Whither Geology: Passive Information Source, or Pro-active Environmentalism?

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In this age of interdisciplinary interaction, we probably owe one another disclosures of our qualifications for commenting on each other's profession. And you might well wonder why a philosopher would be asked to address this distinguished society of professional geologists. So, let me give what information I can about my qualifications to talk this evening about, of all things, the ethics of water geology.

I first started thinking about water geology as a young married adult. During those early years marriage, my bride and I headed for the southern Colorado Rockies and the cabin that my parents were renting. We got a month-unsupervised use of it; they then joined us for the second month. That first summer we "earned" our keep by my digging a water well in the alluvial soil of the Cuchara river valley, at the base of the slope on which my parents were erecting their summer cabin. The digging was mostly through a soil that had a heavy concentration of sand and gravel, although I encountered an occasional rock of moderate size;. I devised a rope and pulley contraption that enabled me to pull up buckets of sand and soil, and the occasional rock, and dump them without having to climb out every trip.

I inadvertently learned something about the mixed blessings of cattle while digging the well. My activities attracted the attention of several heifers after I was down about 8 feet. I became aware of a "presence" above me, and glanced up to see 4 quizzical faces (my wife, then an animal behaviorist, asked how I could tell they were quizzical) staring down at me. I shouted and threw a shovel full of dirt at them. Most of the dirt fell back on me; one of the heifers, for good measure, "anointed me," thereby demonstrating the complexity of mixed septic tank fields and water sources. My understanding of water ecology, if not water geology, began to grow—at least, drop by drop.

I encountered a good flow of water in an aquifer at about twenty feet, and sunk a length of road conduit there to keep the sides of the hole from collapsing. An immersible pump was installed, and my parents began drawing water from the well, and the aquifer, for their summer use: kitchen, bath, watering their vegetable garden, and the like.

At first the water supply was both plentiful and of excellent quality throughout the summer. As the years passed and the valley, particularly the valley upstream from their cabin, became more populated, the supply of water began to diminish, so that as they neared the end of the summer, they often would have to "borrow" water from neighbors

who had drilled a much deeper well, by connecting the two water systems so that the water from the deeper well flowed into my parent's cabin. A ski run was put into the upper valley, with many very expensive homes being built at the base. Several other clusters of cabins and homes were built by local developers, at times very energetically as the combination of excess disposable income due to a booming economy caused demand to surge, at other times stagnating as the OPEC screws were put to the West during the Carter administration and the economy shrank. Most of these residential structures relied on septic fields.

Eventually the county forced all privately-held wells and septic systems to be abandoned, and imposed a valley-wide water system and sewage system. The water system involves a series of deep wells drilled through what is known locally as the Dakota sandstone uplift. (My geology on the subject is primitive, but I believe this is a situation where the Dakota sandstone has penetrated the Ogallala aquifer from below.)[ii]

Although we no longer own that cabin, I do have friends who still maintain summer homes. For the past several years, a drought has further reduced the amount of water available to the valley. The Cuchara river has become a narrow trickle for much of the summer. Fires have been banned, water rationing has been imposed, and residents have adopted various household rules to minimize water wastage. My favorite is "Color yellow, let it mellow; color brown, flush it down." Further lessons in the harsh realities of water geology.

My second set of lessons in water geology and management came when I moved to Austin, Texas, in 1997. I purchased a house in the suburbs, and quickly grew sensitive to aquifer issues as the highways routinely sprouted signs like "Entering Barton Creek Watershed" and as new subdivisions sported catchment basins and ponds that conducted runoff water down into area aquifers.

During my first August in Austin, there was a knock on the door. One of my new neighbors was there. Somewhat surprised I said, "Hi, Curtis!" Curtis said rather curtly, "It's Thursday." I agreed: "Yes?" He said, "You're watering your lawn." I said, "Curtis, you are batting 1.000." Frustrated at my obtuseness, he said, "There's water rationing, and we can't water on Tuesdays, Thursdays, or Saturdays. The police will ticket you if you don't stop." He turned and stalked off, having done his civic duty. And I turned off the water.

