM. The conversation focused on who Mineros SA is, what they do, where they operate, their corporate social responsibility, and what they are doing proactively to work with small scale miners in the areas that they work in.



PIRE team members in front of a mural in La Comuna 13  
Photo credit: Nicolas Mantilla

During the two week stay, students were able to experience both Medellin and Andes beyond mining. These trips included going on a walking tour in “La Comuna 13” where the walls are covered with graffiti and very impactful works of art. Another trip was taking a cable car up the side of a mountain to a national park, Parque Arvi, and exploring the park. While in Andes the students were able to experience the conditions of the mines and processing plants in which the project revolves around. Not only were the students able to walk around the processing plants and have meaningful conversations with the workers there, but

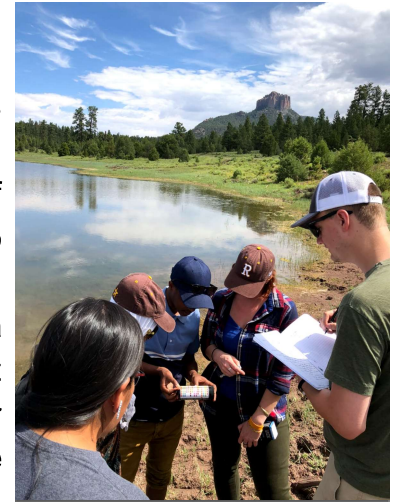
they were also able to walk around the town in which the mines were located. Coffee farming is a very prominent source of income in this area as well. Students were able to go tour one of the farms nearby.

September 2019

## Diné College, Navajo Nation, Tsaile, AZ

*Graham Braly, Leadership in Social Responsibility Minor Student*

I started this trip, this experience, not really having a good understanding of what it is we as an interdisciplinary group of students and professors, planned to do on the Navajo Nation. However, as with everyone else, I came with an open mind and a significant level of flexibility. It very quickly became clear to me that this trip was going to be a different type of experience and education than that which I had experienced before in more conventional settings. This would be a class focused as much on emotions and personal connections as it was on science and research methodology. The irony would come later when we as a class started to learn that in Navajo, all things are connected in some way. By learning Navajo philosophy and history, I was learning research methodology and science at the same time.



Graham Braly working with colleagues of the Navajo Nation

Once we started the official form of the class on the first Monday, I began to realize that time was flying by listening to the varied speakers we had. I was learning new information, stories, and ways of thinking at a pace so fast that it took me every out-of-class hour I had each day to think about and process it all. Even then, I ended the trip with plenty left to think about. This two-week class had as much immersion and mental involvement as classes many times its length. Many guest speakers and other people involved with the class made it very clear that the Navajo Nation faces many challenges, and that they almost all do not have a clearly defined, simple solution. Many of these challenges will require a multitude of policy changes, societal changes, changes in business practices, and detailed reviews of Navajo sovereignty working in concert to affect positive changes. Some of these challenges initially seemed impossible as I heard about them from our varied guest speakers; however, I was struck by the persistence and dedication that all of our guest speakers demonstrated, each in their own personal way.

Some presenters reverted to utilizing traditional Navajo philosophy and ways of thinking, while others saw a balance of western science and Navajo thinking as the best way forward. What every presenter shared was a common thread of dedication and the belief that whatever challenges may exist, they can be solved. The idea that these challenges are not hopeless and can be solved, even if each person only does a little bit to help. I think I partially understand the Navajo concept of K'é, "interconnectedness" or "interrelation," but I never fully understood how it, or other Diné concepts, empowered the guest speakers to have the level of faith in our ability as humans to solve problems that we face. This hope was inspiring and really helped me handle hearing the often-times heavy stories that we heard from our guest speakers. At the same time though, I struggled to combine my own engineer-like ambition to solve problems with the level of

September 2019

caution, thought, and trusting copartnership that our speakers made clear was necessary for a partnership with Navajo problem-solvers. The stories I heard made it clear to me that clear bilateral communication and involvement of indigenous people from the problem definition phase all the way through to reporting results is the only way to conduct research and problem-solving with indigenous groups of people.

## **Bumwalukani, Uganda**

### **Mines Without Borders**

This summer, Mines Without Borders sent four students to Bumwalukani, Uganda to complete an assessment trip for the club's solar lighting project. The project is working on implementing solar lighting units in the community. The team stayed with the community for almost two weeks, interacted with the community, and mapped out potential locations for the lighting units. All students came back with practical engineering experience on learning about how to interact with the community they work in, how to properly meet the community's needs through social surveys, and much more real engineering fieldwork. This semester on campus, this project is working on designing the lighting system, specifically focusing on the foundation of the lighting unit and working to decrease the cost of the system. The goal is to implement the lighting units next summer depending on the community, the lighting design, and funding.

## **Directors Corner**

### **Juan Lucena**

#### **HE Director, Undergraduate Programs and Outreach**

After graduating our largest cohort ever and getting approval for our first MS in Humanitarian Engineering and Science: Geophysics, the HE program is now in full recruitment and growth mode and undergoing an administrative reorganization that will allow us to be more effective. Prof. Jessica Smith will be Director for Graduate Programs and Research, Juan will be Director of Undergraduate Programs and Outreach, while Julia Roos continues to be Associate Director, supporting both Jessica and Juan. Here are some of our highlights since Spring 2019.



- During the summer, members of our project on engineers and artisanal and small-scale gold mining (ASGM) communities traveled to Colombia to learn and engage with multiple stakeholders and define problems with them. Our students (Cassidy, Franco, Jake, Jule, Seamus) engaged in community-centered problem definition that resulted in projects now

September 2019

living in the HE courses Projects for People (EDNS 401) and Capstone Design (EDNS 492). In the latter, the HE program now has its own dedicated Design Studio, populated with six different community development projects in water distribution, sustainable energy, efficient agriculture, ASGM and STEM education in Nepal, Uganda and Colombia. In this Design Studio, which mimics an HE consulting firm, students from different disciplines and interests (often led by HE seniors) work on various projects simultaneously, deploying different skills and rotating around projects. We will continue with the Design Studio in the coming years so HE seniors find an exciting design space where to apply their coursework and attend their passions for community development.

- Our HE program also continues to have a significant impact outside of Mines in the US and abroad. For example, through the PIRE project, we brought together multiple partners that are now developing Centers of Social Innovation for ASGM women miners in Colombia under the leadership of MIT. In Colombia's Universidad Sergio Arboleda (the alma mater of Colombia's current president), Mines HE served as inspiration for an HE senior thesis option that students from any engineering and non-engineering majors can choose to graduate. In the UK's Swansea University (Wales), we serve as advisors on faculty development and student learning in their master's degree in Sustainable Engineering Management for International Development. In the US, Marie Stettler, a Ph.D. candidate in Science and Technology Studies at Virginia Tech, selected our HE program as one of three programs in the US to research for her doctoral dissertation on how religious values shape humanitarian engineering programs.

---

## Humanitarian Engineering Newsletter

Humanitarian Engineering Program  
Department of Engineering Design and Society  
Colorado School of Mines  
1500 Illinois St., Golden, CO, 80401  
Email: [humanitarian@mines.edu](mailto:humanitarian@mines.edu)  
Web: <https://humanitarian.mines.edu/>