ELSEVIER

Engineering Geology 65 (2002) 47–79

ENGINEERING GEOLOGY

www.elsevier.com/locate/enggeo

7th Annual Report on the International Status of Engineering Geology—Year 2001 Encompassing hydrogeology, environmental geology and the applied geosciences

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Abstract

The year was marked by noteworthy advances in multinational consortia of commercial firms and of forward-looking universities. Again, the tenor of the practice of Engineering Geology has picked up. Not to be in the vanguard does indeed mean that one languishes in the dust raised by those on the move. Engineering geologists must understand an infinity of challenges stemming from land development, environmental protection and cleanup and resource development. This is a profession in which age can bring wisdom and increased competence. Most practitioners were busy in 2001; more than 80% of ASFE member companies report that business has increased or stayed the same for the past 6 months. Sixty percent of practitioners expect that their 2002 revenues will be stable or increase for Year 2002.

Keywords: Engineering geology; Environmental protection; Natural hazards; Geotechnical engineering; Professional practice

1. Noteworthy events

Every year we are faced not only with recurrence of events for which we are routinely trained, but for those expensive events (in both lives and dollars) that make for commentary on the threat-increasing activities of a more crowded planet.

1.1. Aircraft terrorist attack on United States

All but a small portion of the informed peoples of the world were reviled by the Al Quidia terrorist cult's cowardly use of hijacked airliners to kill over 3000 people, of many nations, in three suicide impacts and one additional attempted event on 11 September, 2001. Following this attack were incidences of anthrax biological warfare in America's eastern States. While most of the world mobilized against the perpetrators, hiding mainly in the formerly militant state of Afghanistan, it was not but days before the thought of applied geology came forth to the lawmakers, public officials and the military.

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0013-7952/02/$ - see front matter
PII: S0013-7952(02)00027-3

Applied geology was recognized early on in the call for testimony and innovation from the hydrogeologic community in terms of protection of potable water supplies and by the military in its interdiction and counter-terrorist campaign conducted in Afghanistan within weeks of 11 September. The authors are not privileged to know details of the actual program of application of military geology, but the most pointed use has been the systematic explosives—destruction of existing hard-rock caves by American-orchestrated forces, including aerial bombardment and indigenous freedom fighters of the Northern and Eastern Afghani Alliances.

1.2. Mega-redevelopments

The City of Denver is redeveloping the nearly 2000 ha of the historic Stapleton Airport. Airport buildings and runways will be recycled into construction aggregate and the space totally "plowed over" for high-density residential units, commercial and business space, malls, recreational facilities, and 38% was reserved as open space. Geologic input probably will be minimal, but the message of airport recycling is strong.

1.3. World Commission on Dams (WCD)

We watch the picture of international dam building as reported by the International Committee on Large Dams (ICOLD) and its member-country committees. ICOLD provides technical oversight and technology-transfer for dam construction and maintenance. Latest recommendations (Nov, 2000) tell us that serious, broad concerns must replace the basic national right of a people to have the use of precipitation that falls on their watersheds. Already the numbers of engineering geologists with actual large-dam experience is quite small and our services in this discipline will continue to shrink. Likely the doctrine of Sustainable Development, gained in near-universal acceptance at the Earth Summit of 1990, will guide what new dams will be allowed. As always, we will serve to find the best available siting options, in consideration of geology.

Not to be confused with the International Committee on Large Dams (ICOLD), which deals with accountability of dams and technology transfer, the US component (US Committee on Large Dams) has become the US Society on Dams (USSoD).

1.4. Saguenay Fjord: positive consequences of the large 1996 flood deposits

In 1996, we reported on the disastrous July flood in the Saguenay region of Quebec. Catastrophic swelling of tributary rivers poured 20 million tonnes of sediment into the upstream section of Saguenay Fjord. This event was doubly damaging, as the new sediments have buried underlying industrially contaminated sediments. In the last 5 years, a group of scientists and engineers have evaluated the new sediment for its performance as a geological barrier. Emphases include geological, geotechnical, hydraulic, geochemical, and biological impacts. Preliminary results have shown that bioturbation and erosional and slope instability-related processes are the most important negative factors that might affect the performance and integrity of the flood-capping layer.

