Science Societies

The distance and depth problems: A thought experiment for mid-summer

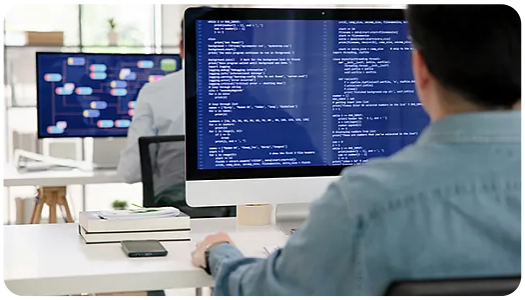
By Aaron Lee M. Daigh

June 15, 2026

In last month's column, I closed with an invitation to dig a hole this summer. While drafting it, I also realized that for a growing share of soil scientists, that invitation is not obvious. Not because folks are unwilling, and not because they do not love the discipline, but because the work, as we have structured it over the last couple of decades, does not always require it. I think the discipline, along with other related disciplines in hydrology and plant sciences, is living through a shift, and naming things is usually the first step toward being deliberate about them. So, this month I want us to run a thought experiment together.

In brief, soil science is increasingly practiced at a distance from soil itself. That distance shows up in at least three places, and I want to walk through each of them briefly. Rather than diagnosing the discipline, I want to ask what we want to be deliberate about as we keep moving forward. Then I want to look at what sits beneath all three.

Distance from the pit



In some cases, data scientists are being hired over soil scientists. Photo courtesy of Adobe Stock/ChayTee.

The first distance is the most visible of the three. Over the years, a growing number of graduating students pursue their degrees without ever having taken a soil sample themselves for their own research. The samples were collected for them or the dataset came pre-delivered from a collaborator. In the last couple of decades, the same may be truer for the PI's themselves. This is not a criticism of those students and colleagues as many of them

are excellent scientists doing rigorous work. It is simply a description of how the pipeline is now structured.

The hiring side of the ledger is shifting too. Industry positions that used to pull exclusively from our soil science programs are now reviewing candidate pools that mix soil science with data science graduates. In some cases, the data scientist is being hired over the soil scientist. This signal tells us something about what some employers now believe the job requires.

None of this is an argument against proxy measurements, remote sensing, or AI-facilitated research. All of these are here to stay, and all are genuinely expanding what our discipline can see. The question underneath is different. What changes, over 20 years of a career, when the field becomes optional? I do not have a robust answer. I have my suspicions. But I think we owe ourselves the question.

Distance from the 'diversity of ground'

The second distance is harder to see because it lives in our habits of attention rather than in our curricula. The 'diversity of ground', meaning the fundamental breadth of soils, geographies, and conditions that any confident statement should be tested against, is one of the few things that only we can protect. It is worth protecting on purpose. Spend any time on professional social media or read the popular framing of new soil research, and you will notice a pattern. Single studies get framed as revolutionary. Preliminary results are exalted as immediately applicable. Every other finding seems to be a paradigm shift that should change how land is managed starting this Tuesday… and if you wait until

Thursday, you have missed the opportunity.

That is not how soil science works. Our discipline is, at its best, a patient accumulation of cautious and consistent evidence across many sites, many seasons, many soil orders, and many decades. The story we are actually qualified to tell is the story of what holds up fundamentally and its emergent expression under any set of local conditions.

I understand the incentive to over-hype a single result, and I sympathize with colleagues (regardless of their career stage) who feel pressure to perform visibility. However, a discipline that trains itself to speak in revolutions will eventually lose the ear of the producers, policymakers, and public who need us to be right, not loud.

Our discipline is, at its best, a patient accumulation of cautious and consistent evidence across many sites, many seasons, many soil orders, and many decades.

Distance from our own data

The third distance is the one I understand the least well. The carbon-market and ag-tech boom of the last decade has generated soil data at a scale our discipline has never seen before. Soil carbon measurements, nutrient maps, and sampling across millions of farmland acres. Much of it is of genuine scientific interest. Most of it sits

inside proprietary systems that the scientific community cannot access, verify, or replicate.

