THE GEOLOGIST AS DETECTIVE: A VIEW OF OUR PROFESSION

By Sarah Andrews

As a geologist and a writer of a series of mystery novels about a geologist who solves crimes, I've spent a lot to time contemplating what makes a geologist tick. In order to make the world of the geologist compelling to mystery readers, I must invite them inside the geologist's head, show how a geologist thinks, and let them see why a geologist's mode of thinking is fascinating. I tell myself, "Geology fascinates me, so why shouldn't it fascinate the reader?"

The should or shouldn't isn't a simple matter. Why? Because we don't think like most people. Our thinking is subtle, complex, intuitively based, and essentially ornery. In order to "sell" this mode of thinking to the popular audience, I've had to learn to do what any writer of fiction must do with her main character: I've had to portray my fictional geologist in such a manner that the reader will care about her, root for her, and long to know what she'll be up to next.

Because popularizing the geologist is the theme of our symposium, I will do two things. First, I will present a manifesto, a grand assertion of how the mind of the geologist works and what is wonderful and important about its workings. Second, I will explain what I've learned about making this wonderfulness and importance known to our waiting public.

People who are drawn to the discipline of geology have minds capable of assembling information into three-dimensional mental images. Not everyone can do this. Not everyone has what's called a visual-spatial mind. Many of us can not only construct a 3D image in our minds, but rotate it, and approach it from any angle. Further, geologists can imagine this 3D construct influenced through the fourth dimension, namely time, mentally adding time-term processes such as erosion, diagenesis, deformation, transport, or combinations thereof. Very few people can do this.

So facile is our capacity to assemble multi-dimensional models that we do not require continuous data to form them. We mentally fill in gaps, making an intuitive leap toward a working model the instant we have enough data to perceive even the most rudimentary pattern within the data suite. Our talent for constructing mental models is, I believe, a very sophisticated form of pattern recognition, pattern comparison, and pattern matching. Not surprisingly, this talent grows with experience, because as we come across additional patterns, our mental software continuously expands to accommodate them. We experience our multi-dimensional world as a vast symphony of themes and variations. Instead of feeling daunted by the abundance and complexity of incoming data, we find pleasure in recognizing the groups into which they fall, prize variation, and play games with the scales of the repetitions of themes. And, as we spot new data, we feel stimulated and immediately adjust our understanding of themes and variations to accommodate it.

An engineer, by contrast, thinks in a linear mode, rather like a cog railway, and must have his data in a set sequence in order to process it through a set formula. We often have

trouble communicating with engineers. We find them hopelessly rigid, while they find us hopelessly protean, and perhaps hallucinatory. They think, "What's the matter with geologists that they can't settle on one interpretation of their data?" We think, "What's the matter with engineers, that they think the task of the geologist is simply to provide maps to be attached as addenda to engineering reports?"

Our engineer is but one node of variation among geoscientists. There are in fact two other loose cannons rolling around on our deck of misunderstanding. Let's define that deck. Imagine a graph bound by two axes, X and Y. X measures a continuum between sequential and random acquisition of data, our engineer and our geologist, while Y measures a scale of abstract versus concrete thinking. Now, divide the field described by these two axes into four quadrants, namely concrete-random, concrete-sequential, abstract-random, and abstract-sequential. Presuming everyone listening is a geologist, I know you are with me so far, as we are only defining and dividing a plane, a simple task. Very few minds fit only into one quadrant, but for the sake of my argument and assertions, let's consider those that do, as it will help clarify the difficulties present in popularizing the geologist.

In order to answer a given question, our concrete-sequential thinker, our engineer, needs information fed to him in order. He will apply a standardized method towards arriving at a pragmatic answer, check his results, and move on to the next question. In order to move comfortably through this routine, he requires that a rigid set of rules be in place.

The concrete-random thinker, our geologist, grabs information in whatever order, and instead of crunching down a straight-line, formulaic route toward an answer, makes an intuitive, mental leap toward the simultaneous perception of a group of possible answers. The answers may overlap, but none are perfect. In response to this ambiguity, the geologist immediately runs a risk assessment, chooses the best working answer from this group, and proceeds to try to shoot holes in it by gathering further data. Unlike the engineer, whose formulaic approach requires that the unquestioned authority of the formula exist in order to proceed, the geologist questions all authority, be it in the form of a human or acquired data.

Before we proceed with the two abstract quadrants on our graph, imagine which is easier to manage in the workplace, the geologist who flaunts authority, or the engineer who requires it? And how can these two disparate types of thinkers possibly communicate? The geologist perceives images an engineer can't, and perceives multiple answers to any question. The engineer finds pleasure in rigidity, while the geologist finds beauty in variation. In my experience, the reason these two minds can work together at all is that they both prefer to work within the concrete, pragmatic world, where results reign supreme. Because both want to get the job done, therefore they tolerate each other. Moreover, the geologist can perceive the worth of the engineer's efforts, and would be bored to tears if he had to learn to do such tasks himself.