1.5. Martinsville, West Virginia coal waste impoundment failure

As a result of the Martinsville, West Virginia coal waste impoundment failure, the US National Research Council has been asked by the Congress to investigate the need for rational regulation of the siting and design of these fine-grained, liquefiable wastes.

1.6. Geology and foot-and-mouth

Foot-and-mouth disease beset Britain in April and resulted in official orders for the wholesale slaughter of affected beasts. In one instance in Cumbria, bovine corpses and disinfectant were consigned to a disused gravel pit, without sanction by geologists. Odor of the disinfectant soon appeared in nearby water supply and the Royal Army was handed the unsavory task of recovering the moldering corpses for secondary disposal at Eppynt Artillery Firing Range, Wales. Again the disinfectant broke out there, as well as rearing its head along the River Anglesey where cattle had been treated, subsequently killing fish and eels in the runoff. Based on Britain's long trial with high-level radwaste management, the fallout was dubbed the "Sellafield Effect," after the former candidate site. At mid-year, an engineered disposal site was being constructed at Ash Moor, near Petrockstow, with leachate collection and flaring of biodegradation gases.

1.7. Putting earthquakes in their proper perspective

Since origination of this report in 1995, we have given much attention to the world's major earthquakes (Table 1). Such information is critical to our record of the profession, but earthquakes are now expected to occur, and to occur in seismogenic places. Hence, we downgrade that presentation to an annual table that will give us pause to reflect on their serious threat, without consuming too much space annually! Even if all of us cannot be involved in this exciting work, we must remember that some 20 of the world's "mega-cities"

Table 1
Major earthquake and seismic research activity of 2001

Location	Magnitude	Details
Tethys Belt	To greatest possible	Tethys Tectonic Collision Belt; two proposed tectonic regions: PANCARDI and SEAWPAC. The former corresponds to Turkey, through the Stable Eurasian Plate and east of the Eastern Alps. The latter consists broadly of Southeast Asia, from eastern Tibet, through Yunan and Vietnam, to the South China Sea.
San Francisco–Oakland Bay Bridge, California	Selection of Retrofit Seismic Design Parameters; Determinist @ M 7.5, Probability @ M 7.25	A debate opened on this subject in Year 2000. This was and is the prime battle ground between the geologically proofed method of seismic determinism and the geologically scuttled method of probabilistic estimation. Probabilists are deep entrenched in the Bay area and have yet to face the definitive return of a 1906-type event such as will provide maximum shaking for the fruits of anti-seismic design such as have grown up and out of the University of California and Stanford University, both fueled from the damages of nearly a hundred years ago.
Mt. Fuji Japan	Ominous increase in magma-induced tremors	The famous stratovolcano symbol of Japan has exhibited a notable increase in low-frequency earthquakes emanating from the magma. National Coordinating Committee for Volcanic Eruption Prediction will activate monitoring; its first decision since its inception in 1974. Fuji last erupted in 1707.
El Salvador 13 Jan. 2001	M 7.6	Subduction-zone event west of San Salvador, the capital. Prime cause of death a ridgeline-to-toe earthflow that obliterated dozens of homes at the puebla of Santa Tecla. Interim casualties at more than 700 dead, 500 missing and 4000 injured. World Bank, already funding at $200,000,000 in development, is interested in financing some reconstruction. Comprehensive year-end report by EERI at http://www.eeri.org/Publications/cdroms.html.
Bhuj (Gujarat State, Western India 26 Jan 2001	M 7.9 inatraplate event in known Kutch Fault Zone	Over 20,000 deaths, more than 167,000 injuries and $5 billion in damage. Thick, folded Mesozoic through Tertiary section; thrust-fault with focal depth of only 20 km; liquefaction prevalent in the Holocene deposits. First recurrence since 1819; Expected to bring recognition of high-magnitude/long return events elsewhere in regions not currently thought to be at high seismic risk. Thought by many to be the worst natural disaster of the past 50 years.
Nisqually (Olympia) Washington, USA 28 Feb 2001	M 6.8 @ 52 km depth; Repeat of 13 Apr. 1948 event used for regional seismic design	Normal displacement along subducting Juan de Fuca plate. One death and some 30 hospitalizations speaks well for degree of preparation, though failures of historic brick buildings were common from Olympia to Seattle, a range of about 100 km. Collection of damage photos on the net in two days (http://www.clients.shanwil.com/project.php?projectid=Quake_2001); EERI has posted extensive information on its net (http://www.eeri.org).
Geiyo, Japan Western Seto Inland Sea 24 Mar 2001	Mj 6.7 Philippine Sea Subduction Plate	Normal fault displacement along 20 km of N-S-trending fault with epicentral depths of 40–50 km, but shock distributed along fault zone 10 km wide. Two deaths, 296 injured, 628 homes completely to half-destroyed, with 41,392 homes damaged.
Arequipa, Peru South Coast 23 Jun 2001	M 8.4 Subduction zone event	Epicenter 600 km SE of Lima; City of 1,000,000; 97 dead (20 from associated tsunami), 46,000 homeless. See http://www.eeri.org/Reconn/Arequipa_Peru/Arequipa.html.

