## Robert E. Tepel – 2012 AEG Honorary Member Citation and Response Delivered at the 2012 AEG Annual Meeting in Salt Lake City, Utah.

### CITATION

**By: Scott F. Burns**

Welcome and Good Evening!

I have known and worked with Bob Tepel for many years, and it is a great pleasure for me to be the citationist tonight, and to describe for you some of Bob's major contributions to the profession of engineering geology, and how they came to be. We will start the story in the mid-Holocene.

Robert Edward Tepel was born in Ohio in 1937, the first of three children of George and Thelma Tepel. Bob's father was an electrical engineer, as was his father before him. His mother was a traditional homemaker of the times. The vonTepel's emigrated from Germany during the rule of Kaiser Wilhelm II; it seems that Christian vonTepel, Bob's great-grandfather, who was an inventor at the Krupp works, was bit too outspoken in his criticism of the Kaiser, and found it wise to emigrate. He settled in Pittsburgh, Pennsylvania. There, he helped found a Presbyterian church and got together with inventor friends to build their own automobile. Moving forward in time, early in the Great Depression, as a young single man, George Edward Tepel had two very different stints in the military. He enlisted in the Army, where he was trained as a court reporter for courts martial, and he later enlisted in the Marine Corps, which stationed him in Panama, where he played saxophone in the Marine Band, and contracted malaria (which he survived). His military background served him well in two ways: as an engineer, he could take excellent meeting notes in Gregg shorthand and type them in final form accurately and quickly, and after his Marine Corps service he augmented his depression era income by playing saxophone in dance bands. Growing up in northeastern Ohio, Bob came to share his father's interest in science, especially astronomy, as well as his appreciation of classical music. His mother thought that taking her children to a museum was an excellent Sunday afternoon outing. Bob's childhood introduction to geology originated in the Cleveland Museum of Natural History.

The family moved to Pasadena, California, in the mid-1950s, and Bob attended Pasadena High School. At PHS, he worked in the school library, which led to summer jobs in the rare book vault of the Huntington Library in nearby San Marino. He found the researchers and librarians to be sociable group, and briefly considered a career as a librarian.

Family weekends and longer vacations often involved automobile trips throughout the desert southwest, and Bob soaked up the geology exhibits in national parks and monuments. On many summer weekends he backpacked and climbed in the Sierra Nevada with the Sierra Peaks Section of the Sierra Club. He has climbed Mt. Whitney twice, first by the mountaineer's route pioneered by John Muir, and second by the trail with a childhood friend from Ohio; they stayed overnight on the summit. For a while the family lived in a rented house a few blocks from the Cal Tech campus. Bob and his father often attended Cal Tech's popular Friday night lecture series. One of the speakers was a recent doctoral graduate by the name of Clarence Allen. Dr. Allen's talk about his dissertation work on the San Andreas Fault system in San Gorgonio and Banning Pass area was Bob's introduction to faults and seismicity.

Bob's serious interest in a career in geology came about as a hobbyist mineral collector in his junior college days at Pasadena City College. He visited active and abandoned mines in Arizona and California. His first car was a 1949 Studebaker, and you should ask him to tell the story of brake failure just as the car left a winding canyon road and started down the steep apex of an alluvial fan in the Dragoon Mountains of Arizona, carrying Bob as driver and three fellow geology students and all their camping gear. At Pasadena City College, his first physical geology course and field trips were under the tutelage of Edwin V. Van Amringe, and his first mineralogy course was taught by H. Stanton Hill. In his junior college days, his dream job was to be a pit geologist at an open pit copper mine in Arizona. His interest in engineering geology arose later, while a student at Los Angeles State University in the early 1960s. He took a geology class that was only available in the evenings, and an engineering geologist who worked by day for the California Department of Water Resources, Bob Aggas, also attended that class and shared stories of the role of geology in the planning, design, and construction of the California Water Project. Perry Ehlig was already teaching at Cal State when Bob enrolled, and Martin Stout started his California teaching career there while Bob was a student. Both of these outstanding professors brought engineering geology into all of their teaching, especially field trips. Ask Bob to tell you the story of how Marty Stout got his first consulting engineering geology job in California.

Bob's first full-time professional job after graduation was as a Junior Engineering Geologist with the California Department of Water Resources, working in the Palmdale, California, Design and Construction office. He started on October 21, 1964, with a salary of $619.00 a month. This is where he learned, as did so many other young geologists, how to put engineering geology to work in the planning, design, and construction of major civil infrastructure. His mentors there were Arthur B. Arnold and Frank C. Kresse, both of whom held high professional values and expected the same of their employees. Art was one of Bob's sponsors for membership in the Geological Society of America, and Frank was a sponsor for his membership in AEG. Bob was initially sent to Cedar Springs Dam Site, on the north side of the San Bernardino Mountains in San Bernardino County, to work with an experienced engineering geologist by the name of Jack Jacks, who had recently directed the excavation of a bulldozer trench that exposed an active fault in the proposed footprint of the dam. This discovery was, as you can imagine, a big deal. A few weeks later, a loop of sorts was closed when Art Arnold arranged for Clarence Allen to inspect the trench and he basically said, "Yes, you have an active fault here." Cedar Springs Dam is the first dam knowingly built over an active fault and designed for fault offset in the era of modern soil and rock mechanics. (The story of the interaction of the site's geology and dam design is told in a recent paper by Frank Kresse and Art Arnold, published in Environmental and Engineering Geoscience in the August, 2010 issue.)

It was during his DWR days that Bob met and wooed a high school mathematics teacher by the name of Alice Lappin. Alice will tell you that one of their early dates was an AEG field trip to Cedar Springs Dam Site. She must have liked it. They married in 1968.

