2012 Presidential Address: The Scientist as a Citizen of the World[1]

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One of the great pleasures of being president of the American Society of Human Genetics has been the opportunity to think about human genetics in the world beyond the lab. I was doing so one weekend near the beginning of my term, and part of my brain was also listening to reports from Tahrir Square on NPR. The reporter was a citizen journalist named Mona Seif, whom I'd heard several times previously on NPR and whose reports I had found very informative, rich in detail, concerned with precision, and aware of the limits of information from the frontlines. On this particular evening, it was difficult to hear the report from Cairo over gunfire in the square, but it was nonetheless direct and clear. A few months later, I heard an interview with Mona Seif, and in this interview she was asked about her work when not in Tahrir Square. She was a graduate student, she said, working in cancer biology. "My work in particular is on the *BRCA1* gene," she said, "which is one of the genes connected with breast cancer incidence, and I'm investigating the mutation pattern in Egyptian patients…. Both [science and activism] are very consuming, time and energy—and emotions. And I'm only starting to get the handle of doing both at the same time and juggling between my activism and my work" (see Web Resources). Her political work after the events in Tahrir Square has been as a member of No to Military Trials for Civilians, which advocates for the release of civilians detained by the military during the revolution. Hearing this interview on a quiet evening in my lab, I had a Proustian sense of déjà vu.

In this essay, I will explore that sense and its possible implications for a new generation of geneticists. Throughout this past year, I've been thinking about the scientist as a citizen of the world, the role personified by Mona Seif. In thinking about this role, I've realized that the scientist does not come to it by making explicit choices as for a field of study or a research project. Instead, the citizen-scientist role seems to me to grow organically from the culture of 21st century human genetics. I will try to suggest how this culture defines us in a natural way as world citizens. I hope that this analysis can provide a "reference sequence" for involvement in the world.

Our Culture

What, then, are some of the iconic features of our culture, what does it mean to us, and what responsibilities does it impose on us? The central feature of life in science is that the people doing it want to be here. We enjoy this life. Science is fun. Human genetics is enormous fun. It allows us to be imaginative and creative. It is work for a greater good yet appeals to our curiosity and our pleasure with puzzles solved. The work is useful and valued by society. What more could we ask?

We are all aware of our good luck to be working in a revolutionary period in human genetics. It's irresistible not to succumb to a sense of unlimited horizons. Every result, regardless of gene, pathway, or organism, is part of a whole story that will eventually make sense to us. The lesson of evolution is that the natural world is ordered and that people can figure it out. Each new discovery is like opening a gift box from Nature. In genetics, there are hard problems and incredibly hard problems, but we do not acknowledge any unsolvable problems. The most daunting task for us is not tackling new discovery but rather integrating discovery into a meaningful social context.

[1]This article is based on the address given by the author at the meeting of the American Society of Human Genetics (ASHG) on November 6, 2012, in San Francisco, CA, USA. The audio of the original address can be found at the ASHG website.

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http://dx.doi.org/10.1016/j.ajhg.2013.01.017.

Successes

A critical feature of enjoying the process of doing science is that little successes matter. In order to enjoy genetics, it's essential to be able to share the little successes that happen all the time: a particularly nice experiment, the first partial formulation of a notion, a paper read or a seminar heard suggesting a new experiment. Sharing these little successes with each other is the stuff of our daily lives. Big successes are another matter and are of course much more rare. These are good ideas that are proven true by accumulated evidence and have an impact on our collective way of thinking about a problem. We can't count on these very often. For example, in about 40 years, I believe I've had four. It's the nature of our culture that each of us could probably say how many major successes we've had, would agree with each other's definition of one, and would consider one every 10 years or so to be reasonable. It is a related feature of science that most of us work in it for a long time before believing we will make a really meaningful contribution. It's completely natural that for years, we continue with small successes and a growing confidence that these will fall into place in a larger picture.

Respect

A second critical iconic feature of our culture is that we respect each other. This might be obscure at times because the world of science is a pretty critical place. Criticism and respect might seem to conflict, but they don't. In the most productive fields, they are both obvious. Any one of our ideas is only as good as yesterday's experiment, this morning's data, and this afternoon's interpretation. None of us delude ourselves that we have all the answers, and those of us who have been in the field longer have simply had more opportunities to make mistakes. When our ideas are inevitably frequently incorrect, we develop great respect for good ideas, both for the difficulty of coming up with testable hypotheses and for the hard work of designing and doing the projects to find the answers.