lie in the seismic belt that extends from Southeast Asia to Central Europe. Looked at in another way, this is the stage where a million people died in the last century, from plate tectonic earthquakes and associated volcanic eruptions.

1.8. A look at engineering geologic activity in Africa

Oliver Barker, a long-time South African practitioner, provides these elements of activity (Table 2) from the Annual Report on Southern Africa, released by the South African Geological Survey, Council for Geoscience.

1.9. The year in Canada

Geological engineering programs have slipped down to nine, country-wide, and Dr. Rejean Couture, Chairman of the Engineering Geology Division of the Canadian Geological Society (CGS), commissioned a

Table 2
Engineering geologic activity in Africa (2001)

Location and organization	Details
	Guidelines for Development on dolomite published jointly by SAIEG and CGS.
South African Council for Geoscience (CGS)	Second in the series on Popular Geoscience guides, on the Bushveld Complex by Hugh V. Eales; Follows the guidebook to Tshwaing crater.
South African Institute for Engineering Geology (SAIEG)	Mapping underway for six 1:250,000 sheets in Mozambique as part of World Bank project and to restructure the national Geological Survey. Geologic (constraints) hazard map program has completed first six quadrangles of the East Rand Sheet. Ten Geotechnical sheets of the national series completed at 1:50,000 have been published in 2001, with four more slated for completion for field mapping. Mid-year completion of the geotechnical investigation for the national Freedom Park monument on Salvokop. On-going field work in the Gauteng Mining Pollution Forum, for site and waste characterization of sources of dust pollution from slimes dams, along with hazardous underground openings and surficial geotechnical hazards, as well as sources and effects of acid mine drainage.
South African Institute for Engineering Geology (SAIEG)	Revised Guidelines for Soil and Rock logging published.
Authors Tim Partridge and Rodney Maud, Durban, SA	Definitive book on the environmental geologic conditions of the Cenozoic of South Africa; An extension of A.B.A. Brink's excellent four-volume series on Southern Africa.
Need authors names here	Attention given again to hazards of development on dolomite ground, by way of articles in the Pta News and by the sinkhole collapse at Klipspruit Hospital.
Fujaira	Geochronological, lithological and chemical mapping now in report compilation phase.
Lobatse Geotechnical Survey	Worth US$500,000, 2-year contract, 700 profiles and 1-km core plus 45 percussion holes. Final report of 1000 pages plus 15 A0-size geologic maps in 50 copies.
SADC Geotechnical Mapping Programme.	Riaan Joubert is currently producing geotechnical maps for Lusaka and Luanda as part of the SADC Engineering Geological mapping programme to assist SADC countries.
Botswana Geological Survey	Geophysical survey of Francistown dam site delimitation of derelict mine workings.
Morocco	Geochemical mapping of Morocco completed July, 2001.

national survey by Prof. (Dr.) Oldrich Hungr. Conclusions included such concepts as encouraging undergraduates to approach geotechnical careers through either geology or civil engineering, and that the geological engineering departments should be offering courses in geotechnical engineering and related applied geology where conflicts were not evident with other campus departments.