After just less than five years at DWR, Bob left to try the consulting field. He landed at the Newport Beach, California, office of W. A. Wahler and Associates, a small consulting firm specializing in earth dams, although it also worked in commercial and residential development. He stayed with Wahler until 1977. During that time his major projects included acting as principal field investigator on the 1972 Buffalo Creek, West Virginia, coal waste dam failure (the client was the U.S. Bureau of Mines); the Santiago Dam spillway failure in Orange County, California; review of the Teton Dam failure in 1977 for the prime contractor's insurance company, and exploration and design engineering geology for Upper Oso Dam in Orange County. Also during this time, Bob published his first AEG paper, a short note on the Avenida Columbo landslide in San Clemente, California, co-authored with Dan Eberhart, for an AEG field trip held during the 16th AEG Annual Meeting in Los Angeles in 1973.

In 1977, Bob left Wahler and returned to the public sector, as an engineering geologist for the Santa Clara Valley Water District in San Jose, California, where he stayed until he retired in 1999. The District owns and operates a dozen dams and reservoirs, three water treatment plants, and many miles of pipeline. One of the dams is Coyote dam, which was built athwart the Calaveras fault. The fault is actively creeping in that area, although the designers did not know that in the mid-1930s when the dam was built. Chester Marliave was the engineering geologist consultant on Coyote Dam. One of the water treatment plants is on an actively creeping landslide. The engineering geology challenges at the facilities if the Santa Clara Valley Water District produced several papers of which he was author or co-author.

At the SCVWD Bob was charged with consultant selection for major geotechnical consulting projects for its facilities. He put his experience as a consultant to work. Bob re-structured the District's consultant selection process and set up a consultant's study table with file information, record drawings, and library references for every project, as well as opportunities for guided site field visits by the consultants. The result was better and more competitive proposals. After he organized a few review boards to evaluate consultant proposals, Bob saw that some consultants were still floundering in the process with unsophisticated approaches, so another paper was born, one of the very few non-technical papers to appear in the AEG Journal. It was published in 1983 and titled "How to Succeed in Business by Really Trying, or Ideas for Consultants Who Want to Do Better in the Public Agency Consultant Selection Process." A few months later, Bob received a letter from a consultant in England, thanking him for the paper and saying that their small firm had won a major project over large establishment firms by following his recipe.

After studying reports on damage to water infrastructure during the 1971 San Fernando Earthquake, Bob initiated two program at the Water District, one to undertake non-structural seismic retrofit and emergency response preparation measures at all of the District's water treatment facilities, and another to provide automatic rapid-response post-earthquake inspections of the District's dams 24/7. Both of these programs served the District well in responding to the damaging earthquakes that followed.

It was during his time at SCVWD that Bob became active in the San Francisco Section of AEG, taking officer positions in 1982-1986; he was Section Chair in 1984-1986. Alan Tryhorn asked him to be Finance Chair for the 1986 AEG Annual Meeting in San Francisco (it returned a nice surplus to AEG, by the way). These efforts brought him to the attention of AEG leadership, and he served as AEG Secretary in 1991-92, Vice President-President-Elect in 1992-93, and President in 1993-94. When Bob was president of AEG, he built the associations' present policy structure. Here is an example of Bob's leadership technique: At the spring, 1994, AEG Board of Directors meeting, directors were surprised (and confused) to walk into the board room on the first day and find round tables set for groups of six instead of the formal giant U-shaped table arrangement normally used. Bob told them to just pick a table and introduce themselves to their companions. It was a time of contention, when directors challenged every recommendation or decision of the Executive Council. Bob gave each table of directors a couple of AEG problems to solve and report upon. Executive Council members walked around the room and answered questions, but it was up to the groups of board members to solve the problems. Each group had to have a representative stand up and describe how they solved the problem, provide a recommended action, and take questions from their fellow directors. Guess what? They came up with the same solutions that the Executive Council was considering, but the ideas were theirs, not those of the Executive Council, so the solutions were acceptable and the directors felt very involved in the process.

Bob's interest in professional licensure began in 1987, when John Williams, as President of AEG, asked him to chair the association's committee on professional registration (we call it *licensure* today). This assignment also deepened Bob's interest in professionalism. His first major effort, suggested by Alan Stover, AEG's legal counsel at the time, was a session at the 33rd annual meeting of AEG, held in Pittsburgh, Pennsylvania, in 1990. The session was rather grandly titled as the "National Colloquium on Professional Registration for Geologists." This well-attended pioneering effort brought together geologists, geophysicists, and engineers representing a variety of organizations and viewpoints, and marked a new beginning in AEG's support of licensure. Eventually, multi-organization support for licensure was brought about by an informal coalition of geological professional organizations that wrote a Suggested Geologists Practice Act. Chris Mathewson and Bob were AEG's representatives on that team.

The discussions emanating from the National Colloquium and the Suggested Geologists Practice Act effort convinced Bob that many of the sticking point issues in professional licensure for geologists needed point-by-point detailed treatment. Thus was born the idea of a regular column in the AEG News on licensure topics. To date, the AEG News has published 64 columns written by Bob under the banner "Issues in Professional Licensure for Geologists." The first part of the series was collected into a book published by AEG in 1995 as Special Paper 7, "Professional Licensure for Geologists: an Exploration of Issues." Beyond this rather amazing effort in the periodical literature, Bob's bibliography of papers and presentations totals 50. The breakdown by classification is: 18 technical papers, 23 professional practice papers, four AEG proceedings volumes edited, and five miscellaneous publications or presentations. His 23 professional practice papers, presented at national and international conferences, address the nature of the profession of engineering geology, its relationships with other professions and the public, its role in society, and the ways that geological professional organizations operate (and don't operate, but should) to serve and promote their professions. Of those 23 papers, four were presented orally and published in abstract form, and 19 were published in full in proceedings volumes, and 17 of those were also presented orally. Beyond writing papers, Bob brought people together to discuss the challenges facing the profession. In 2002, 2004, 2007, and 2010 he convened or co-convened professional practice symposia at AEG Annual Meetings under the theme "Visioning the Future of Engineering Geology." In 1998, Rex Upp asked Bob to be the General Chair of the 2000 AEG Annual Meeting held in San Jose, California, and Bob put together a team that delivered a very successful meeting, setting an organizational structure that is still followed today.