The way ideas get better is by open unrestrained criticism, but criticism of ideas is coupled with respect for the person having it. An idea can be scientifically immature: most ideas are. But the person with the idea must be mature in order to reveal a not-fully-formed and therefore fragile notion to his or her friends, who will immediately jump all over it. Those of us who are teachers try very hard to let our students and postdocs see our regard for them and their ideas. We're not perfect at this, but I hope students understand that we take them seriously, believe in them—both as our students and as the future of the field—and are proud of them. Young investigators are just beginning to have their own ideas work. We've all been there.

Criticism of students by teachers is certainly reciprocated. In 1988, my then graduate student Ming Lee and I were teaching a course together in Shanghai.[1] We'd developed a routine in which I would explain a concept for a few minutes with lots of sketches on overheads and he would then expand the same point in Mandarin with the same sketches while emphasizing bits where either my English or the genetics hadn't been clear. But one time, well into the course, after one of my short explanations, Ming said nothing. I looked at him: maybe I'd been perfectly clear. But no. Ming looked at the class, looked at me, and said (in English), "There's really nothing I can do with this. You've got it all wrong." Of course everyone in the class understood that comment perfectly. It's an indication of our shared worldview, even for two cultures quite isolated from each other 25 years ago, that everyone laughed at me.

From another lab comes a more positive example. A scientist friend who took a job in Washington, DC testified to Congress recently about some particularly complex issues. "How'd it go?" I asked. "Oh, pretty well," he said, unexpectedly cheerfully, "my lab showed up to listen and thought I'd done a good job." "What about Congress?" I said. "Oh yeah, them too," he said, "but my lab is a lot harder to please." This is true. Our lab is where we go for a reality check. In the lab, we expect to hear honest responses to our ideas. We also expect, and receive, loyalty. Everybody knows that we ran the lab out of sequencing reagents and used too much space on the server, but we are welcome anyway.

Acting Globally

So how does this culture define us as citizens of the world? First, human genetics is inherently global in both content and talent. All people share the same biology. A gene responsible for a human trait in any family, anywhere, is part of the biology underlying that trait in everyone, everywhere. It is axiomatic for us that the discovery and characterization of genes responsible for human traits are best undertaken by the study of the families most informative for those conditions, wherever they live. The geneticists best qualified to work with such families—those who understand cultural context, historical demography, and gene-environment interactions—are geneticists from the same places as the families they are studying. We take this axiom so much to heart that we often do not even notice it. For example, I'm part of a group of collaborators who just published a gene-discovery project. It's a single project, not a huge international consortium, yet the 22 coauthors on our project come originally from ten different countries. This is so unremarkable that probably no one else in the collaboration noticed it, but its very naturalness is a fundamental strength of our field.

The extraordinary success of contemporary human genetics is due both to the revolution in genomic technology and to the advanced training of scientists from across the globe. Collaborations formed for each project from the very best talent lead both to productive science and to an understanding of people and places outside of our home turf. We take this for granted in our field, but we have the right to celebrate it. It is not a universal experience for people in all jobs.

In projects that involve research on more than one home turf, insisting on rigorous science can be an act of political, and sometimes even physical, courage. One of my favorite collaborations in human genetics is that of Karen Avraham of Tel Aviv University in Israel and Moien Kanaan of Bethlehem University in Palestine; with their students and colleagues, they study the genetics of inherited hearing loss in Middle Eastern families.[2] Their groups carry out collaborative genomic analysis under conditions that would be daunting to the rest of us. Their region is a uniquely valuable resource for human genetics research but also presents unique challenges to cross-cultural work. Their ingenious, no-drama approach to overcoming every imaginable obstacle has made their project a model for successful partnership. By dint of patience and persistence, they have won the support and goodwill of the critical Palestinian and Israeli ministries and security forces. Insofar as I can tell, it has never occurred to them that an obstacle cannot be overcome. Their focus is simply on how best to address each one. These colleagues are not naïve—far from it. They have profoundly different political and historical views, but they do not reject each other because of these differences. Rather, they share the understanding that science is inclusive, that their best research can be done in partnership, and that productive partnership depends on the quality of data, on respect, and on trust. They carry out rigorous, elegant science while leaving a legacy among far more people than those directly involved in their projects.

