

“Mind the Gap”: GSA’s Role in an Evolving Global Society

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GEOSCIENCES: THE SCIENCE INTEGRATOR

Geoscience is the integrator of the natural, physical, and mathematical sciences as our efforts increasingly span across a spectrum of disciplines. As such, we are the stewards of the Earth. Our science, whether basic or applied, has relevance to society. It provides the foundation and path forward for addressing everything from environmental and natural hazard issues to informing discussions on public health, climate change, and global security. And it provides the fundamental context for understanding humanity’s existence in the universe. Should it not follow then that the geosciences are a fundamental science—taught as part of a foundational curriculum in all schools in order to create an earth-literate public? The answer to this rhetorical question is clear.

There continues to be broad public support for the nation’s scientific achievements, a trend that has been stable for the past few decades. Approximately 76% of Americans have at least a fair amount of confidence in scientists to act in the public interest (Pew Research Center, Oct. 2016), including an appreciation for the positive impact that science research has on the environment. And about the same number (~70%) think that government investment in basic science research pays off (Pew Research Center, 29 Jan. 2015). There is, however, substantial disparity between how the public and scientists perceive science-related issues and the contribution of scientific efforts to society. For example, the same study (Pew Research Center, 29 Jan. 2015) reveals the divide among the public regarding perceived consensus by scientists on fundamental topics such as the big bang theory, climate change, and evolution (Fig. 1A). The public is also largely pessimistic regarding the role geoscience research plays in guiding clean air, water, and land-use regulations. And despite the fact that nearly 60% of the public appreciates the impending resource limitation due to population growth, 4 in 10 remain confident that “the world will find a way to stretch its existing natural resources” (Fig. 1B). In this context, it is not hard to appreciate why we struggle to generate government and public support for the geoscience enterprise.

“MIND THE GAP”: A PERSISTENT MULTI-DIMENSIONAL PROBLEM

This introduces the “Mind the Gap” in my title. Eldridge Moores, my long-term friend and colleague at the University of California Davis, introduced “the gap” in his GSA Presidential Address, 21 years ago (presented in Oct. 1996, published as Moores, 1997). He spoke of the divide that separates the science literate from those in society who have far less knowledge of and/or regard for the sciences. And he articulated how this divide fuels misunderstandings regarding the scientific process and the

relevance of its findings. Since that time, aspects of the “gap” have been a recurrent theme in presidential addresses. This has been articulated by past GSA presidents as the need for increased

A Mixed Perceptions of Scientific Consensus About ‘Big Bang,’ Climate Change and Evolution

% of U.S. adults saying that scientists generally believe/are divided that the universe was created in a single, violent event often called “the Big Bang”



% of U.S. adults saying that scientists generally agree/do not agree that the earth is getting warmer due to human activity



% of U.S. adults saying that scientists generally agree/do not agree that humans have evolved over time



Survey of U.S. adults August 15-25, 2014. Q32, Q23, Q18. Those saying don’t know are not shown.

PEW RESEARCH CENTER

B Resources and Population Growth

% of each group saying the growing world population will or will not be a major problem because...



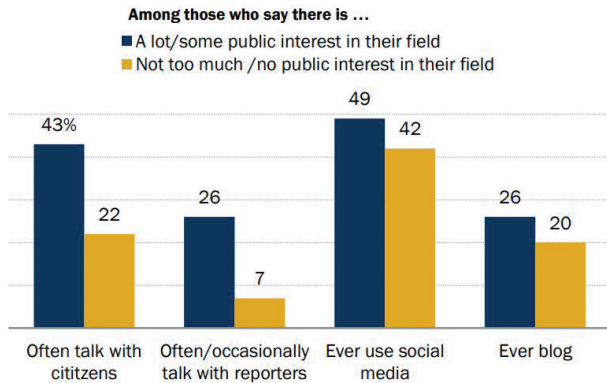
Survey of U.S. adults August 15-25, 2014. Q28. AAAS scientists survey Sept. 11 – Oct. 13, 2014. Q24. Those saying don’t know or giving no response are not shown.

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Figure 1. Pew Research Center study (29 Jan. 2015) of the public’s view on science and society. (A) Results illustrating the divide among the public regarding perceived consensus by scientists on the big bang theory, climate change, and evolution. (B) The public and scientists’ response to whether the growing world population will negatively impact food and resources.

