

Report: 2021 Annual Meeting and Student Research Conference of Sigma Xi

by Willy Hereman, President of Mines Chapter

Sigma Xi members and chapter delegates, researchers, and students came together virtually Nov. 4–7 for the 2021 Sigma Xi Annual Meeting, Student Research Conference (AMSRC), and STEM Art & Film Festival. The central theme was ‘Roots to Fruits: Responsible Research for a Flourishing Humanity – How Scientific Virtues Serve Society.’ The conference was focused on the core values and virtues of research: ethical conduct, integrity, honesty, and trustworthiness. Parenthetically, a special issue of *American Scientist* – the journal published by Sigma Xi – was also dedicated to ‘Trust Worthy Science’ (vol. 109, No. 4, July-August, 2021).

The conference was attended by over 900 research professionals, journalists, communicators, and students from across the scientific and engineering disciplines. I had the privilege to represent Mines as a designated delegate. The conference made me reflect on the virtues of scientific research and how we practice our trade. The summary below covers the highlights of the meeting annotated with some personal comments and suggestions for further reading.

The *first day* was reserved for a business meeting for delegates who represented Sigma Xi chapters and the Membership-at-Large constituency. Sigma Xi leaders provided background information about the society and discussed finances of the Society.

Despite its decline in membership from a high of 55,000 in 2008 to about 26,000 today, Sigma Xi is still the world’s largest international and multidisciplinary honor society for scientists and engineers. Based in Research Triangle Park (Durham, NC), Sigma Xi has over 500 chapters around the world at colleges, universities, government laboratories, and industry research centers. Its mission is to enhance the health of the research enterprise, foster integrity in science and engineering, and promote the public understanding of science and the science process for the purpose of improving the human condition. More than 200 Nobel Prize winners have been members.

Current president Robert Pennock (Professor of Philosophy, Michigan State Univ.) will be succeeded by President-Elect Nicholas Peppas (Professor and Director of the Institute for Biomaterials, Drug Delivery and Regenerative Medicine, Univ. Texas–Austin) while Jamie Vernon remains Executive Director and CEO.

The caucuses for the Northwest Region and Research and Doctoral Universities (to which our chapter belongs) reviewed updates to the code of conduct of Sigma Xi and discussed various initiatives to reinvigorate a local chapter and enhance the membership experience. A list of possible initiatives for our local chapter is given at the end of this report.

On the *second day* I attended the key note lecture “Expertise and Responsibility: Why the Possession of Specialist Knowledge Entails an Obligation to Moral and Political Action” by Don Howard (Univ. Notre Dame), well-known as a co-editor of the Einstein Papers Project (einsteinpapers.press.princeton.edu). His presentation expanded upon his recent essay ‘The Obligation to Act’ (published in the fore mentioned issue of *American Scientist*) in which he argues that citizen scientists have a responsibility to engage in public debate about the potential use and misuse of the products of their work. Of course, there is no consensus among researchers whether or not to engage in the policy arena, possibly through activism and advocacy. He presented compelling historical examples of scientists and engineers who faced such

a moral dilemma. A famous example is the ‘Franck Report’ (www.atomicheritage.org/key-documents/franck-report) in which James Franck and his colleagues argued strongly against dropping an atomic bomb on a civilian target. The most notable dissenting opinion came from J. Robert Oppenheimer, Director of the Manhattan Project. The debate about the moral issues of building and using the atomic bomb and civilian versus military control of atomic energy eventually lead to the creation of the civilian-led Atomic Energy Commission which later became the Department of Energy. Another example is that of atmospheric physicist James E. Hansen, activist and pioneer in the debate on global warming. His early advocacy for aggressive action on global warming got him in conflict with the politically-appointed NASA leadership. Hansen eventually resigned from NASA to become Director of the Program on Climate Science, Awareness and Solutions at Columbia University’s Earth Institute. A more recent example involves Jeffrey Wigand, former vice president of research and development at Brown & Williamson, who worked on the development of reduced-harm cigarettes and later blew the whistle on tobacco tampering at the company. Very recently, under protest of thousand employees at Google, the company stepped away from involvement with the Department of Defence’s Project Maven because of ethical concerns centering on the use of Artificial Intelligence (AI) for full-motion video analysis to provide computer vision on drones.