What else has he done for the profession? He founded the California Council of Geoscience Organizations in 1996. He was active in cooperating with other concerned professionals in California to support the California geology licensure board as it went through successive sunset reviews in the 1990s and early in this century. He has served as a Subject Matter Expert on the ASBOG (Association of State Boards of Geology) Council of Examiners since it was formed, working on the national geology licensure examination.

All of this demonstrates his deep passion for our profession, and AEG recognized his yeoman service to the Association with the Floyd T. Johnston Award in 1997. But Bob's professional service career goes beyond service to this Association. He accepted two three-year terms on the Board of Directors of the AEG Foundation, starting by holding the office of president in 2005-2007, and leaving the Foundation Board at the end of 2010. His overarching goal for the Foundation was earn and build donor trust by making its governance standards and transparency equal to those of much larger foundations. During this time he led the board in developing new programs for the Foundation and created the concept of a "Fund Charter" to document each fund's purpose and operating principles.

He is a Life Member of AEG and the United States Society for Dams; and a member of the Geological Society of America; the Council on Licensure, Enforcement, and Regulation; the Geo-Institute of the American Society of Civil Engineers; the Earthquake Engineering Research Institute; and the International Association for Engineering Geology and the Environment.

So much for his service to the profession; we must now ask, what has he done for the public?

A glance at his bibliography is not enough; you must read his writings to realize that, in promoting the profession, he is not promoting the profession for its own sake, but rather he is striving to position the profession to better serve the public and the public interest.

His direct service in the public interest started after retirement. In 2001, he was appointed to the California State Mining and Geology Board by Governor Gray Davis, and appointed to two subsequent four-year terms by Governor Arnold Schwarzenegger. The State Mining and Geology Board has a quasi-judicial role on administering California's Surface Mining and Reclamation Act, and also acts as a policy advisor to the State Geologist and the California Geological Survey.

It is Bob's passion for his profession over the last 48 years that has brought him the honor we bestow upon him tonight: Honorary Member of the Association of Environmental and Engineering Geologists. Please join me in welcoming the Association's newest Honorary Member. Robert E. Tepel.

## **RESPONSE**

**By: Robert E. Tepel**

### **PROLOG**

Thank you, Dr. Burns, for that gracious citation. And thank you from me to the members of AEG who nominated me for this honor and to the Board of Directors for confirming it. It is a pleasure to accept this award, and certainly a pleasure to recognize and appreciate that the efforts that bring this honor were supported by my wife, Alice, and by many colleagues who generously shared their thoughts and insights about the basic character of engineering geology, either in person or by way of their publications.

The leaders who created this meeting chose a theme that resonates with me: Ascending to Greater Heights; Elevating Our Profession. They dedicated a special session to this theme. Immediately, the implied question that follows from their theme jumps to mind: ***How*** can we elevate the standing of our profession in the views of our employers, our clients, and all the stakeholders in our work? The answer to that question is that we need a two-part sales pitch. Part One is a comprehensive but succinct statement of the value of engineering geology to humankind that explains the value of our work (and what is special about that work that provides a unique benefit to them) not just to our clients and employers, but to everyone else — the people, businesses, regulators, and lawmakers who are direct or indirect stakeholders in our output. Part Two is a short "nutshell" statement is that describes what we do and the value of our work to the guy sitting next to us on the airplane — people who have an indirect stake in our work whether they realize it or not.

Creating these statements requires a deep understanding of the nature of our profession and its relationships to the engineering profession and to other segments of the geology profession. It isn't as though we haven't tried to develop this understanding, but progress has been glacially slow. The reasons why are a story in themselves. Engineering geologists and compatriot engineers have been exploring these questions for most of the life of our profession — well pover a hundred years. Until this century, Europeans tended to emphasize the role and place of our practice in infrastructure design and construction, and North Americans emphasized solving the conundrum by looking at our workplace setting and reporting hierarchy. I do not wish to impugn the sincerity or abilities of these great pioneers who pondered the problem, but without realizing it they were trying to do the impossible; they were n a box but the boundaries were soft and invisible to them. If they were hound dogs, I would say they were barking up the wrong tree. So, let's find out WHY the hounds were barking up the wrong tree.

## INTRODUCTION

I'll begin at the beginning. I am passionate about this profession because, to me, *engineering geology is people geology*. The distinguishing feature of our practice is that it affects people and their health, safety, and wellbeing more deeply, more personally, and more extensively than does any other applied geology practice. This was brought home to me on a college field trip led by Martin Stout. He took a class to a hillside grading project where mass grading was in progress. He pointed out the landslides that had to be removed, and the slopes that had to be rebuilt to support houses and community infrastructure. As we listened to him through the roar of the Cats and cans, coughing on diesel exhaust, I could see the connection between engineering geology and the well-being of the people who were about to buy the houses being constructed on nearby graded fills.

Tonight, I explore the deeper implications of that simple observation. I'll use examples from my career experience and draw inspiration from the thinking of leaders in our profession (both engineers and geologists) to come to a concluding statement that describes what I think is the essence of 21$^{st}$ century engineering geology practice. So join me on a personal journey of discovery. What do I want to discover? I want to discover why this profession had such a modest opinion of itself for the first century and more of its existence. And I want to discover what 21$^{st}$ century engineering geology is "really all about" in a way that makes a bold and assertive statement.

Let me explain how this profession thought about itself in the 20$^{th}$ century by starting with my own experience. Let me step back to 1964. In October of that year I reported to Art Arnold at the Palmdale, California, Design and Construction office of the California Department of Water

Resources (DWR) to work as a fresh-out-of-school Junior Engineering Geologist on the California Water Project. At that time, jobs in economic geology were scarce, and it was time to make living doing geology. The starting salary was $619.00 per month. Art assigned me to Frank Kresse, who supervised several engineering geologists in developing geologic and engineering data for the design of features of the East Branch of the project, which included a pumping plant, two dams and reservoirs, a power plant, a major tunnel, and canals and pipelines to convey the water.

