2008 GSA Joint Annual Meeting Presidential Address:
A field geologist looks at a digital world

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We are living in a world that is changing at an ever-accelerating pace. In 2005, artificial intelligence engineer and futurist Ray Kurzweil provided some compelling documentation to show that we are turning the corner on an exponential curve of technological complexity and facility. The first part of an exponential curve looks linear, but once you turn that corner, everything changes, and projections that have been based on this linear portion are going increasingly wrong.

Kurzweil predicts a singularity, when humans and their technology will be indistinguishable, meaning, among other things, that all human knowledge will be downloadable directly into our brains and we will be able to process that knowledge with what would seem now like infinite speed. If such a world comes to pass—and we are closer than you might think—what would be the role of the Geological Society of America? That is the subject of this paper.

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Before I get into the role of GSA specifically, let me review a couple of trends. Science is becoming more democratic, and scientists are being gradually displaced as the sole primary producers in societal knowledge systems. As a former dean, I hear a rumbling noise approaching from behind that is the desire of our citizens to learn quickly, inexpensively, and on their own terms, not necessarily on the terms of the knowledge gatekeepers—us. If we don't respond, we will be made irrelevant. Based on my own observations and Kurzweil's trends, I believe we are much closer to this reality in some senses than we realize, and I believe we need to be thinking deeply and profoundly about how to stay ahead of these trends.

Five or more years ago, I started hearing colleagues and, especially, students complain when they had to go to the library. When I came out of administration and started getting seriously back into the literature again, I was astonished at how much I could access from my desktop, and now even I feel a slight disgruntlement when I have to interrupt my work to make the trek to the library, especially when it's snowy and icy. Of course, like everyone else, I have long been using the World Wide Web extensively. Note the contextual definition of "long"—barely 15 years.

If we're accessing information that way, so is everyone else. An active interest and participation in science by citizens is becoming much more common. With increased access, people are doing their own analyses of the literature, and there has been a proliferation of Web sites tracking such analyses—right alongside Web sites that we would regard as reliable and authoritative, that is to say, Web sites that contain analyses by the knowledge gatekeepers. Those of us in academia know directly the challenge this presents, when students seeking knowledge stumble into plausible-sounding Web sites that present conclusions and hypotheses that are at variance with those of the established scientific community.

This means that the relationship between citizens and scientists is changing and changing quickly. First, students and others are far more likely to know about and expect answers to information that contradicts the wisdom we attempt to present. This is both healthy and distracting. It is healthy because it keeps us on our toes and means people are engaged. But it is distracting because we often feel our time is wasted answering points that we regard as spurious, and we sometimes feel dragged backward into issues we regard as settled but that in the minds of others are not.

Second, we are, as I have already alluded, being displaced as the sole primary producers of knowledge. In this era of what has been called post-normal science, society is no longer content for us to unilaterally choose and conduct our studies. There is a much greater interest in science at the front end, not only in what questions are asked but even how they are asked and what methods are used and the time frame within which the problems are resolved. If you don't believe this is happening, you aren't doing fish ecology on Native lands or fire ecology in logging communities or trying to start a new mine or remediate an old one. This change manifests itself in numerous ways; examples include the more-focused and shorter-time-frame research-funding initiatives at granting agencies or the participation of stakeholders in the definition of problems and the methodologies used to solve them.

And it also manifests itself in the conflict that arises—ever-increasingly it seems—between the scientists who conduct the research and the knowledge consumers who don't like the answers we come up with, particularly if they perceive that our political biases have interfered. Those who think this isn't important should look to our own institutions, where people who might be politically conservative are often not only shunned socially but scientifically as well. In my conservative state of Idaho, students frequently complain that the values their professors teach are contradictory to the values they were raised with, and they feel discriminated against. If we look

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upon our own colleagues and students with suspicion because of their political views, why should we expect a different behavior from our fellow citizens toward us?

Imagine, now, this world in which every citizen is enhanced, every citizen has access to information as soon as it is produced, and every citizen is producing or has the potential to produce information. Where does that leave us?

GSA generates well-regarded journals and other publications; GSA also archives data—a very important function that I will return to because it may become vastly more important than it is now. We host meetings, where people can gather to present and discuss their science and, not incidentally, socialize, or to put it another way, celebrate the fact that we are a community that shares a common interest. GSA provides a venue for running field trips—opportunities to see new geology and discuss science as it is happening. We also provide educational materials for teachers and students and help our members stay connected with other societies and with Washington, D.C., through the activities of the executive director, officers, and volunteers.

Which of these activities will be needed in the world of post-normal science and technologically enhanced humans?

GSA already uses the Internet almost exclusively to provide educational materials and to stay connected with other societies, Washington, and our members around the world.

Which of these activities will be needed in the world of post-normal science and technologically enhanced humans?

There will, I think, still be a place for venues in which to release information that has been transformed into knowledge and peer-reviewed. And even if we can download all human knowledge into our brains, that doesn't mean that the generation of new information will stop—indeed, it might speed up because we can spend more time on generating new data and less on trying to accumulate the background information all researchers must know to provide context and meaning to their new data. That new knowledge will have to somehow be encoded into what one might call the Universal Brain Access Database, or UBAD. So, one future role of GSA should continue to be the dissemination of new knowledge. Naturally, the information will be increasingly disseminated in electronic form, but we're already way down that track.