Digressing from Howard’s presentation for a moment, today we are confronted with ethical questions about harvesting personal (including biometric and financial) data without consent, spreading fake news on social media, using synthetic media (deep fakes) to create fake content, weaponizing drones and robots, gene editing, and using AI systems without safeguards. The latter was the subject of Anderson Cooper’s interview of Yuval Noah Harari, author of the global bestseller ‘Sapiens: A History of Humankind,’ on CBS’s 60 Minutes (www.youtube.com/watch?v=EIVTf-C6oQo). In his books ‘Home Deus: A Brief History of Tomorrow’ and ‘21 Lessons for the 21st Century,’ Harari discusses the challenges humanity will face as it moves closer to creating not just an enhanced species of humans but an entirely new kind of being, one that is far more intelligent than we are. It sounds like science fiction but Harari argues that it is far more dangerous and frightening than that.

Under the title “Trust in Science: Ending the Debate?” Dominique Brossard (Univ. Wisconsin–Madison), argued that her research shows that there is no war on scientists but that scientists need to better communicate scientific results with society and that the media should not portray science issues as ‘black or white, right or wrong.’ These sentiments were echoed by Jessica Wyndham (Director, Scientific Responsibility, Human Rights and Law Program, AAAS) in her keynote address “The Social Responsibilities of Scientists: A View from Within.” Teaming up with leading scientific and engineering membership organizations, AAAS probed scientists and engineers about their views on their social responsibilities, what influences those views, and their ability to act according to those responsibilities. The results of this global survey are available at www.aaas.org/news/social-responsibilities-scientists-and-engineers.

Breakout sessions included panel discussions, specialized talks, and workshops across several conference tracks. I participated in the ‘Responsible STEM Education’ track with Glenn Branch who as Deputy Director of the National Center for Science Education (ncse.ngo) works with teachers, parents, scientists, and concerned citizens to ensure that topics including evolution and climate change are taught accurately, honestly, and confidently.

I enjoyed the interviews with renowned climate journalist Andrew Revkin (founding director of the Initiative on Communication and Sustainability at Columbia University’s Earth Institute) and environmental journalist Juliet Eilperin (Pulitzer Prize-winning journalist at The Washington Post). For more than two decades, Revkin has written for the New York Times about global environmental issues and climate risk. I highly recommend Revkin’s ‘Sustain What’ bulletins (revkin.bulletin.com; revkin.medium.com), podcasts (www.owltail.com) and blogs (dotearth.blogs.nytimes.com). He advised to “build a relationship with your audience by speaking from two perspectives: connect what you say to your research as well as to you being a responsible citizen. Listen, understand, ask questions, and work with social scientists to better communicate your message.” Eilperin addressed the ‘wall of misinformation’ that forces a convergence of two professions that requires mutual respect: scientists are becoming media people and investigative journalists are becoming data scientists. “One difference is that a publication of a journalist gets only peer reviewed after it is published,” Eilperin joked. More information about her work can be found at www.washingtonpost.com/people/juliet-eilperin.

The day concluded with the induction of the 2021 cohort of Sigma Xi Fellows which includes John Trefny. At that ceremony Andrew Revkin and Juliet Eilperin were awarded Honorary Membership to Sigma Xi in recognition of their work covering the impact of climate change and federal environmental policies.

On the *third day* Robert Pennock reported in his presidential address on the findings of the ‘Scientific Virtues Project,’ a six year study in which 1100 scientists, engineers, and medical practitioners, were asked to reflect upon scientific values. In response to the question “What are trades and character virtues that make for excellence in science?” *curiosity* and *honesty* came to the top, ahead of collaborative courage, humility to evidence, objectivity, integrity, competence, perseverance, veracity, patience, and a healthy balance between trust and skepticism. An initial account was published in Pennock’s book “An Instinct for Truth: Curiosity and the Moral Character of Science,” in which he calls for science education not only to teach scientific findings and methods but also to nurture the scientific mindset and its core values.

Baruch Fischhoff (Dept. Engineering and Public Policy & Institute for Politics and Strategy, Carnegie Mellon Univ.) spoke about ‘the science of science communication’ which identifies methods to best formulate messages and ways of testing drafts before communicating with the public at large. He illustrated the research in diverse applications, including energy, climate, medicine, pandemic disease, natural hazards, and cybersecurity. Results of the research have been reported in the (free) Proceedings of the National Academy of Science of the USA (www.pnsa.org).

I participated in the workshop organized by Jory Weintraub who teaches a course in science communication at Duke University. He had great advice for speakers: “Give a compelling story that is easily understood, memorable, and focused. Hook the audience with something surprising or counter-intuitive. Set up your talk using the ‘And... But... Therefore (ABT) template, perhaps as a puzzle to be solved or a mystery to be revealed. Be concise because that always wins the day with a general audience. Be definitive because people want clear answers. Use active tense, metaphors and similes when appropriate. Share the passion for your research with your audience. Use drama and self-deprecating humor but don’t overdue it. Avoid jargon!” He pointed us to the ‘De-Jargonizer’ available at scienceandpublic.com which helps one create jargon-free research statements in accessible language.