Scientists Who See More Interest Among Citizenry Are Also More Likely to Engage with Public

% of AAAS scientists in each group who do the following in connection with science research



AAAS scientists survey Sept. 11- Oct. 13, 2014. Q50a-f. Ever use social media based on combined responses to Q50d,e. Ever blog based on combined responses to Q50a,f. Other responses and those giving no answer are not shown.

PEW RESEARCH CENTER

Figure 2. Pew Research Center study (15 Feb. 2015) of the percent of AAAS scientists who engage with the public. Those scientists who perceive some to a lot of interest by the public in their field (dark blue boxes) also engage more with the public than those who see less interest in their scientific field (gold boxes).

engagement with our elected representatives and decision makers, broadening of inter- and cross-disciplinary efforts, investing in the next generation of geoscientists through more effective mentoring and better alignment between student training and future industry trends, and greater infusion of geoscience into K–12 education (Zoback, 2001; Mosher, 2002; Bahr, 2010; Geissman, 2012; Davis, 2013). So why revisit this message now? Because the “gap” is a persistent and detrimental problem. The “Mind the Gap” in my title is a play on words. In Ireland, where I was on sabbatical in April through July 2017, there are signs in rail stations and trains cautioning travelers to “mind the gap” between the railway and the platform. Irish transportation authorities persistently warn people to be mindful of this gap as it is often larger than one appreciates.

We live in a historically significant time—one with new norms. We are moving away from a culture that values evidence-based decision-making to one that is more accepting of actions that are informed by “alternative-truths.” This is reflected in the confusion that fake news has created regarding Americans’ understanding of issues, including those that are science-based (Pew Research Center, Dec. 2016). And so the gap expands as the inherent uncertainty that we accept as part of the scientific process is translated into cut-and-dried discussions. Or when overly simplistic, unsubstantiated claims are

imposed on complex science-based issues. I argue that a fundamental contributor to this problem is the lack of sufficient *effective* public engagement, including science communication. There is much potential to resolve this problem. We see this potential manifest in Americans’ overall level of curiosity about science (81%)—a curiosity that is not matched by the amount of desired information they receive (Pew Research Center, Sept. 2017).

We, as part of the scientific community, are contributing to the gap. It turns out that geoscientists stand out well in this community for recognizing the importance of reaching out to the public. I define the public here as including the media and key decision makers. But still, studies show that relatively few among us regularly engage with the public (Fig. 2; Pew Research Center, 15 Feb. 2015). We tend to shy away from such activities for fear of being misrepresented or politically branded. Some argue a lack of time or skills to do so effectively or consider more than “dissemination of information” a futile distraction from research (The Royal Society, 2006; Besley and Nisbet, 2011). Consequently, only 31% of Americans believe scientists communicate effectively (Heagerty, 2015). This is despite their interest in and respect for the importance of scientific contributions to current environmental, political, and social issues. Change, however, is on the horizon—the enthusiasm for public engagement is

increasing, in particular among younger scientists (Scientific American’s Board of Editors, 2018).

The March for Science earlier this year was one of the first outpourings of support, but it was a sedate affair. I participated in the March in Dublin, Ireland (Fig. 3A), whereas many others participated in marches in the USA and around the globe. What we all recall are the folks on the sidelines encouraging us to shout more. Maybe we should. Not in a partisan manner but figuratively in well-strategized ways that capture the attention and persuade those outside of the scientific community of the importance and relevance of what we do. Notably, a recent study shows that the public’s support for such engagement efforts scales by age group (Fig. 3B; Pew Research Center, May 2017), a trend that anecdotally is mirrored in the new generation of geoscientists (Scientific American’s Board of Editors, 2018).