Dr. Scott Shearer named this tension during the keynote panel at CANVAS 2025 in Salt Lake City. What does it mean to be the scientific society responsible for a medium whose largest emerging dataset lives behind non-disclosure agreements (NDAs)? I am not arguing that landowners and private companies should be obligated to open their books. They have legitimate reasons for the structures they have built. The question on my mind is more along the lines of "what are the professional norms, data-sharing standards, and partnership frameworks that will let the scientific community stay relevant to the evidence base accumulating around us?" I think we need to lean into developing answers together before defaults settle into place, get ingrained, and without our input.

Beneath all three: The depth problem

The everyday practice of soil science is moving further from direct contact with the medium we are named for. However, the distances are not really the cause of the shift. They are the visible part. To understand why all three are possible at the same time, we have to look at what is happening beneath them in the academic and institutional foundations of the discipline itself.

The load-bearing subdisciplines that our community has been built on, including soil physics, mineralogy, pedology, chemistry, and biology, are being quietly thinned even as the concepts built on top of them (such as soil health) gain cultural momentum. Photo courtesy of NRCS Flordia. PDM 1.0.

Soil health has broken through in ways that few of us who started in the field two decades ago would have expected at the scale we see today. Recognition in policy circles. Farmer uptake. Coverage in the popular press. Even mentions in Hollywood movies. Hartemink and McBratney (2008) saw the early signs of this shift nearly two decades ago, describing what they called a soil science renaissance driven by renewed public and policy attention to soils. That is a major win for our discipline. Our community has worked for a long time to get soil into the broader public conversation, and we should own that accomplishment.

However, popularity at the surface can also not reflect what is happening underneath. The load-bearing subdisciplines that our community has been built on, including soil physics, mineralogy, pedology, chemistry, and biology, are being quietly thinned even as the concepts built on top of them gain cultural momentum.

This is not a new concern, and our community has been documenting it for some time. Baveye et al. (2006) found that enrollment in M.S. and Ph.D. soil science programs across U.S. and Canadian universities dropped by approximately 40% between 1992

and 2004. Hartemink and McBratney (2008) documented how soil science departments across the country were being renamed, merged into broader units, or cut altogether during this same period, and Brevik (2014) showed that SSSA membership itself declined by approximately 15% over the decade from the early 1990s to the early 2000s.

More recent reviews (Brevik et al., 2022; Uchida et al., 2026) have shown that the discipline of soil science has been attenuated at many universities worldwide, with declining public support for higher education and pressures for cost-effective teaching pushing soil science out of dedicated departments and into broader environmental or land-resource units. Faculty lines in these foundational areas are flat or declining at many universities. Departments have been absorbed into broader units, sometimes losing the word "soil" from their names altogether. Graduate training has been shifting toward applied synthesis at the expense of foundational depth. When I joined the Connections podcast series earlier this year with the ASA and CSSA presidents and our ACSESS CEO, this was one of the overarching challenges I named for soil science.

Basic soil science is where our future questions get their footing, and when it is no longer funded, we find ourselves in a position of slowly spending down a reserve that took

generations to build.

The funding environment pushes in the same direction. A growing share of the research dollars available to our field flows toward utilitarian, deliverable-driven projects (work with a near-term application and a tangible product at the end) instead of toward the basic, curiosity-driven soil science that the applied work ultimately depends on. This is certainly understandable as applied questions are easier to justify to funders and to the public, and they often come with industry partners who can help carry the cost. However, basic soil science is where our future questions get their footing, and when it is no longer funded, we find ourselves in a position of slowly spending down a reserve that took generations to build.

Soil science is not alone in this pattern. The taxonomy community in biology has been living through a remarkably similar shift, where the rise of molecular and bioinformatic approaches has been accompanied by a documented decline in classical taxonomic expertise (Funk, 2018; Páll-Gergely et al., 2024; Engel et al., 2021). Fewer faculty positions are dedicated to organismal taxonomy, fewer students are training in it, and fewer institutions are investing in the natural-history collections that the work depends on. The result, as biologists have described, is a "taxonomic bottleneck," where the foundational ability to identify what is being studied is shrinking even as the demand for that knowledge grows. The parallel to soil science is worth noting. It is a different discipline experiencing the same kind of shift.

> The point here is that broad is not the same as deep. A discipline that has a popular concept on top but a thinning bench of foundational expertise underneath is, over

time, a discipline that loses the ability to ask the harder questions. The three distances I described earlier are all downstream effects of this thinning.