1.10. Toulnustouc River, northern Quebec

Canada has launched planning for $380,000,000 in the hydroelectric development of northeast Quebec. The layout includes a 71-m-high dam, a 526-MW two-unit powerhouse, and a 9.8-km power tunnel in graphitic gneiss. The local indigenous tribe will be a partner.

1.11. COSTA-Canada: a Canadian study of continental slope stability

Canada has begun to assess slope stability along its continental margin, emphasizing estuaries and fjords. This new emphasis is tied to increasing economic activities in natural resources (oil and gas), transportation (port development), electrical transmission, and communication (particularly fiber optics cables).

Canada sees major risks from natural hazards such as earthquakes, submarine landslides, and tsunamis. This project will be the Canadian contribution to a major European effort on this very same topic, involving Norway, France, England, Italy and Spain. A 4-year effort will draw comparisons and extrapolations based on well-investigated sites in the Atlantic and Pacific. New analytical characterization methods will be developed, based on field, laboratory and numerical modeling of submarine landslides.

A first task will be to establish a reasonably precise database, integrating field (seismic surveys) and laboratory data (strength and deformability testing) into a three-dimensional (3-D) model that will encompass the full extent of submarine landslide hazards. This visualization will be incorporated in a new approach to define the slide hazard and integrate it into a risk assessment methodology. Extensions of this new methodology are expected to prove valuable for the other associated risks of earthquakes and tsunamis. This project is part of COSTA-Europe (J. Mienert co-ordinator).

2. Conduct of the profession

We must never lose sight of the apparent health and nature of our profession. Measuring its health is difficult, but we offer these observations as a clue to the "big picture."

2.1. Government

Our rule of thumb concerning the practice of geology in government is "the more the better." This is a moving target, but younger readers should keep in mind that the geological career picture in government appears to be quite stable, if not improving.

2.2. Federal

There remains no clearing house for assessment of the numbers of geologists employed in US Federal agencies, nor of programs in those agencies that have a geological thrust. We report on what we hear.

2.3. US Army Corps of Engineers

The Corps has been taking a yearly census of its Civil Works geological staff since 1974 and we are pleased to learn from Chief Geologist Michael Klostermann that the comparative numbers are 334 for 1974 and a pleasing 313 for 2001.

The Corps continues its excellent yearly 3-day Annual Geotechnical Conference. For 2001, the theme is "Maintaining Technical Expertise."

In 1999, we sadly reported that "social engineering" had been initiated at the Office of Chief of Engineers, relating to career advancement in the professional grades of the civilian professional staff, including geologists and geoenvironmental engineers.

However, under the new Chief, Lt. General Robert Flowers, P.E., we have the impression that merit and professional qualification have been reinstated to the promotion competition of the Army's civilian staff in the Corps.

2.4. FEMA raises environmental awareness

The Federal Emergency Management Agency (FEMA) is a national disaster awareness and control arm of the US government. We have seen FEMA

continually improve upon its basic capability. In Year 2001, FEMA has launched an internet resource to educate the populace on a variety of sites representing various forms of environmental dangers. This resource attempts to offer representative hazards accessed by postal code. FEMA also played a key role in locating and coordinating demolition work and human-remains-recovery efforts at "Ground-Zero," the terrorist-destroyed World Trade Center, at New York City.

2.5. US Bureau of Reclamation

Bureau geologists have lapsed into a low profile of late years. The office of Commissioner, however, has been returned to the professional ranks with the appointment of a retired Bureau 34-year career civil engineer John W. Keys, III, in 2001. Former Commissioner, political appointee Dan Beard, has returned to his nontechnical origin as chief executive of the American Audubon Society.

2.6. States and Provinces

We found that apparent activity in the States and Provinces to be also at a regrettably low profile. Again, there is no clearing house for these important near-grass-roots contributions of our colleagues. Sub-Federal geological surveys internationally rely on the stimulus of local disasters to receive enabling funding after the fact. State and Provincial legislators everywhere continue to retreat from recognizing the crying need to fund fundamental geologic studies.