Adding to the size of the gap is the fact that the scientific community has long assumed that public apathy and disagreement with science is based on ignorance—this is, the well-studied “information-deficit model” (Besley and Nisbet, 2011; National Academies of Sciences, Engineering, and Medicine, 2017). And scientists further believe that the solution to the problem is a flood of more data, at times with an unconscious bias to “dumb it down.” But studies repeatedly show that this assumption is unsubstantiated and

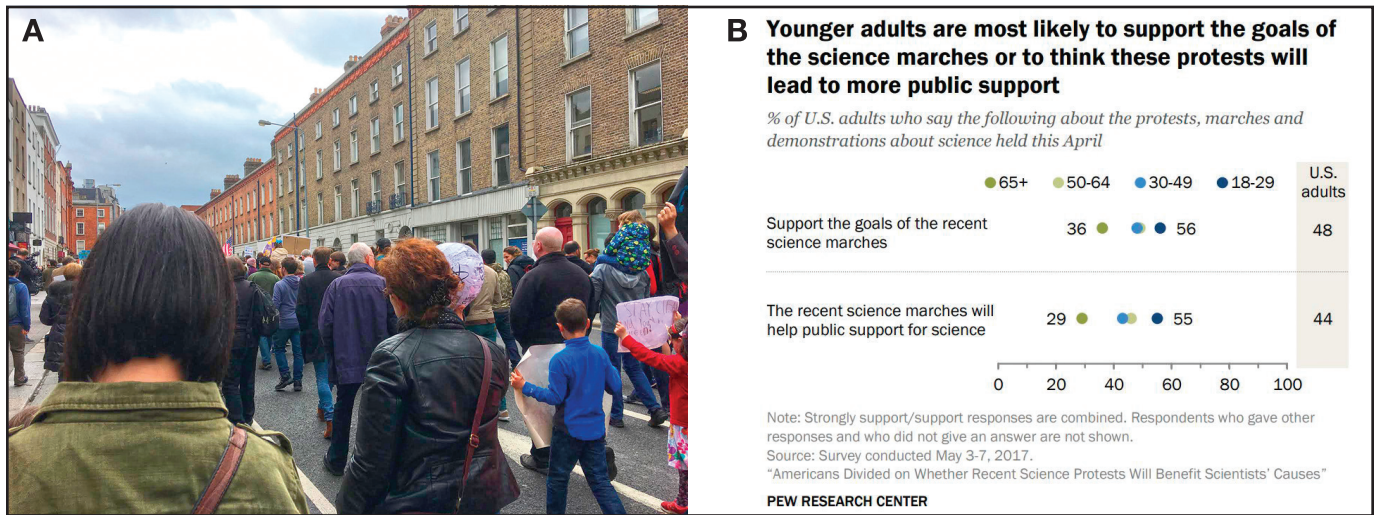


Figure 3. The March for Science, 22 April 2017. (A) The March in Dublin, Ireland. Author’s photo from Merrion Street Upper on the way to the Government Buildings, Dublin. (B) Pew Research Center study (Pew Research Center, May 2017) indicating that support for the goals of the science marches and their perceived impact generally scales by age group.

only serves to expand the ideological divides developed around evidence-based issues (Kahan, 2010; Braman et al., 2012; Pew Research Center, Oct. 2016). Complicating this issue is the rapidly evolving shift from legacy media to online platforms. It is clear, however, that dissemination does not equal public engagement (Heagerty, 2015). The scientific community needs to move beyond the traditional focus on one-way transmission of knowledge to one of community discourse (e.g., National Academies of Sciences, Engineering, and Medicine, 2017).

OPPORTUNITIES TO BRIDGE THE GAP

In every crisis, there is opportunity. High-quality public engagement has been shown to increase the public’s positive perception of science (Liang et al., 2014), to elicit policy change, and to increase federal research funding (Bergan, 2009). The scientific community appreciates that decisions informed by scientific understanding will always trump those based on unsubstantiated or confused arguments.

Here, I build on the “call to bridge the gap” articulated so well by previous GSA presidents. Why? Because the “gap” remains, has grown larger, and now represents a true threat to how geoscience research will be funded, accepted, and utilized by those outside our scientific community. And GSA is critical to bridging the “gap.” A core component of GSA’s mission is to promote and communicate geoscience findings. The Society has several programs available that do this well and I’ll highlight a few in the following discussion. I see three emerging opportunities for enhanced public engagement by the Society.