My more recent return to the subject of water geology was occasioned by the surprising invitation of Leah Cervi to address the Buffalo Association of Professional Geologists. She assured me that it was OK – even desirable – to talk about ethics, provided the ethics I talked about weren't too "medicalized." Still, I wanted somehow to connect my interest in medical ethics with your interest in the structures and phenomena of the earth. As medicine is a profession, and as professions have certain common features, I felt comfortable exploring your profession's characterization of the ethical obligations of its members.

I began casting about on the Internet, trying to learn more about professional geology. I did discover a number of Geological organizations – in the U.S. and elsewhere – that had rather elaborate codes of ethics and discussions of professionalism. I've taught courses in professional ethics and done some writing on the subject, so that began to feel familiar. Still there was the geology side of the talk to attend to. So, integrating my not very extensive knowledge of water geology with my only slightly more extensive knowledge of professional ethics, and throwing in a dash of generalizations about water tables and their interactions with their human users, I have formulated some observations about professional geology to share with you this evening.

Let me start by observing that professions occupy a rather exalted place in society and (at least for some of them) in the economy. I suppose there are many historical reasons for this, but I am inclined to dwell on the often-vital importance of the services they offer to both individual employers and clients and to society writ large. Because of the pressure on professionals to deliver services effectively and safely, preparation for joining a profession has increasingly involved specialized and extensive training, at least to the baccalaureate level and often beyond. Even professional baccalaureates have tended to expand; it is not uncommon, for example, for engineers to take five years to complete their study, and increasingly composite programs offering the baccalaureate and master's degrees in 5 years are seen, as with UB's on department of Geology. Much of this training is of the intellect, because professions provide advice more than they make things.

Most professions have a process of certification or licensing – a condition of membership in the profession that often is controlled by its members.[iii] Thus a feature common to professions is one or more organizations of members, which organizations work to set standards of membership and licensure that generate what may fairly be described as a monopoly on its services, thus advancing the goals of the profession and promoting the economic well-being of their members. But professional organizations are something more than trade unions, for the goals of the profession, as opposed to other occupations, exist within what we might call a social contract. You don't find used car salesmen organized around a set of ethical canons, the first of which reads: "members should be guided by the highest standards of personal integrity and professional conduct" – the first canon of the American Institute of Professional Geologists Code of Ethics.[iv]

Another feature of the professional is at least a strong element of autonomy in the professional's work. Much is left to the judgment of the individual professional about what will serve the interests of the client and of society (although as we have recently seen with the profession of accounting, this autonomy is not totally divorced from accountability). Given that the services of the profession should be available to all who need them, and the services should be provided so as to promote the public interest, the profession itself is the sole judge of the method for achieving these two principles. That judgment, however, may be countermanded if it leads in directions that fail to serve the public interest as it is viewed by the public.

It is worth introducing at this point the notion of a social contract between the public and the profession. Basically, the idea behind this convenient fiction is that society

extends a variety of rights privileges to a profession in exchange for the profession's commitment to serve a set of social goods. Hence, professional autonomy isn't absolute: professions are not like Thomas Hobbes's Leviathan, to whom absolute power is ceded in hopes that the limits on individual's maximization of their interests will conduce to something better than the state of nature, in which "life is nasty, brutish, and short."

Looking at the code of ethics of several professional geologists societies and institutes, I found substantial recognition of the multiple loyalties of the professional geologist, to clients, to other members of the profession, and to society. Some of the obligations are specific to employers and clients; these include the disclosure of actual or potential conflicts of interest, such as owned mineral interest that may have bearing on the interests of the employer or client, the protection of confidential information, and limiting professional services and advice to areas of personal expertise and competence.

Professionals are enjoined from false representations of credit for others' work and from making sensational, exaggerated, defamatory, and false or misleading statements about professional colleagues. Obligations to the public are substantially negative duties, the bulk of which are passive: not to knowingly participate in illegal activities, not to offer bribes to public officials, and to report violations of laws or regulations that appear to materially affect the public health, safety, or welfare.