Now, back to our two abstract thinkers. Like the engineer, the abstract-sequential thinker needs ordered data to arrive at an answer, but he is more interested in the process of

arriving at that answer than in the answer itself. If someone, such as our geologist, uses a different method, the abstract-sequential thinker presumes the answer to be wrong. Further, unlike our geologist, who is an intellectual extrovert who enjoys jumping into the middle of a thought and discussing it with colleagues, our abstract-sequential thinker is an intellectual introvert who prefers having the discussion presented in written form, which he may read, privately contemplate, and then shoot down with a written memo. Within the pantheon of geoscientists, I find this type of thinking most abundant among hydrogeologists, our computer modeling junkies, who are as much mathematician as anything else. Without the power and authority of their program, they don't function. Therefore, the program becomes all. If a geologist has the temerity to feed them data that won't fit in their program, they will tend to behave as if the geologist hasn't spoken. Outside of the geosciences, this type of thinker often becomes a bureaucrat, the lower-level administrator who is damned well going to require that we cross our t's and dot our i's.

Who is the abstract-random thinker? This is someone who intakes data in whatever order, believes absolutely in his system of analysis, arrives not at AN answer but at what he considers THE answer, and installs himself as the authority. The system is supreme. This is a manager, a CEO, a politician. Meet him early in his career and he's the young buck who's going to have your job the instant he can figure out how to make you look incompetent. The geologist by contrast tends to evade the pressures of management and administration, because he perceives that something as simplistic as THE answer is dangerous. The geologist feels responsible for the results that ride on taking the right course, rather than on the course itself, and the enormity of that responsibility can be daunting. Besides, to function at his best, our geologist needs to get out away from other people in order to narrow the incoming stream of stimulation. He must eliminate the mental cacophony of the work place inn order to tune into the exquisite sensibility of nature. He prefers working in solitude in the field, but likes to get together periodically with selected colleagues to extrovertedly think aloud.

One hundred and fifty years ago, before geology became a profession, our geologist would have become a cavalry scout, that incredibly perceptive lone eagle who peers across the plains from atop various promontories, logs in his information, then rides back to the general--our abstract random thinker--and says, "This is what you're up against, what you do about it is on your conscience."

Now, back to the focus of our symposium. How does this analysis of the mental workings of the geologist apply to the problem of garnering support for the profession? I think it points up a few ways in which other types of minds tend to find us if not obscure, then at least difficult to comprehend. In a world run by run by abstract minds and administered by linear thinkers, we ride in on our cavalry ponies and speak of things unseen and unseeable by others. Worse yet for our interests, in our highly competitive society, we tend to mature late. In the time it takes the engineer to learn how to apply certain linear formulae and begin to function, we have only begun to form, still gathering experience with which to fully assemble our multi-dimensional mental software. We tend not to shine in schools, which, administered and staffed by linear thinkers, reward using "the

right" process to arrive at "the right" answer. Feeling ourselves confined to a mental straightjacket, we gad about questioning authority, and come off like a bunch of deathless adolescents.

How on earth are we going to sell such a prickly, incomprehensible character to the public? Let us for a moment look upon ourselves as fictional characters. We are talking about a loner, a thinker, someone who feels so compelled to get at a better answer, to near that impossible dream--the truth--that he is willing to run contrary to accepted authority, thereby risking his security. He becomes that most difficult of personalities . . . (may we have a drum roll, please) . . . the rebel. But wait! Stop the presses! Popular media LOVE this guy! This is the hero, that sojourner after truth who faces great risks to venture out from the safety of the tribe to slay the monster and gain wisdom. He is not only the cavalry scout, but also the Spanish knight who tilts after windmills, the Danish prince who perceives too much and therefore cannot decide which way to jump when his uncle murders the king, the detective who walks through every mystery, painstakingly accumulating facts as he risks his hide to uncover the truth.

Taking just this last example, consider the unmined popularity of the geologist. The mystery endures as one of the most popular story forms ever created, and the geologist is, after all, a natural detective.

Let's face it, folks, we are romantic folk heroes. Even more to the point, the world needs our wisdom. We live in a time of such complex, changeable problems that those of us who are capable of "seeing" a complexity of possible answers must grasp a mandate toward having our input heard, respected, and indeed sought and supported. This requires that we continue to mature in our capacities to cope with the ambiguities of incomplete, discontinuous data until we are comfortable asserting our authority and taking on the responsibilities of management and leadership. Being more flexible in our perceptions, we must learn to educate our colleagues through whatever systems of thought they employ. We must in short be willing to ride in off that range, help the general off his horse, mount it ourselves, train some new scouts, and apply our formidable talents and skills toward a less tragic outcome for the battles in which we find ourselves.

How do we do this? A great tenet of fiction-writing is to show the reading audience what we want them to know about a character rather than just telling them that it's so. It's time that we learned to invite the public into our world and show them how we do our detective work. We must show also our passion for understanding the natural world, and share that central all-consuming sense of magic which drives us into an ever deeper understanding of it. In order to feel more comfortable doing this, we must better perceive our own value. It's no accident that the geologist-sleuth I created for my mystery series started out with low self-esteem. She's a hard-headed loner, an underachiever who prefers to go unnoticed. But with each new adventure, she gains confidence, and her waiting public get a chance to better know the value of her own special way of thinking.

(Presented at the annual meeting of the New England Section of the Geological Society of America, March, 1998)