1. Empowering a New Generation of Receptive Geoscientists

This opportunity is presented by the current demographics of our membership. Students and early career professionals make up 43% of GSA (Fig. 4). This age group of geoscientists has spoken clearly regarding their interest in being part of the solution. They want to develop professional skills that provide them access to high-profile and interactive science discourse. In 2013, the National Science Foundation “challenged” graduate students across the USA to identify ways to improve their education. More than 500 students articulated a common desire for improved training in transferable and marketable professional skills, which are not traditionally taught in the geosciences or other STEM fields. The single most common skill identified was science communication—they want to excel at making science more accessible to the public (e.g., Shorr et al., 2013; Scientific American’s Board of Editors, 2018). The students appreciate that engaging the public increases science literacy, leads to more informed policy decisions, and improves K–12 education. More effective public engagement will inspire the next generation of scientists and create advocates for the geosciences.

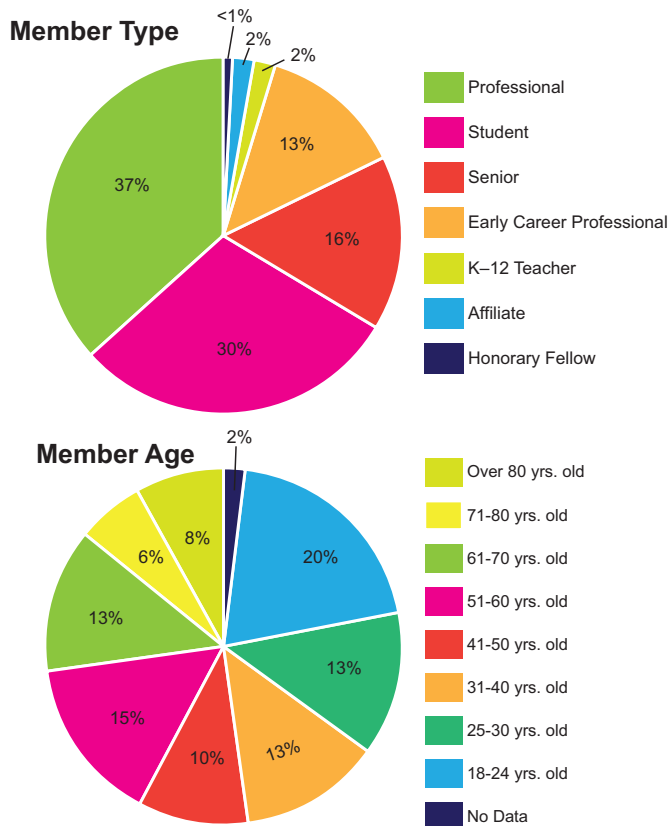


Figure 4. Demographics of GSA members by membership category and age (2017).

Industries of geoscience graduates' first jobs by degree field for the past four years