Acting Locally

An important principle of the activist is that of Saul Alinsky, the Chicago community organizer of the 1950s and 1960s. Alinsky taught that the best advocates for a community are members of that community; in other words, he taught that we are most effective at home.[3] For the scientist as citizen of the world, I interpret this as our responsibility to advocate for common sense and for reason—and therefore for science—in our hometowns. Mona Seif, Karen Avraham, and Moien Kanaan are all working in their hometowns. The details are different in each community, of course. In the United States, the confrontation is more likely to be with a creationist, a Tea Party activist, or a New Age Tinkerbell. In a conversation with any flavor of fundamentalist, it is worth remarking on a mutual friend who is alive because of genetics-based cancer prevention or treatment or another friend who has a healthy child because of a pregestational diagnosis—that is, specific examples of what modern life and civil society owe to scientific research. Our neighbors might not agree, but at least we won't have conceded the field by default. Eventually, some views might evolve, even without explicit acknowledgment. It takes patience and persistence.

Secular Immortality

I wrote above that our lab is home, where we share successes and failures and go for a reality check. This is true worldwide. We all have homes away from home. Anywhere we go in the world, we will be welcome in genetics labs. I would bet that in any genetics lab in the world, each of us would meet colleagues with whom we share no more than one degree of separation. They say we can't go home again, and insofar as home is where we lived before the age of 10, I think this is often true. Childhood homes have often changed too much to be comfortable or welcoming or even recognizable. But as scientists, we have second homes as well: the places where we chose to live as young adults and where we began our scientific lives. These homes we can, and do, return to.

In this context, the ASHG offers a reunion each year for all of us who have left home. The reunion crosses generations and geographic distance and plays an important role in our lives. Actually seeing each other and spending time together matter. We are all adept at electronic communication, but not everything that matters in scientific relationships can be conveyed electronically. At the ASHG meeting in the fall of 2006 in New Orleans, I ran into Maimon Cohen standing at the foot of an escalator. I hadn't seen him in a year and had heard he was ill. We had a long and lovely talk about teaching and genetics and agronomy and our children. Eventually I said, "Maimon, a half hour ago I was headed to the posters. Want to walk over there with me?" "No," he said, "I want to stay right here and catch as many friends as I can." It was the last time I saw him. He died the next January.[4] From our colleagues, we have learned about aging and about scientific immortality. Jim Crow and Victor McKusick and Maimon Cohen and Ernie Beutler taught us how to keep enjoying life until the end of it. They also taught us about secular immortality: the legacies that we leave to our students, our patients, our colleagues, and the truth.

World Citizenship

Let me return finally to direct action of the scientist in the events of the world. Occasionally the specific technologies of genetics are useful. For me, using genetics to identify kidnapped children in Argentina was an obvious example.[5,6] Even more often, it's not genetics per se that's applicable but rather the insistence on common sense in public life, as in the case of Mona Seif. As scientists, we have a long-practiced ability to detect nonsense, and we are in close contact with a large worldwide network of similarly well-practiced people. In crises, we make excellent use of those networks. The Internet has changed enormously in the past 25 years, but it was used remarkably effectively in June 1989, after Tiananmen. Accurate information and the ability to communicate it were, and are, major forces for democratic change. It is impossible to tell bright young people utter nonsense and expect them to believe it or to be eternally patient with those responsible for it. The values we share and can communicate to one another impact events

beyond science in ways that cannot be predicted in advance.

The job of the citizen scientist is to put his or her knowledge and common sense to use. We rarely know in advance when opportunities will arise. Knowing when we can next be useful is like knowing when we will next discover a gene: if we knew, we would have done it already. Responding to opportunities for direct action is up to us, and although we cannot know when or where, we can keep our minds and hearts open to the world. In my experience, three thoughts have been good guides in doing so: the most important questions come from people on the frontlines, the most righteous projects demand the most rigorous science, and no question is too big to ask.

Acknowledgments

I thank Arno Motulsky, Ephrat Levy-Lahad, Jack McClellan, and Cait Rippey for conversation and advice.

Web Resources

The URLs for information presented herein are as follows:

No Military Trials for Civilians, http://en.nomiltrials.com/

On the Media, http://www.onthemedia.org/2011/apr/15/state-run-newspapers-and-mona-seif/transcript/

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