Archiving is also extremely important. Anyone who has been involved in trying to figure out the best direction to go in electronic journals knows that long-term accessibility to information preserved electronically is a major issue. Kurzweil pointed out that accessibility of old information is inversely proportional to the sophistication of the technology in which it is archived, with reading words on paper the easiest, onward to the greater difficulty of opening old word-processing files that haven't been upgraded with the installation of new versions of the programs. We can still read books written hundreds of years ago, but just try to read a file generated 15 years ago in, for example, MacDraw, if you haven't kept upgrading that file with new software. Kurzweil argued that only information someone cares about is preserved. As scholars, we know that important work might be ignored for decades then suddenly gain relevance as new hypotheses about how the world works are formulated, and we know how important it is to maintain the chain of scholarly reasoning on a subject. Just as I might be frustrated because I suddenly find myself in need of an old MacDraw file that I can no longer read, we might also find ourselves in need of previous scholarship and insights that were largely ignored at the time of production but have taken on new significance. GSA cares about geological information, and I see professional societies taking a larger role in preserving the information that *they* care about more than anyone. After the singularity, as humans upgrade their personal brain software to run the knowledge they want, they might not maintain what they don't care about, and that information could be irretrievably lost from the UBAD. Libraries will be overwhelmed and have to do triage, as they do today, so it will be up to societies like GSA to make sure that information important to us is permanently accessible.

Will we continue to host meetings? Can we imagine never seeing our colleagues again? The answer to that already exists—the technological capabilities for virtual meetings increase every year, and the uses of virtual reality have also developed apace. These technologies have merged, though still rather crudely, and we can already go to conferences without leaving our homes or offices. We can already enter this building and hall, see and greet each other, even shake hands or hug, go out for drinks—in other words, engage in all the activities that keep us connected as humans, all without leaving our families or spending the money to fly to some far off city—not to mention without adding more CO_2 to the atmosphere. Such virtual communities already exist, such as the one called Second Life®. Remember that the technology for such a community didn't exist—was barely conceived of—a scant 10 years ago. With such a community, you could be listening to my talk from the comfort of your living room and go to the talks that others give and be able to meet afterward for discussion. No more running around trying to catch talks adjacent in time but separated by the seeming miles of corridors in convention centers. Indeed, you could even replay a talk from a simultaneous session, because all this would, of course, be recorded. Even better—the person you are in the convention halls could look 15 pounds lighter and a little less gray!

But someone will have to organize all this, so GSA would still provide the service of constructing the meeting framework.

What about field trips? Field trip leaders have to run through the trips ahead of time and could record them as they go. Once the outcrops have been encoded, no reason not to do the field trips virtually as well, only without the long bus rides and lack of pit stops—definitely a boon for women and older men. Of course, some of the best conversations are on those long rides, so we might want to simulate them anyway using an enhanced version of Google Earth, but since we're at home, we can make our own pit stops without holding up the whole group. Oh, and we can always

have perfect weather, too. As with the meetings, GSA would provide the service of arranging these experiences, and a lot more people could attend.[1]

I used to have some reservations about virtual communities in general, even those merely composed of chat rooms and forums. But I found myself caught up in a couple of such groups, composed in my case of pilots. I have become friends with fellow pilots all over the world, and I have met many of them in person. I'd say my friendships with those I've met are richer, of course, but the face time I've had with those friends could have been done virtually in the manner I've just illustrated.

What couldn't be easily duplicated, of course, is the challenge and joy of flying to where I met them. The same sense of adventure and desire for challenge is what drives a lot of geologists, too, so there are some experiences that those of us with the adventure gene will never want to give up—risk and unpredictability are part of the experience. But there are times when risk and unpredictability are just inconvenient—personally, I hate trying to lead field trips in pouring rain.

In closing, let me add one other thought. Kurzweil's key prediction included the idea that the singularity, which he posits will occur in 2045, will be so profound that we will be able to keep ourselves, including our biological bodies, if we wish, alive forever.

Barring accident, I will be only 95 in 2045, well within my potential life span, given my fortunate genetic inheritance. That means that I and others my age could be among the very first to have to decide whether we want to live forever. I think it must be in human nature to wonder about the possibility of living forever, and I would be surprised if there is anyone who hasn't dreamed of it. But we have always been secure in the knowledge that it is impossible. When that impossibility becomes a possibility, however small, the implications are profound, and I would bet that many of you are saying to yourselves, as I did, "But I wouldn't *want* to live forever." But consider this: Wouldn't you love to see how Earth processes really *do* play out over geologic time?

Wouldn't you love to see how Earth processes really do play out over geologic time?

REFERENCE CITED

Kurzweil, R., 2005, The Singularity Is Near: New York, Viking Press, 672 p.

[1] The previous three paragraphs were, in my oral address, presented by my avatar in Second Life®. To view the presentation, go to www.geosociety.org/pubs/PresAddress.htm.