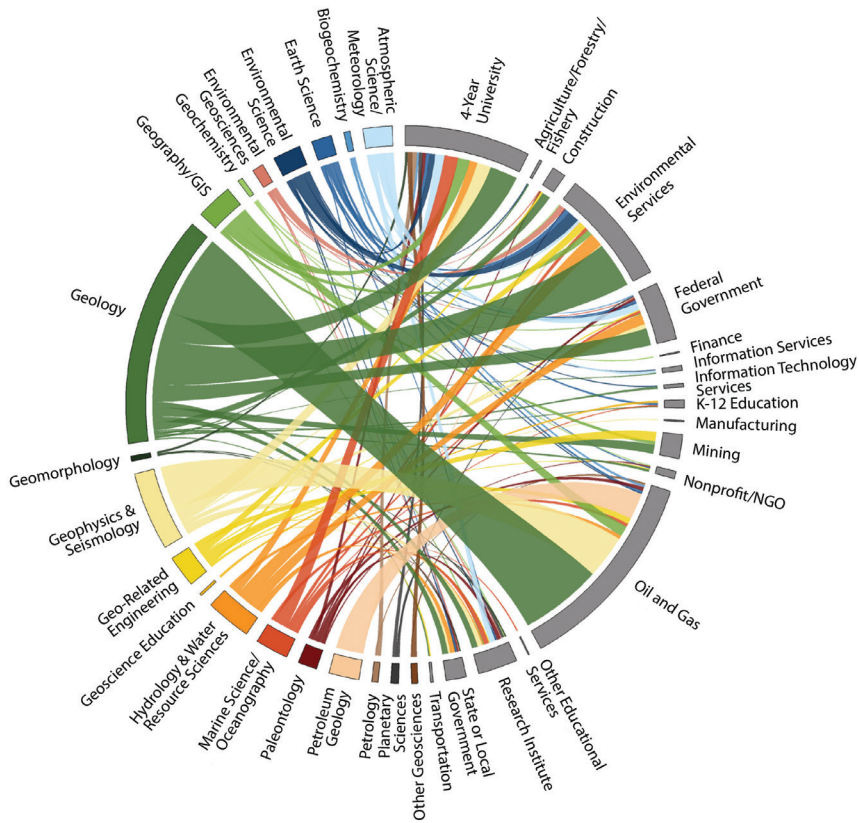


Figure 5. Visualization of the industries in which geoscience graduates obtain their first jobs by degree field for the period 2012–2016. Reprinted from AGI report on the “Status of Recent Geoscience Graduates” (Wilson, 2017). Courtesy of Carolyn Wilson (2018).

At the same time, the new generation of geoscientists is also casting a wider net regarding career options. A recent American Geosciences Institute report (Wilson, 2017) demonstrates the complexity of the workforce and diversity of jobs in which geoscience graduates are placed—at all degree levels (Fig. 5). In this environment of expanding geoscience career paths (e.g., science policy, media outreach, public affairs strategy firms, not-for-profit organizations), incorporating effective science communication into their training expands students’ career options.

2. GSA’s Decadal Strategic Planning for Future Vitality

The second opportunity is provided by the Society’s decadal strategic planning effort. Through 2018, we will be working to develop a bold and empowering plan to guide the Society and to enhance its vitality. This effort will engage the membership broadly. We are asking members to envision future needs within the framework of this changing societal landscape. A key

component of assuring our future vitality is evaluating how we can best engage with the public and guide geoscience policy. We have a lot to build on at GSA given our existing activities in this arena. For example, the Society offers professional development in science communication through a short course at our annual meeting, designed on the basis of the American Association for the Advancement of Science (AAAS) workshop *Communicating Science: Tools for Scientists and Engineers*. We are active in “pushing out”—that is, distributing press releases and facilitating press interactions with our members at our meetings as well as throughout the year. Christa Stratton, the Director for Education, Communication, and Outreach at GSA has proactively developed a member-experts directory for media inquiries. Our efforts in these venues are successful, but it’s a case of small numbers. This year, we appointed our first Science Communications Fellow, Beth Geiger, chosen from an impressive pool of more than 125 science journalism applicants. This is made

possible through the largess of the Bruce R. and Karen H. Clark Fund, which is directed at improving the level of understanding between GSA members and the non-scientific community. As part of a longer-term effort, to which I am strongly committed, Geiger mentored four communication interns in Seattle. These are students who want to be part of the “solution” by creating a more scientifically informed public.

On the science policy side, GSA engages through the Geology and Public Policy Committee and the Geology and Society Division. And it maintains a geoscience policy office in Washington, D.C. Kasey White, who directs that office, and our new Science Policy Fellow, Lindsay Davis, along with the on-the-Hill Congressional Science Fellow, Melanie Thornton, represent GSA within the Beltway and work to bring science and scientists into the policy process. But, if my experience is any indication, I suspect that many of our members underappreciate the opportunities that GSA’s policy office provides. For example, Geoscience Day on the Hill and Climate Science Day provide opportunities for our members to obtain hands-on professional policy and communication training and to interface one-on-one with members of Congress and their staff. The Earth and Space Science Caucus sponsored by the U.S. House of Representatives is testament to the success of these visits and the power of individual GSA members to build champions for the geosciences. This event is a direct response from Congress to the scientific community’s “ask” delivered at a previous Geoscience Day.

During the strategic planning process, we will be looking for additional ways to better engage the public. As we look inward within our Society, we will be asking “How can we better communicate our professional development opportunities to the members?” Looking outward, our public engagement initiatives can be guided by the new science of “science communication” (National Academies of Sciences, Engineering, and Medicine, 2017). A whole discipline is addressing the need for public discourse in the context of the ideological values that underlie science issues. Opportunities to leverage existing resources are plentiful. For example, the success of the National Association of Science Writers (<https://www.nasw.org>), composed of 2,200 plus freelancers, relies

on good working relationships with individual scientists. We can help to connect them. We might consider how we can become involved as a Society in activities that broaden the public audience to include the sector that is not typically reached by traditional outreach approaches (e.g., museum exhibits, websites, science documentaries; Nisbet and Scheufele, 2009). Or we can find ways to better engage the public by addressing issues through the perspective of shared ideology. Three GSA members recently initiated a dialogue for this type of paradigm shift in science advocacy (Davidson et al., 2017). And I'll admit, I still hope to see one of our colleagues as the guest on one of my favorite late-night comedy shows.