There is an admonition to "promote public awareness of the effects of geology and geological processes on the quality of life," but that appears more an admonition to be responsive to questions from the public than to assume a strong advocacy role where the geologist's professional knowledge discloses activities that, though not illegal, are nonetheless incompatible with important social goods. There is one statement in the AIPG's code that hints at a more proactive role: "members should participate as citizens and as professionals in public affairs," but the rule that that standard yields is more focused on "members acting in a position of public trusts" exercising their authority impartially, and avoiding using that authority "for personal profit or to secure any competitive advantage."

I want to argue that, in addition to the duties outlined in the AIPG's and other geology societies' codes of professional ethics, there is a duty to assume a more active role in protecting the public's interests, a duty that arises out of the special knowledge geologists possess that enables them to predict long-term consequences of practices and policies. I want to argue that geologists should be activists in the pursuit of public goods where those goods are not being adequately protected by laws and regulations. And my argument will try to tie up this brief review of professional ethics with my interests in water geology.

In their syllabus for a course in the department of geology at the University of Dublin's Trinity College, Phillip Allen and Alex Dinsmore have a lecture on Ethics and the Geology of Water in which they present a case study about my old Colorado friend, the Ogallala Aquifer. I found this fascinating reading, because it gave me a broader understanding of the Cuchara Valley's water table that I had tapped some 40 years ago in digging my parents' well. Let me quote a few of their observations:

> The cordillera of mountains in the western US has been in existence for the past 60 million years. As these mountains have eroded, they have shed a large amount of sediment towards the east, over the central part of North America. These sediments form huge deposits of sand and gravel that are thick near the edge of the cordillera and thin gradually to the east.

So, when I dug my parents' well, I was penetrating this sediment in its youthful form, still at a fairly high elevation (8500 feet), that extends far into the plains of the Midwest.

> One of these units, the Ogallala sandstone, is thick, laterally extensive (it covers 400 thousand square kilometers) and permeable enough to make a good aquifer. The total volume of recoverable water in this unit is . . . about the volume of water in Lake Huron. Given current recharge rates . . . , the residence time of the Ogallala is about 25 thousand years. This means that water molecules that entered the aquifer during the height of the last glacial [age] are only now making their way back out again.
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> **But**. Humans have intervened, searching for water to support the agricultural transformation of the Great Plains (using, for the most part, farming methods that were developed or perfected in the much wetter eastern US, Ireland, or the UK). Since evaporation greatly exceeds precipitation over much of the Great Plains, wells have been dug for irrigation purposes since the late 19th century. Well-digging really took off, though, after World War 2, with a booming population to feed and cheap electric pumps. Much of the irrigation is done by incredibly inefficient large-scale sprinklers.
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> There are now something like 170,000 wells taking water from the Ogalalla, and the annual pumping rate is . . . two orders of magnitude higher than the recharge rate, which means that the residence time of water in the aquifer . . . is down to less than 100 years. This has had [the following] immediate effects:
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> - a decline in the elevation of the water table of 30 to 60 meters. Thus, new wells must be dug deeper, and more energy must go into pumping
> - a decrease in the quality of the water
> - a decrease in the overall permeability of the aquifer. As water is withdrawn, the pore spaces between the sandstone collapse, which further decreases the amount of water that can be removed.
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> Clearly the geologic solution is to stop pumping. And yet this region of the US calls itself the breadbasket of the world, supplying grain, feed, and livestock to hundreds of millions of people – much of it on the back of the Ogallala. Can you rightly call for an end to that way of life? Where will the money to convert the Ogalalla farmers to drought-tolerant crops and drip irrigation come from?[v]

Not too surprisingly, Allen and Dinsmore don't answer their questions. But behind them looms an even broader question: What are the responsibilities of water geologists who know of this problem? Must they wait for public pressure on politicians to send the latter to holding hearings to which water geologists might be involved to explain why, for example, the profit margin for wheat farmers is so tiny that only the largest organizations that have consolidated vast acreages can afford to grow wheat?