Faculty advisers and mentors should consider encouraging students to take on fundamental research fully or nest it within an applied research project. Photo courtesy of Adobe Stock/qunica.com.

This is not a problem any one member can solve alone. However, there are concrete actions that members and leaders within our community can take immediately. Faculty advisers and mentors can encourage students to take on fundamental research fully or by nesting it within an applied research project. Students can present their foundational work in other discipline's departments and display their knowledge to not just new stakeholders, but to new colleagues too. Department heads can defend foundational faculty lines when they come up for replacement, rather than letting them be converted into broader appointments by default. All of us can nominate colleagues for Society awards, where recognition still carries weight in promotion and tenure decisions. None of these actions are dramatic, but when taken together, they could aid in changing the trajectory.

Why the hard parts matter

There is a human dimension to all of this. The foundational work of our discipline (the digging, the describing, the patient characterizations and measurements that do not always produce a quick result, the reconciling the nuances of a first-principles theory with your observation) is hard, and it is supposed to be hard. That difficulty is part of the point because it is where a great deal of the learning and growth happen.

Universities are under pressure right now to make college fun and constantly stimulating. I am not against students enjoying their education, and I am not romanticizing struggle for its own sake. But I worry that in chasing constant positive stimuli, we have grown reluctant to let students wrestle with problems that feel insurmountable at first—the kind you do not know how to solve on Day 1 and that require you to fail, recover, and try again. There is an idea in learning science called "desirable difficulties." The basic notion is that real struggle, when a problem is hard enough to demand genuine effort but still within a student's reach, is what produces the deepest focus, learning, and growth. I recall folks referring to examples of this type of induced focus as "athletes in the zone" and "jazz musicians locked in the pocket."

One kind of desirable difficulty is standing in a freshly dug pit, trowel in one hand, trying to decide whether that lower horizon is truly argillic or just a change in color, working the soil into a ribbon between your fingers to argue yourself toward a texture class, debating where one horizon ends and the next begins, and slowly assembling the story the profile is telling about climate, parent material, and time. Another desirable difficulty is taking a dataset you collected with your own hands and realizing that no one is going to tell you what it means and that the interpretation is now yours to build.

Caption: Standing in a freshly dug pit with trowel in hand, interpreting whether a lower horizon reflects a true change in soil properties or simply a shift in color is an example of a "desirable difficulty." Photo courtesy of Garrett Liles and originally submitted with this article .

Here is what I think we forget when we optimize that struggle away. College is one of the few places in a person's life that is built to be a safe place to take on real risk. A young scientist can attempt something difficult and intimidating, fail at it without the stakes being ruinous, and come out the other side having learned that they are capable of more than they believed when they walked in. The field is one of the best teachers we have for this because the soil does not care about our deadlines or our confidence. It humbles you, and then it rewards the patience you bring back to it.

Every time we take a student to a pit, hand them an auger, and let them be confused for a while … we are training a soil scientist, and we are giving a person the lived experience of discovering their own capability.

And this is where I have the most hope. The very thing we are at risk of losing is also the thing most within our power to keep, and keeping it costs us nothing but intention. Every time we take a student to a pit, hand them an auger, and let them be confused for a while before the landscape finally clicks, we are doing two things at once. We are training a soil

scientist, and we are giving a person the lived experience of discovering their own capability. I have watched that shift happen many times over the years—the moment a student stops asking me for the answer and starts defending one of their own. There is a particular joy in that moment, for the student and for me, and it is not a joy our discipline will ever automate or outsource. Better still, it is renewable. It is on offer every field season, with every new student, for as long as we are willing to keep handing over the shovel and opportunity.

None of us are doing this alone

The Society is not a bystander to any of these problems, and neither are you. Over just the past year, I have watched us push on every level where this fight actually happens.

At the federal level, more than 50 of us walked the halls of the Senate and House this winter during our Congressional Visits Day, making the case for AFRI, AgARDA, and FFAR, and we held our first House Soil Caucus reception of the 119th Congress to put soil science in front of the people who fund it. That is how we defend the research dollars our discipline depends on. However, we can do more to defend basic research dollars by expanding our science policy portfolio to include programs within DOE, NSF, and other government programs.