3. Taking a Leadership Role in a Geoscience Culture Change

I referred previously to three opportunities. The third is to assume a leadership position in changing the culture in our workplace. This culture change requires overcoming the negative stigma that we hold regarding public engagement (Mellor, 2010; Liang et al., 2014). In academia, we can add science communication training to our curriculum. Recall the bygone days when graduate programs had a language requirement? Well, consider science communication training as making the next generation “bilingual” (as coined by Jane Lubchenco [2015])—that is, having the skills to captivate the public by effectively translating complex scientific knowledge.

There are well-regarded professional training and engagement workshops, such as those offered by AAAS or COMPASS, which can seed future in-house training efforts in the workplace, whether it be academia, industry, government, or NGOs, thus reaching out to many. I want to share one of my favorite out-of-the box examples. It took just three Ph.D. students, who self-proclaim to have been “frustrated with the public perception of science,” to instigate a university-wide initiative in cutting-edge science communication at Carnegie Mellon University (Shorr et al., 2013). The program offers a curriculum of workshops and seminars utilizing empirical knowledge on how modern societies interpret science-based debates in order to train the next generation of scientists to be effective communicators. But here's the cool thing: this initiative, which involves students, faculty, administrators, science

communicators, and journalists, was an outgrowth of these students' submission to the NSF Graduate Education Challenge that I mentioned earlier. Now that is what I call being empowered!

Even when we acknowledge the value of public communication and the efforts needed to do so, there is little protocol for legitimizing them (e.g., Lubchenco, 2017). GSA, through its platforms for public engagement, serves as a beacon of support for such activities. But it also requires that individual members be advocates at their institutions. As individuals we need to look for ways to formally recognize investments in public engagement and to educate administrators as to the importance of such endeavors, clearly articulating that such efforts do not come at the expense of scholarly activities, which are perceived as more important. Doctoral candidate Daniel Pham provides a poignant perspective on this issue and the overall importance of public engagement to young scientists and future science research (Pham, 2016).

I offer one final point. That is, each of us needs to constantly reevaluate the relevance of the science in which we are engaged and find ways to effectively communicate that message. My point is not to advocate for the need for “the relevancy of our work” but rather to stress that every one of us invests in work-related or training efforts that benefit humanity in one way or another. This relevance, however, is not always intuitive. As a sedimentary geologist and geochemist interested in deep-time paleoclimatology, establishing the relevance has been all too often hard earned. But I never miss the opportunity to view my large classes of undergraduates as keen future voters receptive to new ideas. And I've pitched the relevance of the deep-time geologic record to climate change discussions to the public and to federal funding agencies (National Research Council, 2011), as well as on the Hill through opportunities provided by GSA's policy office in Washington, D.C.

CONCLUDING THOUGHTS

I reiterate GSA's commitment to promoting the geosciences through effective public engagement. As individuals you may choose to “engage” in various ways or to differing degrees, but it is our collective responsibility to bridge the “gap” through championing the efforts put forth by our colleagues and students. And we can all

actively promote informed conversations within and beyond our Society. As my graduate students and family know all too well, I'm a big fan of President Abraham Lincoln. There is wisdom in his words “Public sentiment is everything. With public sentiment, nothing can fail, without it, nothing can succeed” (A. Lincoln as recorded in Angle, 1991).

ACKNOWLEDGMENTS

Many thanks to Joseph White (Baylor Univ.), Chris Fedo (Univ. of Tennessee), Tessa Hill (Univ. of California, Davis), and Kasey White (GSA geoscience policy office) for engaging and eye-opening discussions. Thanks also to Christa Stratton, Director for Education, Communications, and Outreach at GSA, for her help in developing aspects of this address and to Eldridge and Judy Moores and David Osleger, whose feedback greatly improved its effectiveness.

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Status

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Indianapolis, Indiana, USA, Annual Meeting Mini-Workshop, 2–4 Nov.	COMING SOON

Garden of the Gods, Colorado Springs, Colorado, USA. Photo by Dean Moosavi.



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