It was three-fourths field work and one-fourth office work for junior staff at DWR. Aside from the fact that I always seemed to be working in the desert in the summer and mountains in the winter, this was a good mix. At DWR, I, as did many other novice engineering geologists, received excellent training, both formal and informal. In the office, we junior staff occasionally had discussions about the nature of engineering geology, or "what it was really all about." There were those who said that an engineering geologist was a geologist who knew something about engineering and did geology for engineering projects under the direction of engineers and reporting to engineers. There were those, I among them, who said that was not a satisfactory description; there had to be more to engineering geology than that, but we could not pin down the reason why. Actually, this humbling attitude toward what engineering geology "was really all about" was common in the profession worldwide in those days. Recently, Ronald Williams (2011) collected and edited many of the papers, letters, and diaries of Rudolph Glossop, the leading British engineering geologist of the mid-twentieth century. In that collection, in Glossop's 1969 address as Chairman of the Engineering Group of the Geological Society of London, he answers the question "What is an engineering geologist?" with the response (page 194) "*an Engineering Geologist is a geologist who has a thorough understanding of the problems which arise in civil engineering and devotes himself to them.*"

Back in the 1960 and 70s, my colleagues and I knew that there had to be more to our profession than merely providing geological service to engineers as they directed, but we were too busy doing great geology on challenging projects to look around and see the bigger picture about the societal value of our work. Not only were we southern California engineering geologists trying to figure out what our profession "was really all about," but others around the western world had been pondering the question for decades and continue to ponder it to the present. Let's take a look….

## BACKSTORY — A SUMMARY REVIEW OF 20^TH^ CENTURY PONDERING ABOUT NATURE OF ENGINEERING GEOLOGY

The earliest European contribution to the discussion I have found was a 1939 paper by Josef Stini titled *Ingenieurgeologie und ingenieurgelogischer*, published in the journal *Geologie und Bauwesen*. I have never been able to travel to a library that has a run of that journal, so if anyone can provide a copy I'd much appreciate the favor. Stini is known for creating the first continental European university programs in engineering geology. Then in 1943, Leopold Müller (who also used a hyphenated version of his last name, Müller-Salzburg), wrote a paper (in German (although he also wrote in French and English) titled "*Wo steht die ingenieurgeologie*?" which can be translated as "*Where does engineering geology stand*"? Müller was an Austrian practitioner who was later influential in the development of what we call "The New Austrian Tunneling Method." And in 1949 Josef Stini again took the stage, posing the question, "*Wie stärken wir das Ansehen des Baugeologie?* This can be translated as, "*How can we strengthen the future of engineering geology*?" That question from 63 years ago is amazingly close to the question behind the theme of this meeting. We are still trying to answer Stini's question today!

In the United States, probably the earliest writing on the role of geology in engineering, and the workplace relationships between geologists and engineers, included two papers by Kirk Bryan. His 1928 contribution to USGS Water Supply Paper 597 is titled "Geology of Reservoir and Dam Sites." The last major heading in that paper is "*Relations of Geologist and Engineer*," probably the earliest American publication to cover this topic. In 1929 two important papers were published by the American Institute of Mining and Metallurgical Engineers in its Technical Publication 215. Kirk Bryan authored "*Problems Involved in the Geologic Examination of Sites for Dams*" and Charles Peter Berkey authored "*Responsibilities of the Geologist in Engineering Projects*," In 1942, Frank Nickell wrote "*Development and Use of Engineering Geology*," which was published in the Bulletin of the American Association of Petroleum Geologists. The eminent Canadian practitioner, Robert Legget, who became an AEG Honorary member in 1971, wrote extensively on the topics of geology and engineering, and cities and geology. In the fiftieth anniversary volume of the journal Economic Geology, he contributed a paper titled "*Engineering Geology — A Fifty-Year Review*" (Legget, 1955). In the 1988 (third) edition of his classic book "Geology and Engineering," his co-author was Allen W. Hatheway, now an AEG Honorary Member and past president. In 1950, Edward B. Burwell, Jr., and George D. Roberts wrote "*The Geologist in the Engineering Organization*," published by the Geological Society of America and included in what we call "the Berkey Volume" (Paige, 1950). In 1955 George Kiersch wrote "*Engineering Geology — Scope, Development and Utilization*," published in the Quarterly of the Colorado School of Mines. In 1972, Legget wrote a paper for the Bulletin of AEG, *Engineering Geology in Perspective*, in which he traces in particular the military applications of engineering geology. The timing of this publication leads me to believe that it was his Response to his Honorary Member citation of the previous year. The Geological Society of America Centennial Volume 3, edited by George Kiersch (1991), is a monumental compilation of works that describe the heritage of engineering geology up to that time. More recently, Richard Galster provided additional perspective and references in his paper presented at the Reno, Nevada, AEG Annual Meeting (Galster, 2002). Galster served AEG as president and became an Honorary Member in 1998, and was also was a founding director of the Engineering Geology Foundation (now called the AEG Foundation). And these are just a sample of the literature. So you can see that the theme of this meeting, and the challenges that stand behind it, were pondered by leading practitioners since the early days. *All this pondering did not lead to a useful conclusion about the basic nature of engineering geology. We have to ask, why?*

Defining what Engineering Geology "was really all about" even puzzled Karl Terzaghi. Professor Richard Goodman, in his wonderful biography of Terzaghi (Goodman, 1999), offers a delicious quote that reveals Terzaghi's thinking about the nature of engineering geology. Goodman describes (p. 212) Terzaghi's feelings about the nature of engineering geology thus (and here I'll quote from Goodman quoting Terzaghi): "*But he continued to find it 'a strangely elusive subject, slippery like an eel.'*"

They were all climbing the mountain from the summit of which they could see what engineering geology "was really all about." They were disappointed. They chose the wrong mountain because the right mountain lay in the future and could not be seen by them. .