2.7. "Distance" (continuing) education

The marketers of "what is new is better" have renamed our historically successful concept of "continuing education" as "distance education." As Universities perfect their transitions from institutions of higher learning, to contemporary business organizations, the scramble to project from the campus to the market place has become intense. Administrators rise and fall on their ability to steer the ship of education between the icebergs of baby-boom and baby-bust.

Generally, society is downsizing its attention with respect to funding higher education. Most university administrators are incapable of teaching and indulge in flogging the teaching staff to make up the shortfall through "research" (any activity to raise off-campus funding, no matter the utility of the activity). A new trick is marketing ploys to send out roving teams of prestige-paid off-campus mercenaries to offer distance education to the practitioner. The market, however, is not healthy as the downside of bid-shopped commoditization of professional services has left the consultants with poor margins of profit over investment. Who is left to support distance education? The universal target-person remains the middle-manager and middle-practitioner, persons who are bright and hard-working and who have reasonable goals for achieving success in their careers.

The Year 2001 twist has been for aggressively marketed courses to be shared with a faraway campus; witness the entrepreneuristic University of Wisconsin conducting specialty geotechnical short courses conducted half a continent away, at the University of California at Los Angeles (UCLA).

On a refreshing departure from raising money, the Earthquake Engineering Research Institute (EERI) has created its Linbeck Distinguished Lecture Series in Earthquake Engineering. These lectures will be archived for later viewing, at http://www.nd.edu/~linbeck/> http://www.nd.edu/~linbeck/.

2.8. Military geology

The increased tenor of Third World guerilla warfare and now the worldwide scope of fanatic middle-eastern terrorism was anticipated by our military geologist colleagues.

A major military geology book appeared in the UK, and the US Proceedings of a 1996 military geology conference at Warwick University have been brought out by The Geological Society (London) by military geologist organizers and educators, Drs. Edward P.F. (Ted) Rose and C. Paul Nathanail, as "Geology and Warfare; Examples of Influence of Terrain and Geologists on Military Operations" (Geological Society of London, 2001a).

In retrospection, Evans' (2000) "The Fall of France" (1940) deals with Hitler's fear of using an armored advance to trap the British Expeditionary Force and its French allies at Dunkirk, Belgium, gained from a misinterpretation of the otherwise excellent Whermacht Oberkommando military geologic maps of the field. Likewise, the Geologists Association (UK)

has issued its Guide "Geology of the Western Front, 1914–1918" by Professor Peter Doyle. The last title is reminiscent of Brooks' (1920) (namesake of Alaska's Brooks Range) "The Use of Geology on the Western Front".

As students of the technology know, military geology is a strictly utilitarian form of engineering geology!

3. Consultants

Consultants continued to represent the most active sector of our profession, if only for the reason that the capitalistic situation requires them to continually probe new markets for work. We should not forget that it is the consulting arm of the profession that continually advances and raises our profile.

3.1. Employment situation

Jobs were available across the planet, but under new rules in which potential employers seldom offered transportation expenses to and from their cities for the interview. In fact, during 2001, firms hiring entry-level staff began to employ computer-based video interviews. In this system, the graduating candidate responds to a pdf text file asking for standard resume information, which then administers a series of questions aimed at characterizing "work style." Next, the candidate video responds to a web camera in which the candidate first has a couple of trials, followed by the submittal. The initial vendor claims that the process can be accomplished in 20 to 30 minutes. We do not applaud this cheapening of the professional experience.

These retractions in the interview process have been hard to accept for graduating seniors, and understandably so, for this is the expected result of bid-competition for professional services. As in the past, the secret to optimal employment is to select university departments which offer the benefit of faculty who are concerned and who are known by potential employers.

The market remained exceptionally bright for competent technical minds with 5 years-plus experience and the ability to manage projects or branch offices. That demand literally will never cease. The requisites, of course, are worthwhile experience, professional registration, people and communications skills, an ability to market, and skills in business management.