There is a saying that comes from the 19th century philosopher Georg Wilhelm Friedrich Hegel: "The Owl of Minerva spreads her wings only with the falling of dusk." Minerva was the goddess of wisdom, and Hegel seems to be lamenting that wisdom occurs to humans about their affairs only too late in the day to provide anything more than rueful, 20/20 hindsight.

Occupations such as geology are designated *professions*, under the social contract, because they involve important enough interests of individuals and society to warrant their special treatment. My sense is that part of our interests as individuals and as society lies in the future. When a profession is able, by virtue of its mature knowledge base, to tell us that human practices already underway will result in future major negative situations, I believe the social contract will prompt us to impose a stronger set of duties to act so as to avoid those situations.

Another way of putting my point is to say that an individual who enters a profession, who takes advantage of the opportunities that publicly supported educational institutions offer, acquires with that professional knowledge a broader professional responsibility than is often acknowledged in professional codes of ethics. There is no mystical thesis here: the social responsibility of the professional to address the broader and longer-term issues that are not found in a present employer's or client's relatively narrow slice of time, arises from the professional's ability to see farther into the future than the non-professional, to have whatever level of certainty that the profession's knowledge base permits about the consequences of allowing processes already underway to proceed unchecked. "Geologists are trained to think on longer timescales than the public, certainly longer than legal or political timescales." If I may speak as a representative member of the society with whom you geologists have a social contract, I want you to be more in my face, and my representatives' faces, about the consequences of my well-digging and about the long-run necessity to switch to more sustainable practices.

Such duties might be taken to imply that geologists should become "rock-huggers." However, the forms of activism are not limited to interventionist hugging trees. In fact, activism has been given a bad name by those "tree huggers" that act more on emotion and conviction than on solid empirical grounds. Leaving to the typical activist the protection of these larger social goods seems to me to be a mistake, precisely because of the absence in the amateur of the kind of authority vested in the professional.

How do geologists become activists? I was pleased to see the number of geologists to be found on the staff of various U.S. Congress members, and even to

discover that some geologists have become members of Congress: for example, John Wold,[vi] a geologist and former congressman from Casper Wyoming, or Jim Gibbons,[vii] a hydrologist and representative from Nevada's second district. In 2000, I was pleased to learn that:

> Several House Members . . . announce[d] the creation of a new Congressional caucus on water matters.
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> Representative Sherwood Boehlert (NY), one of the founders of the new caucus, talked about the many water infrastructure challenges, stating, "In response to this situation, Congressman Borski (PA), Congressman Bilirakis (FL), Congressman Brown (OH) and myself have formed the bipartisan Water Infrastructure Caucus. The objective of this Caucus is to educate policymakers in Washington on the funding crisis facing our nation's 54,000 community drinking water systems and 16,000 municipal wastewater treatment systems." [viii]

While this caucus's agenda seems to be focused on municipal water systems, it may form a forum before which issues such as the Ogallala aquifer problems can be addressed with an eye to generating the political will to finance and mandate changes in irrigation practices.

I was also pleased to learn that the Woodrow Wilson International Center for Scholars has a new initiative, *Navigating Peace*. With a grant from the Carnegie Corporation, this three-year initiative aims at bringing together a diverse collection of individuals to develop policy alternatives in three areas:

- The balance between water as an economic and social good, so that it can be provided equitably, efficiently, and universally;
- Conflict, conflict potential, and cooperative models over shared water resources; and
- How lessons from water-conflict resolution could build dialogue and cooperation between the U.S. and China—their governments as well as nongovernmental organizations.[ix]

The aims of these working groups will be to meet several times a year, to create on-line listservs for dialoguing and exchanging information, and for each to issue a series of reports addressed to different audiences: researchers, practitioners, and policy-makers.

All of these activities illustrate the wider social responsibility of the professional water geologist. But, if you will pardon a pun, these efforts are a mere drop in the bucket of needs such as the Ogallala aquifer depletion. The trend toward more social responsibility of the profession should be encouraged and actively supported by its members as a part of the ethical practice of their profession and of the education of the would-be geologist. I humbly suggest that this social dimension of the profession of geology should be emphasized in its published codes of ethics, for they serve as a public statement of the profession's understanding of its obligations under the social contract.