The prevailing sense of dissatisfaction over the lack of resolution about the nature of engineering geology was summed up by Leopold Müller-Salzburg, who in 1976 wrote: *"However, it appears to me that the development of the science in recent years does not seem to head in a direction that one could be satisfied with. Again and again we seem to divert from the right path and one could say that many of us do not even seem to know the ultimate goal. This explains why one gets such different answers to the basic question what Engineering Geology really is."* (Müller-Salzburg, 1976, also quoted in Knill, 2003). That suggests that the hounds were in the wrong forest while barking up the wrong tree.. The right tree was nowhere near them. Again we must ask, *why?*

Clearly, the profession was in a state of identity confusion. The view we had of our profession's role was later revealed to be myopic. We focused on the wrong criteria to create our self-identity. In my own thinking, the issue did not start to clear up until 1997, and, by 2010 I had proposed an answer to Müller-Salzburg's dilemma. Let me rephrase Müller-Salzburg's question the vernacular as: *what is engineering geology really all about?*" I have already answered that question in a rather enigmatic way: engineering geology is people geology; it is really all about people. But, HOW and WHY is engineering geology people geology? Now, that is the real question.

The continued profusion of unsatisfactory answers should have indicated that we needed to re-examine the framework of inquiry for hidden and limiting assumptions, but it took a while to realize this. To answer the question, "How do we strengthen the future of engineering geology?" we should first understand the fundamental nature of our modern practice. It is very different today than it was when all of the twentieth century works I cited above were written, and describing that difference tells us why the early engineering geologists were lost in the woods when it came to defining what their profession "was really all about." To get ourselves in to forest that holds the tree of knowledge of the deep worth of engineering geology, we have to know what engineering geology is good for in a broad societal context, and what it is good for today is very different today than what it was good for in its first hundred plus years. Two new factors came into the equation we needed to describe the fundamental nature of our practice….

## ANALYSIS — WAKE-UP CALLS 1971 - 2003

I think that the first important wake-up call was the Sylmar (San Fernando) Earthquake of February 9, 1971, in California. This brought many earthquake-caused risks and hazards to the attention of the public, and even politicians, as well as to geo-professionals. The concept of seismic microzonation had been developing before that time, but the Sylmar Earthquake made it clear that earthquake related risks could be defined and even quantified on a site-by-site basis. While quantitative risk assessment was used for critical infrastructure before the Sylmar Earthquake, engineering geologists became more involved in quantitative risk assessment for all projects after that earthquake, and not just for earthquakes as geologic hazards. The effects of the Sylmar Earthquake on our practice rippled through it for years. The next two wakeup calls started slowly and grew slowly.

In terms of the societal and workplace setting of engineering geology practice, the principal difference between 19$^{th}$ to late 20$^{th}$ century engineering geology practice and current practice, at least in the United States and Canada, is the rise of professional licensure for geologists. Licensure changed the game plan — the business model and the employment model — of engineering geology practice. For engineering geologists, licensure meant the ability to take responsibility for one's work that affected the public without the need for the supporting signature and stamp of approval of a licensed engineer. Licensure also freed the engineering geologist from being tethered to the engineering office. We were now legally authorized to practice independently, and many of us did. We practiced for *people*— the general public — in addition to practicing for engineers. While licensure clearly provided changed and expanded workplace settings, the deeper implications of this change for how we should have viewed the role of our profession in society were slow to rise in our group consciousness.

While the factor of licensure is intrinsic to our profession, the next major factor in the development of engineering geology in the late 20$^{th}$ century, and it was a big one, was extrinsic to the profession. It was the rise of environmental concerns and the accompanying environmental impact reports and related laws, regulations, permits, and social activism. Environmental activists, populists, and interveners in the United States quickly realized that the geological basis of engineering design included judgments and interpretations upon which geologists could differ. Geological working methods and reasoning that lead to judgments and interpretations emphasize inductive thinking (*see, for example,* Sullivan, 2010) and the method of multiple working hypotheses (see Chamberlin, 1897), whereas the basic sciences (and engineering as an applied science) emphasize deductive thinking and a single working hypothesis (*see, for example,* Fish, 1950). The different attributes of the two investigative methods proved to be a fertile field for challenges in legislative or regulatory hearings, or in court. The stage was set for legal proceedings based on what lawyers call “the battle of the experts,” and the experts were often geologists. My friend Richard Meehan a geotechnical engineer, notes in his book, “The Atom and the Fault,” (Meehan, 1984, p. 59) that “*Frequently, geologic hazards became the dominant issue in environmental impact reports. Such investigations were likely to turn up new questions of geologic interpretation in which various geologists disagreed. Before the late 1960s, most geologists reported to or through engineers; hence their findings went into the mill of engineering judgment, and their personal opinions and disagreements were dismissed as amusing but harmless eccentricities. However, the loss of engineering and management control over the debate, much accelerated by the National Environmental Protection Act of 1970, provided an open forum for scientific opinion on matters of public safety. Now, for the first time, geology developed a certain autonomy. Geologists were no longer under the engineering thumb, and their views were made known directly to the various commissions concerned with issuing permits for siting of critical facilities*.”

## ESCAPE FROM THE STICKY WEB OF HISTORY

### Introduction: the Flaw in our 20th Century Thinking

Developing a satisfactory answer to the question of what is engineering geology “is really all about” proved to be extraordinarily difficult for decades, and for the simplest and therefore most elusive of reasons: we were trying to ascertain what engineering geology was really all about by looking at its value to our friends the engineers instead of looking at its value to society — to humankind, to *people*. I think that three spotlights lit the path to the solution to, or at least tp my solution, of Müller-Salzburg’s quandary. Three seminal papers that lit the path were published in 1997, 2000, and 2003, spanning the turn of the century. These papers led to a special session at the tenth IAEG (International Association for Engineering Geology and the Environment) Congress in Nottingham in 2006, and papers in that session led to further refinement of my solution to Müller-Salzburg’s quandary. The flaw in our 20th century self-image as a profession was, simply, that what engineering geology “was really all about” was defined by listing the knowledge and experience one needed to practice it, the tasks one did, the workplace setting in which one worked, and the hierarchy that one received instructions from and reported to. In hindsight, this was obviously an incomplete picture of our profession, but it was the picture we perceived. *Why?* Here is the answer: the fact that engineers had licensure and took responsibility for our geologic work hid the broader, deeper, societal contributions our work made to humankind because, as noted by Meehan (1984), our work products were incorporated into the engineering judgment and design process. Before licensure for geologists, engineers served society, geologists served engineers directly and society very indirectly.