In our own publications, our four journals continue to give foundational soil science a home, and the President's Picks section of this magazine exists precisely to pull the patient, careful work out from behind the headlines and put it in front of you each month.

Our new Grassroots RFP invites any member to bring forward a Working Group, Commission, or Consortium and put the full weight of the Society behind it.

At the local and divisional level, our committees, our elections, our award nominations, and the "SSSA: Looking 40 Years Forward" task force are all places where an individual member can shape what the discipline values and rewards. And at the grassroots level, our new Grassroots RFP invites any member to bring forward a Working Group, Commission, or Consortium and put the full weight of the Society behind it, including staff support, our networks, and direct help building external funding. It is not a check handed to you. It is the institution itself, offered to your idea.

And these are only the efforts already visible. Others are in the works right now, and they will become evident later this year. Ninety years in, the most underrated thing this Society offers may be its durability, the way it absorbs the shocks of funding cycles and shifting outside priorities so that our science can keep playing the long game.

I lay all of this out for a reason. The desirable difficulties I have been describing are not burdens we ask our members to shoulder alone. When a young scientist takes on the hard, foundational work, there is a Society working at the same time to fund it, to publish it, to recognize it, and to give it a structure that lasts. That is the part that drew

many of us to this community in the first place, and that pull has not faded over the decades.

Thought experiment

The thought experiment I would like us to chew on is not *should we reverse the drift*. Reversal is neither possible nor desirable. The thought experiment is this: ***what do we want soil science to still require of its researchers, educators, and practitioners in 20 years?***

Not what it *will* require, but what we want it to require. They are different questions, and the second one is ours to answer.

I do not think we have to answer it this summer. But I do think we should start asking it out loud, in our divisions, in our graduate programs, in our hiring conversations, in our conversations with elected politicians, and at CANVAS in Portland this November. The answer we land on, collectively, will shape the discipline the next generation inherits.

So here is my ask: Dig a hole this summer. Stand in it long enough to get confused. Then come back and tell me what you want this discipline to still require of us.

References

Baveye, P., Jacobson, A.R., Allaire, S.E., Tandarich, J.P., & Bryant, R.B. (2006). Whither goes soil science in the United States and Canada? *Soil Science*, *171*(7), 501–518. https://doi.org/10.1097/01.ss.0000228032.26905.a9

Brevik, E.C. (2014). Soil science: Selected historical highlights in celebration of the upcoming International Year of Soils. *Soil Horizons*, *55*(6), 1–5. https://doi.org/10.2136/sh2014-55-6-gc

Brevik, E.C., Krzic, M., Muggler, C., Field, D., Hannam, J., & Uchida, Y. (2022). Soil science education: A multinational look at current perspectives. *Natural Sciences Education*, *51*(1), e20077. https://doi.org/10.1002/nse2.20077

Engel, M.S., Ceríaco, L.M.P., Daniel, G.M., Dellapé, P.M., Löbl, I., … & Zacharie, C.K. (2021). The taxonomic impediment: A shortage of taxonomists, not the lack of technical approaches. *Zoological Journal of the Linnean Society*, *193*(2), 381–387. https://doi.org/10.1093/zoolinnean/zlab072

Funk, V.A. (2018). Collections-based science in the 21st century. *Journal of Systematics and Evolution*, *56*(3), 175–193. https://doi.org/10.1111/jse.12315

Hartemink, A.E., & McBratney, A. (2008). A soil science renaissance. *Geoderma*, *148* (2), 123–129. https://doi.org/10.1016/j.geoderma.2008.10.006

Páll-Gergely, P., Krell, F.-T., Ábrahám, L., Bajomi, B., Balog, L.E., … and Móra, A. (2024). Identification crisis: A fauna-wide estimate of biodiversity expertise shows massive decline in a Central European country. *Biodiversity and Conservation*, *33*, 3871–3903. https://doi.org/10.1007/s10531-024-02934-6

Uchida, Y., Krzic, M., Hannam, J., Brevik, E.C., Field, D.J., Vancampenhout, K., Zhu, F., Reuter, R., Utami, S.R., Mukumbuta, I., & El-Ramady, H. (2026). The future of soil science education at the university level to meet societal demands at the global level. *Natural Sciences Education*, *55*, e70052. https://doi.org/10.1002/nse2.70052

More President's Messages

Back to issue

Back to home

Rate this article