And in making that statement to the public, the professional water geologist invites the question, "What have you done recently to advance my interests in non-renewable resources such as water?"

Now, the first question I will expect after this moderate diatribe is, "Well, professional philosopher, what have YOU done recently to advance my interests in those non-renewable resources? After all, talk is cheap: let's see if you are merely engaging in a 'do as I say, not as I do' exercise; let's see if you are following the Owl of Minerva's timetable." So I am going to answer that question before it is asked.

In 1997, I took early retirement from my position as a professor at SUNY Buffalo. I did this for a number of reasons, but one of the reasons was to get access to my retirement nest egg. I wanted to create a self-directed IRA and then direct its investment into an interesting new agricultural information technology and participate in the organization that is developing it. The organization goes by the name of Agricultural Management Systems, Inc.[x] It sells far infrared imagery of crops, taken at night from an aircraft flying at about 3000 feet, that discloses levels of stress in those crops that originates from too much or too little water, as well as from nutritional deficiencies, disease, and insect infestation. The far-IR radiant emissivity of crops changes with the plant's health, and can be detected with a scanner that averages emissivity over 1-meter pixels.

The technology completes what the USDA has identified for 20 years as one of its main goals: perfection of a system of precision agriculture that minimizes the expenses of agricultural inputs, such as chemicals and water, while maximizing crop yield by optimizing nitrogen use and cutting short crop-reducing diseases and infestations. For the technology permits site-specific application of inputs just where and when they are needed. It eliminates the need for field-wide applications and with it the need for crop-dusting aircraft.

But the most impressive aspect of the technology is its sensitivity and accuracy. It is able to detect 100% of crop stress up to three weeks before the effects of the stressors become visible. And it yields no false positives.

Schemes for drip irrigation – the selective delivery of water when and only where it is needed – require an information technology that can reliably direct that application. Remote sensing technology of the sort being developed by the Agricultural Management Systems scientists (one of whom is a graduate of the UB Department of Physics) are vital to replacing wasteful agricultural systems of irrigation (both center-post pivots and trench-delivered water) with more efficient ones. Coupled with computer controlled valves, remote sensing imagery will one day allow the application of water and other inputs in precise, defined amounts to just those plants that need them.

But Allen and Dinsmore were certainly right to question where we are going to get the money to make the requisite revolution in agricultural usage of water that will save the Ogallala aquifer. Particularly at a time when venture capital is in very short

supply, it will take political will to generate and direct the public funds necessary to bring about these transformations of agricultural practices. And will must be backed by wisdom in order to be sufficiently authoritative to emerge from the clamor of lobbyists in the legislatures of this and other countries. Policy makers will have increasingly to rely on professionals such as yourselves to evolve and enforce new techniques over the no longer adequate ones of the past. This is why I want to suggest that Geologists have a duty to be proactive.

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[i] http://www.bapg.org/.

[ii] See http://www.geology.sdsu.edu/classes/geol351/07groundwater/gwlect.htm. Also see http://www.tec.army.mil/publications/ifsar/lafinal08_01/5.0/5.1.3.htm.

[iii] For these and other points about professions in general, see Michael D. Bayles, *Professional Ethics*. Belmont, Calif.: Wadsworth, 1981.

[iv] At http://www.aipg.org/StaticContent/1/ethics99.htm.

[v] Their Lecture 38: Ethics, and the Geology of Water, may be found at the following URL = http://www.tcd.ie/Geology/ewf/lecture38.html

[vi] http://www.union.edu/N/DS/edition_display.php?e=292.

[vii] http://web0.greatbasin.net/~jag/jagibbons/bio.html .

[viii] http://www.usmayors.org/uscm/us_mayor_newspaper/documents/05_15_00/mcmanus_washington.htm.

[ix] http://wwics.si.edu/.

[x] AMS's URL = www.agriculturalmanagementsystems.com. Its operations company is at www.remoteimagingservices.com.