Professional licensure was the slow-moving wake-up call to our changing world of practice. California's adoption of licensure in 1969 was a major step in a nationwide movement to license geologic practice that grew over the next 40 years. This rise of the environmental movement and consequent laws and regulations also brought engineering geology out of the shadows of engineering. The Sylmar Earthquake brought seismic hazards and risk to the public's attention.

Turn of the Century Developments: Three Seminal Papers

The turn of the century papers introduced three new concepts: The Total Geological Model, Site Characterization, and Core Values into the equation. In fact they displaced the old equation and presented a new one against the background of the risk emanating from geologic hazards. These concepts will take us to where we want to go: to a 21st century statement of the value of engineering geology practice to society, humankind, to *people*.

The Total Geological Model

The concept of the Total Geological Model (also called the Site Model or Geological Model) was developed by geologists based in the British Empire. One of the first major (if not the first) use of the concept was in the First Glossop Lecture, delivered by Peter Fookes in 1997. The title of his Glossop Lecture was *Geology for Engineers*, but the substance of his lecture appears to me to be more along the lines of why engineers should pay attention to geology and geologists. It presented the concept of the Geological Model of a site as a unique geological work product, and one that reduced geotechnical risks to the project. The concept was further developed, mainly by Fookes, Baynes, and Hutchinson (2000): and Davison, Fookes, and Baynes (2002). The vision behind the concept of the Total Geological Model is similar to the vision behind the concept of Site Characterization as developed in the United States by Allen Hatheway.

Site Characterization

In his 2000 Richard H. Jahns Distinguished Lecture tour, Dr. Allen W. Hatheway introduced the concept that the Engineering Geology Site Characterization is the defining and unique work product of engineering geology practice. Having a core function or work product that is unique to a particular profession is part of the definition of the term "profession." It sets a profession apart: it is something we do that nobody else can do because we have special training and expertise in it. Hatheway carries this idea further in a paper presented at an AEG Annual Meeting two years later (Hatheway, 2002), in which he opined that the engineering geology site characterization is the *Raison d'Être,* the reason for being, of engineering geology. And, in 2004, he teamed with Dr. Gregory Hempen to reaffirm that concept in an introductory paper they wrote for a symposium they convened at the 2004 AEG annual meeting (Hempen and Hatheway, 2004), in which they said *"Site characterization is the single most important function of Engineering Geologists in professional practice."* This breakthrough concept opened the window to a new vision of what our profession "was really all about."

One special feature of an Engineering Geology Site Characterization is that it includes, as necessary, the effects of distant geologic hazards on the site, structures on it, on and the people who use it (as well as the investors who own it) for the life of the project. In contrast, a geotechnical engineering site characterization is focused on characterizing the engineering properties of site materials and addressing the effects of those properties on immediate project design features. The geologist is concerned not only with on-site geology and near-site geology, but also with what I call *tele-geologic* hazards (earthquakes, tsunami, volcanos) as sources of risk to the site, its structures, and the people who use it.

Here is a description of the Engineering Geology Site Characterization:

ENGINEERING GEOLOGY SITE CHARACTERIZATION is a geological investigative and evaluative process that produces substantiated and scientifically valid geologic and related information for analyses upon which the geologist bases interpretations, conclusions, recommendations, and expert opinion, either general or project-specific, regarding geologic conditions and processes that affect the design, construction, or utilization of a project (fixed work) or the utilization of a site or region, taking into account both natural and human-induced conditions in the geologic environment. (Based on Tepel, 2004b,c).

Both Site Characterization and the Total Geological Model are scalable. They work for small projects (client wants to know if that hillside lot for his dream home is a good purchase) and for mega-infrastructure projects. Site Characterization is not specifically taught in geology courses in the United States or elsewhere as far as I know. Similarly, Sullivan (2010) laments that the Total Geological Model is not taught in university. Hatheway (2004) proposed tht AEG develop a policy on Site Characterization. Yet both processes/work products remain as on-the-job education passed on from one professional to the next, in spite of their status as the defining work process/product of the profession of engineering geology.

## Core Values

In 2002, the eminent British engineering geologist, John Knill, delivered a paper at the Ninth International Association for Engineering Geology and the Environment (IAEG) congress in

Durban, South Africa. The title was, simply, "Core Values, the First Hans Cloos Lecture." A colleague who was there told me that the paper created quite a stir and energized the whole conference with Sir John's insights into the basic value delivered by engineering geology.

Sir John notes what we all knew at the time, *"The traditional scope of engineering geology was the application of geology in construction practice, but it has become widened in time to embrace other fields of engineering, environmental concerns and geological hazards,"* (Knill, 2003, p.1) Taken in context with the rest of this extensive and deep-reaching work, my take-home from Sir John's paper is that society benefits from reduced risk of the effects of geologic hazards and conditions when we practice engineering geology. ***Our practice is relevant to the societal goals of public safety and risk reduction.***

Following discussion such as Baynes and Hatheway (2003), Baynes and Rosenbaum (2004), Joint European Working Group (2004), and Task Force (2004), I concluded that the route to a new vision of self-identity for our profession had to be based on recognition of the significance of three new factors that re-defined our practice: 1) licensure and independent practice, 2) the newly recognized unique and primary work product of the engineering geology site characterization (or Total Geological Model), and, 3) recognizing that our practice output had application beyond the engineering design process: it supported the societal goals of public safety and risk reduction from geologically-sourced risks.

I built on the original concepts and insights of Fookes and colleagues, Hatheway and Hempen, and Knill to prepare a session keynote address the tenth IAEG Congress in Nottingham in 2006 (Tepel, 2009), which was founded on my earlier work (Tepel, 2002, 2004a, b, and c), that delved into the reasons why our profession could not break out of the box in which we felt so comfortable — the old concept about that engineering geology was "really all about" geologists doing geology for engineers on engineering projects.