Other forms of degraded professional employment are now with us permanently, including the dreaded "six-figure" termination salary, at which point the happy achiever is singled out as a point-source for cost reduction. Likewise, many of the less substantial consulting firms, particularly those of the Beltway around Washington, DC, were pleased to hire the "over-50" crowd at hourly wages, without benefits. One of our over-50 colleagues states, when faced with accepting a no-benefits 39-h weekly "bandit salary" said "During the interviews I left no doubt that I'll work hard, but I won't put up with any crap. I've already worked the equivalent hours of two life-time careers in uncompensated overtime in the mining industry. I want to be paid for all my work." We agree!

3.2. Architectural/engineering (A/E) firms

Worldwide, the traditional place of architectural/engineering firms has been remolded by the same sickness of cost first, then quality. We have seen a small legion of honored pioneer firms, both in North America and in Europe, fall by the wayside, as if a century of achievement no longer counts.

Inherent in some of the many woes of the A/Es is the ongoing policy of "underbidding" the budgets for professional and subprofessional services related to large follow-up projects. Corporate greed among the owners serves to fuel the anxiety of such firms who promise more for less and then hope to recover some earned profit through changes in scope broadly known as "extras."

Last year's sell-down of the venerable Stone and Webster Engineering (SWEC) to the Shaw Group of Louisiana, has brought out six separate charges of "cooking the books" by SWEC senior management. As noted above, some investor groups claim underbidding to give the appearance of enhanced cash flow at the time of ownership transfer. In any sense, "low-bidding" in "loss-leader" services creates undue performance pressures on geologists, who occupy the front-end of all such projects.

In 2001, we saw skilled Cornish bedrock drillers imported to the US by one of the multinational geo-

technical/environmental firms. Their traditionally high levels of technical expertise make these ''Cousin Jacks'' welcome in North America.

3.3. Hail the new king, Washington Group

Washington Group, Boise, ID, is now the resting place for several legendary architectural/engineering names, to include Morrison-Knudsen (1915), Thomas Edison's 1905 EBASCO (Electric Bond and Share Co.), United Engineers and Constructors (1928, the construction arm of the legendary United Gas Improvement [1882]), and half of the giant Westinghouse (1890; The remainder went to British Nuclear Fuels). To this, add the relatively young Raytheon Engineers and Constructors.

Washington Group (WGI) is controlled by Dennis Washington, who grew his heavy construction and railroad-service business from Missoula, Montana. WGI also holds the largest agglomeration of former and present copper-ore ground at Butte, Montana, a city in the way of serious environmental harm as Washington has closed down his recovery and remediation operation in the flooded Berkeley Pit. To off-balance liabilities, Washington, has US Department of Energy (DOE) contracts to remove solid fuel from defunct Soviet ballistic missiles in the Ukraine, the management of the Waste Isolation Pilot Plant (WIPP), and, combined with Bechtel, a $4 billion contract as Bechtel–Washington, to continue working the DOE mess at the Hanford Reservation, in Washington State.

In 2001, the entire combination blew up in the face of owner Washington. WGI moved to Boise, ID and filed for bankruptcy and reorganization, charging that Raytheon had cooked its books and concealed $700 million in liabilities. Certain WGI investors filed a parallel suite and the mess was in court at year end. We predict that the wily Washington will survive and remain one of the largest single employers of engineering geologists on the planet.

3.4. Other major A/E amalgamations

We speak now of a merger of two long-respected A/E firms with strong geological staffs. Harza Engineering (Chicago) and Montgomery–Watson, a decade-old Anglo-American company, who now have merged as Montgomery–Watson–Harza (MWH) Global.

Another new-Millennium giant is Jacobs Engineering Group, having risen from an obscure but respected regional engineering and construction company of the 1950s at Pasadena, California. By 2001, Jacobs had morphed into a typical Washington, DC Beltway firm and had consumed and digested Sverdrup, and was one of the five inner-circle USDOE favored contractors for environmental restoration. Jacobs Group now is totally decentralized in a geological sense and does not provide a spiritual home or central guidance for its many engineering geologists. After the usual 18-month shake-out, seasoned Sverdrup personnel had largely left that venerable and highly respected old firm (formed in 1930).