Sigma Xi's 2021 Gold Key Award winner Shirley M. Malcom spoke about what inspired her research and discussed the values and character traits that are important for the trustworthiness of science, discovery, and innovation. When asked "How did you acquire the virtues of research?" she answered "From people with wisdom through mentorship." The take-away: It is a duty of scientists to share their expertise and wisely mentor the next generation.

The *last day* was focused on the Student Research Conference and STEM Art & Film Festival. Approximately four hundred student presentations were submitted by high school, undergraduate, and graduate students. Their were posters, oral presentations, and creative works, including drawings, paintings, photography, film, and performing arts. Sigma Xi members judged the students on scientific thought, methodology, creativity, and communication skills. Top presenters received a monetary award and nomination to Sigma Xi membership with initiation fees and first year's dues paid.

I attended "An Introduction to the Mathematics of Paul Klee's Art" by Pamela Flattau (Executive Director, The PsySiP Project). In her lecture she also showed how to incorporate art in weaving, a new hobby of hers. To round off the conference, I watched 'LIGO', a documentary of Les Guthman, about the LIGO project and detection of gravitational waves which was awarded the 2017 Nobel Prize for physics.

Next Annual Meeting: The 2022 International Forum on Research Excellence (replacing AMSRC) is scheduled for Nov. 3-6 in Alexandria (VA). The theme is 'Science Convergence in an Inclusive and Diverse World – How Various Disciplines come Together to Solve Big and Challenging Problems.' Everyone is invited to participate.

Possible initiatives for our chapter (some with potential subsidies from the Society):

- Continue to support undergraduate and graduate research opportunities at Mines. For instance, provide information about NSF's Research Opportunities for Undergraduate program and encourage award winners of the Mines Graduate Research and Discovery Symposium (GRADS) to present their research at the College and Graduate Student Fair or the International Forum on Research Excellence, both organized by Sigma Xi. Our Chapter currently participates in GRADS by providing judges.
- Advertise the Grants in Aid of Research (GIAR) program from Sigma Xi and encourage our students to apply for funding. The program awards grants of up to \$1,000 to students from most areas of the sciences and engineering. Sigma Xi reports that 62% of these micro-grants have gone the female students.
- Continue to nominate Mines faculty & researchers, alumni, and students for membership to Sigma Xi. Contact recent PhD students and alumni, in particular those who were recognized for achievements and/or featured in the media. Recognizing that graduate students are the future of Sigma Xi its emphasis is shifting from "being nominated" toward "wanting to join" by extending its portfolio of benefits to members.
- Organize a "Science Café" (www.sciencecafes.org) to engage the non-scientific community into science. Apart from organizing laboratory tours on campus, Mines scientists and engineers could informally share their research in a friendly setting (e.g., libraries, museums, bookstores, theaters, coffee shops and bars). 'Skype a scientist', 'science by the glass',

‘science pub night’, ‘science movie night’ are among the possibilities and Mines Museum would be a great venue for outreach events.

- Have an inauguration banquet for new members of Sigma Xi and student award winners with a speaker from Sigma Xi’s Distinguished Lectureships Program (www.sigmaxi.org/program/lectureships). Invite freshly-minted PhD students to attend to stimulate involvement of students in Sigma Xi.
- Publicize Sigma Xi at “Order of the Engineer” events, the latter in collaboration with Mines Alumni Association. Seek assistance from both the Undergraduate and Graduate Student Governments to get Sigma Xi’s name out at Mines.
- Strengthen our chapter’s ties with the Osher Lifelong Learning Institute (OLLI) which informs senior citizens about current research through a series of lectures. Get involved with the Citizen Science Alliance (www.citizensciencealliance.org) which uses internet-based citizen science projects to further science itself and promote the public’s understanding of science.
- Organize outreach activities for pre-college STEM students. For example, visit High Schools, Girl Scouts and Boy Scouts, and other organizations in the area. Provide judges to High School Science Clubs and help develop resources for science teachers. Reciprocally, bring talented middle and high school students to Mines to talk about the research projects they are doing.
- Establish partnerships with the Society for Women Engineers (SWE) and Women in Science, Engineering and Mathematics (WISEM) at Mines to jointly get involved with Techbridge Girls (techbridgegirls.org) or Science Cheerleaders (sciencecheerleaders.org) to inspire girls to discover a passion for science, technology, engineering and mathematics.
- Establish an affiliate chapter of Sigma Xi at Red Rocks Community College in collaboration with Mines. Consider setting up affiliate chapters with National Laboratories in the vicinity of Mines such as NREL, NIST, NOAA, and NCAR.