Why did we flounder about aimlessly for so long in looking for the answer to what engineering geology "was really all about?" Because the blinders of engineering licensure in the absence of geology licensure did not allow us to think in terms of the larger picture: the societal value of our work. Our work, and its societal value, was just incorporated into the design process and judgment of engineers and they took responsibility for assuring that it had value to society on their terms and under their licenses. I took a fresh approach in Tepel (2012).

Perhaps the reason so many floundered in the last century was is that they were looking at engineering geology in its youth and could not foresee its potential as a fully developed, fully independent, discipline. Many of the identity confusion problems that engineering geology continues to endure today exist because we are trying to fit today's scope of practice into yesterday's very limited concept of the role of engineering geology in society. What characterizes engineering geology practice today?

## TELLING OUR 21$^{st}$ CENTURY STORY — WE ARE RISK MANAGERS

How does our practice benefit humankind? Engineering Geology benefits humanity by discovering, defining, and analyzing geologically-sourced risks or conditions that impact, or might impact, humans as they utilize and interact with their built and natural environments (Tepel, 2004c). ***We help people recognize and manage, and make informed decisions about, geologically-sourced risks***.

If risk management is the essence of our practice as I suggest in Tepel (2010), then the ultimate societal value of engineering geology is this: ***when geologically-sourced risks are well -managed, initial and future project costs and risks are optimized in relation to overall project, user, and societal costs and risks.*** Our practice serves the interests of the client and owner, but serves those interests in the context of serving the over-riding interests of the public. We manage geologically-sourced risks on behalf of the public as a result of our management of them for the client or employer. Our mantra is simple: ***we help people manage geologically-sourced risks***. And, in the process of doing that for clients or employers, we help the public manage geologically-sourced risks, too. (This is what we can tell the guy sitting next to us on the airplane.)

## CLOSURE

At the beginning of this Response I said that Engineering Geology is people geology. And now I answer the questions I asked earlier: ***How*** and ***Why*** is Engineering Geology people geology? Engineering Geology is people geology because ***we help people manage geologically-sourced risks***. Thinking of people in a collective sense, twenty-first century Engineering Geology serves people — society, humankind — because ***our practice supports the societal goals of public safety and risk reduction.***

## REFERENCES

Baynes F. J. and Hatheway A., 2003 Responsibilities of engineering geologists in practice *Perspectives No 55 AEG News* 46 (2) pp 13 - 15, Association of Engineering Geologists.

Baynes F.J. and Rosenbaum M.R., 2004, Discussion arising from the 1st Hans Cloos Lecture, by John Knill, *Bulletin of Engineering Geology and the Environment* , Vol 63 No 1 pp 89 -90. Verify year as 2003 0r 2004.

Berkey, C. P., 1929, Responsibilities of the Geologist in Engineering Projects, American Institute of Mining and Metallurgical Engineers, Technical Publication no. 215, pp. 1-9.

Bryan, Kirk, 1928, Geology of Reservoir and Dam Sites, *in* Contributions to the Hydrology of the United States, U. S. Geological Survey Water Supply Paper 597, pp. 1-37.

Bryan, Kirk, 1929, Problems Involved in the Geologic Examination of Sites for Dams. American Institute of Mining and Metallurgical Engineers, Technical Publication 215, pp. 10-18.

Burwell, Edward B., Jr., and Roberts, George D., 1950, The Geologist in the Engineering Organization, *in* Paige, Sidney, Chairman, Application of Geology to Engineering Practice (Berkey Volume), Geological Society of America. 325 p.

Chamberlain, Thomas C., 1897, The Method of Multiple Working Hypotheses, Journal of Geology, vol. 5., no. 6, p. 837-848.

Davison L., Fookes P. G., and Baynes, F. J., 2002, Total Geological History: A web-based modelling approach to the anticipation, observation and understanding of site conditions, (in press).

Fish, John Charles Lounsbury, 1950, The Engineering Method. Stanford University Press, Stanford, California. 186 p.

Fookes, Peter. G. (1997). The First Glossop Lecture. 'Geology for Engineers: the Geological Model, Prediction and Performance'. *Quart. Jl. Engrg. Geol.,* 30, 293-431.

Fookes P. G., Baynes F.J., and Hutchinson J.N., 2000, Total Geological History: A model approach to the anticipation, observation and understanding of site conditions, Invited Paper, *Geoeng 2000 Conference* , Melbourne Australia , published in *Ground Engineering* Vol 34 No 3 pp 42 - 47

Galster, Richard W., 2002, The Origins and Growth of Engineering Geology and its Professional Associations, *in* Tepel, Robert E.,, Editor, Symposium Proceedings, Visioning the Future of Engineering Geology: Sustainability and Stewardship, Special Publication 19, Association of Engineering Geologists Annual Meeting, Reno, Nevada. CD-ROM

Goodman, Richard E., 1999, Karl Terzaghi: The Engineer as Artist. Reston, Virginia, ASCE Press, 340p.

Hatheway, Allen W., 2000, Richard H. Jahn Distinguished Lecture.

Hatheway, Allen W., 2002, Site Characterization, *Raison D'être* of Engineering Geology. *In* Tepel, Robert E., Editor, Visioning the Future of Engineering Geology, Sustainability and Stewardship, Association of Environmental and Engineering Geologist, Special Publication 19, Vol. 1. Association of Environmental and Engineering Geologists, Denver, Colorado. CD-ROM.

Hatheway, Allen W., 2004, Why AEG Needs an Official Policy on Site Characterization, *in* Hatheway, Allen W., and Hempen, Gregory L., 2004, editors, Symposium Proceedings, Visioning the Future of Engineering Geology: Site Characterization (A Specialty Symposium of Only Invited, High-Expertise Presenters). Special Publication 19, Association of Engineering Geologists, Denver, Colorado. CD-ROM.

Hempen, Gregory L., and Hatheway, Allen W., 2004, Introduction to the Symposium, *in* Tepel, Robert E., Editor, Visioning the Future of Engineering Geology: Site Characterization, Association of Environmental and Engineering Geologists , Special Publication 19, Vol. 3, Association of Environmental and Engineering Geologists, Denver, Colorado. CD-ROM

Joint European Working Group, 2004, Professional Tasks, Responsibilities, & Co-operation in Ground Engineering, Final Report to the Societies, Helmut Bock, Chairman, transmitted to Dr. Niek Rengers, President of the IAEG, 07 June 2004. 20 p.