3.5. Geoenvironmental firms

There is no question but that historic geotechnical consultants now have become ''geoenvironmental'' firms, worldwide, and we will so treat them here and in the future.

A major world consulting force appeared in early 2001 in the form of the reconstituted and renamed AMEC (one of the ''no-name variety''). The story begins with AGRA Earth and Environmental, founded at Calgary, Alberta in 1951. From its early 1990s arrival in the United States, AGRA merged in 2000 into AMEC of the UK. This amalgamation lately includes the venerable US name of ''Ogden'' (from the 1930s). AMEC offices in the US have doubled to 54, and the Calgary-headquartered subsidiary now has worldwide dominance in the field. The new AMEC is a contender for the world's largest employer of engineering geologists, as well as geotechnical engineers.

Worldwide, major consulting engineering firms have taken to bragging on numbers of their employees. MACTEC (another ''no-name,'' established 1975), a large, low-profile finance group at Golden, Colorado. MACTEC has merged its former free-standing subsidiaries, Harding Lawson Associates (formed about 1958) with Environmental Science and Engineering (formed at Pasadena, California in 1954, and later known as Quest Environmental, then QST), and Pacific Environmental Services (Herndon, VA) into Harding ESE, another new name to remember. Employees number 1800. Senior practitioners will recall the name Harding–Lawson from its early 1960s origins at Novato, California as an engineering

geological and geotechnical firm. As for MACTEC, it is partially owned by ''Cherokee,'' yet another shadow entity. We doubt that geologists remain in key positions in the new entity.

Earth Tech, once Fugro, US (formed 1971) and now owned by the shadow Tycho Industries of Holland, but yet operating from Long Beach, California, has now has shifted its public presence into ''global water management provider.'' Its key number is 7000 employees. Fugro US will be remembered by hordes of former geological staff, for its infamous hire-and-fire philosophy of the 1970s and 1980s.

SRK (once known as Steffan, Robertson and Kirsten), originally of South Africa, has had a North American presence since 1980. Its slow but sure growth has been made convincing by expansion outward from Denver in 2001.

3.6. Individual practice

With continued consolidation in geotechnical and geoenvironmental firms, the value of a minimally acceptable house project has crept up to about $20,000, leaving more and more small-project work for exploitation by sole practitioners. Most of the sole practitioners are our ''over-50'' colleagues who have been ''downsized'' as the result of priced-competition for professional services.

3.7. International market

We believe that our world geoenvironmental market is sound and that multinational combinations will have the best chances of success. The top-level firms are those most likely to be called by potential overseas clients, and their marketing effort is largely driven by what remaining goodwill survives from past experiences.

The wild cards in the international market continue to be the Japanese tunneling contractors, South Korean heavy construction, and PRC Chinese consulting engineering firms. These entities continue to register phenomenal successes around the globe.

3.8. Sweeping changes in Japanese government

Japan's 56th Prime Minister, Mr. Jun'ichiro Koizumi was elected on 26 April 2001. Under his direction, the ''Fundamental Plan for the Management of the Economy and Finance, and Reorganization of Economical Society'' was established by the Cabinet on 26 June. This plan includes important matters regarding both the impending decrease in national loan issuances and the formation of the national budget.

3.9. Changes in government organization

On 6 January 2001, the Japanese government was reorganized, and the number of ministries and agencies was reduced from 22 to 12, specifically to cope with the complex political themes of the 21st Century. In taking this pathway, the government plans to reduce its Federal employees by 25% in a decade and to pare down the size of the agencies.

3.10. Special (public) corporations

There are 163 national public corporations in Japan; 77 are termed ''special'' and 86 as ''approval.'' Many of Japan's geological community are employed in these organizations. The Prime Minister and his Cabinet are formulating a plan to rearrange and rationalize the corporations according to the following measures:

- Abolition or shifting of each corporation to private management or to an independent administrative corporation; and,
- Abolition, rearrangement, reduction, rationalization, or transfer of the various enterprises and their parent corporations.