Kiersch, George A., 1955, Engineering Geology — Scope, Development and Utilization. Quarterly of the Colorado School of Mines, Vol. 50, No.3, 122 p.

Kiersch, George A., editor, 1991, The Heritage of Engineering Geology; the First Hundred Years. Geological Society of America, Centennial Special Volume 3, 605 p.

Knill, John, 2003, Core Values: the First Hans Cloos Lecture, Bulletin of Engineering Geology and the Environment, vol. 62, No. 1, pp. 1-34.

Legget, Robert F., 1955, Engineering Geology — A Fifty-Year Review, p. 534-556 *in* Bateman, Alan M., 1955, Economic Geology — Fiftieth Anniversary Volume, Part II, Economic Geology Publishing Company.

Legget, Robert F., 1972, Engineering Geology in Perspective, Bulletin of the Association of Engineering Geologists, bol. 9, no. 2, pp. 79-88.

Legget, Robert F., and Hatheway, Allen W., 1988, Geology and Engineering. Third edition, McGraw-Hill, Inc., NY. 613 p.

Meehan, Richard L, 1984, The Atom and the Fault: Experts, Earthquakes, and Nuclear Power. The MIT Press, 161 p.

Müller, Leopold, 1943, Wo steht die ingenieurgeologie? Geologie und Bauwesen 15, 3. This is probably the article he refers to in 1974/6 as requested by Hans Cloos.

Müller-Salzburg, L., 1976, Geology and Engineering Geology. Reflections on the Occasion of the 25th Anniversary of the Death of Hans Cloos. Bulletin of the IAEG, no. 13, pp 35-36.

Nickell, Frank A., 1942, Development and Use of Engineering Geology, Bulletin of the American Association of Petroleum Geologists, vol. 26, No. 12, pp. 1797-1826.

Paige, Sydney, Chairman, 1950, Application of Geology to Engineering Practice, Berkey Volume, Geological Society of America, 327 p.

Stini, Josef, 1939, Ingenieurgeologie und ingenieurgelogischer, Geologie und Bauwesen, 11.

Müller, Leopold, 1943, Wo steht die ingenieurgeologie? Geologie und Bauwesen 15, 3.

Stini, Josef, 1949, Wie stärken wir das Ansehen des Baugeologie? Geologie und Bauwesen, 12.

Sullivan, T. D., 2010, The Geological Model, *in* Williams, A. L., Pinches, G. M., Chin, C. Y., McMorran, T. J., and Massey, C. Y., 2010 (editors), Geologically Active; Proceedings of the IAEG Congress, Auckland, New Zealand, 5-10 September 2010.

Task Force, 2004, Core Values of Engineering Geology and the Commission's Work, a Working Plan Produced for Discussion. IAEG News, Volume 32, Number 1, p. 1-4.

Tepel, Robert E., 2002, Mission-Capable and Mission-Ready? The Role of the Engineering Geology Professional Associations as Stewards of, and Standard-Bearers for, the Profession, *in* Tepel, Robert E., editor, Symposium Proceedings, Visioning the Future of Engineering Geology: Sustainability and Stewardship, Special Publication 19, Association of Engineering Geologists Annual Meeting, Reno, Nevada. CD-ROM

Tepel, Robert E., 2004a, Confounded Confusion: Implications and Consequences of the Great Definitional Obfuscation Between Engineering Geology and Environmental Geology *in* Tepel, Robert E., editor, 2004, Symposium Proceedings, Visioning the Future of Engineering Geology: Understanding Conflict and Cooperation in the Practice of Engineering Geology, Association of Engineering Geologists Annual Meeting, Dearborn, Michigan. Special Publication 19, Association of Engineering Geologists, Denver, Colorado. CD-ROM.

Tepel, Robert E., 2004b, The Engineering Geology Site Characterization as the Core Function of Engineering Geology Practice *in* Hatheway, Allen W., and Hempen, Gregory L., 2004, editors, Symposium Proceedings, Visioning the Future of Engineering Geology: Site Characterization (A Specialty Symposium of Only Invited, High-Expertise Presenters). Special Publication 19, Association of Engineering Geologists, Denver, Colorado. CD-ROM.

Tepel, Robert E., 2004c, Toward a Philosophy of Engineering Geology, *in* Tepel, Robert E., editor, 2004, Symposium Proceedings, Visioning the Future of Engineering Geology: Understanding Conflict and Cooperation in the Practice of Engineering Geology, Association of Engineering Geologists Annual Meeting, Dearborn, Michigan. Special Publication 19, Association of Engineering Geologists, Denver, Colorado. CD-ROM.\

Tepel, R. E., 2009, The Core Attributes of Engineering Geology - A USA Perspective. Session keynote Paper, 10th International Congress of the International Association for Engineering Geology and the Environment, Nottingham, United Kingdom. Published in Culshaw, M. G., Reeves, H. J., Jefferson, I., and Spink, T. W. (editors), 2009, *Engineering Geology for Tomorrow's Cities*, Geological Society, London, Engineering Geology Special Publication 22, pp. 273-276.

Tepel, Robert E., 2010, Risk Management as the Essence of Engineering Geology (Issues in Professional Licensure for Geologists, LVI), AEG News, June 2010, vol. 53, no. 2, pp. 32-34.

Tepel, Robert E, 2012, (abstract), Renaissance and Rediscovery in Engineering Geology: the Search for Its 21st Century *Raison d'Être*, 4th International Professional Geology Conference: Earth Science-Global Practice, Vancouver, British Columbia. Conveners: European Federation of Geologists, Australian Institute of Geoscientists, and American Institute of Professional Geologists, hosted by Association of Professional Engineers and Geoscientists of British Columbia.

Williams, Ronald E. editor, 2011, Rudolph Glossop and the Rise of Geotechnology. Whittles Publishing, Dunbeath, Scotland, UK, 284p.