Prime Minister Koizumi has ordered dissolution of Japan National Oil Corporation as an initial step in the new program. The Oil Corporation invests money in, makes loans to, and guarantees the debts of approximately 230 private oil companies. It has made bad loans totaling more than 1000 billion yen. Its strategic petroleum oil storage will be managed directly by the national government.

Japan Public Highway Corporation will be grouped with the other three ''road corporations'': the Metropolitan Expressway Public Corporation, the Hanshin Expressway Public Corporation, and the Honshu Shikoku Bridge Authority. These four road corporations will then be divided into six private companies. Prime Minister Koizumi has instituted a temporary freeze on the construction of new expressways.

3.11. Employment situation

Worldwide confusion reigned in the employment marked for applied earth sciences. This was the year of the total end of interview trips for most university graduating seniors. Reduced profit margins left consultants bringing in only seasoned interview candidates for management positions. Recent college graduates are strongly advised to pool travel expenses with colleagues and to drive to cities of their choice, where they should choose contacts with members of professional societies with which the student holds student membership, as well as to attend employment fairs at their specialty professional society meetings.

The good news, however, is that finally, the decade of indifferent employment is over and career positions are there for those who market themselves. Importantly, university contacts with faculty actively involved in the profession remain the most likely to yield good results.

3.12. Contract employment

Contract employment, the odious scheme in which companies can shave staffing costs by temporary engagements through a third-party staffing firm, are on the rise. Implicit in this arrangement is that the employee, professional or tradesperson, submits to an hourly salary (paid when actually employed) that includes neither benefits nor a hint of career status. For employers who hold profit above loyalty, this is a win-win situation with freedom to dump employees, with no legal protection, at a moment's notice. Geologists and engineers remain especially vulnerable to being "sacked" on reaching age 50, and, of course, the entry-level professionals are sometimes easy marks. Some married couples abet the system by having one party take more secure and legally protected employment while the other plays Russian roulette on the temporary circuit. Our congresses and parliaments should look into this modern form of slavery perpetrated by greedy employers and the "job-shopper" temporary employment pirates who serve them.

3.13. Priced competition for professional services

The world trend toward "bigness" has become the major factor in the future of engineering geology. A Canadian colleague and long-time practitioner reminds us that "engineering geology is intellect-driven, as the geologist must spend mind-time predicting the future consequences of engineering actions on the environment." The authors know that it is difficult to impossible to package this professional service in a priced-commodity mode. On the other hand, consulting engineering and much of geotechnical engineering practice also has become commodity-driven, and this means bigger is more profitable, but quality "flies the coop."

We find that today's large A/E firms with engineering geological staffs tend to offer engineering geology and geotechnical engineering as "loss leaders," to get their foot in the door to obtain the higher-margined design and design-build construction work. With these firms, engineering geologists become almost second-class citizens. Quality of professional work under these circumstances consequently tends to drop. The mentality of many large organizations is that law suits become a cost of doing business, and hence, money is no longer spent for quality assurance, such as hiring the best available staff and providing internal and external peer reviews.

But, by their very nature, engineering geologists are quality-driven, because they are dealing with the heterogenieties of nature and they know full well that, under bid-shopping, they cannot provide the quality required to avoid litigation in a commodity market place.

Smaller engineering geological, geotechnical and geoenvironmental firms, those with dedicated quality-driven engineers and geologists find themselves forced out of the marketplace, much as Wal-Mart has forced thousands of high-quality specialty stores from that marketplace. On the other hand, small firms must stress the outstanding benefits of personal service to the client's needs.

So, let it be recorded that, in Year 2001, we were aware that in the engineering geology marketplace, bigness begets commoditization, and commoditization begets low quality of service. Let it be known that our profession remains capable when employed with inherent freedom related to competence of practice.

3.14. ASFE provides self-help to the consultants

ASFE is the "no-name" not-for-profit professional association that provides programs, services, and

materials to help geoprofessional, environmental, and civil engineering firms prosper through professionalism. This consultant watchdog protective association continues to provide essential corporate and small-practice survival information, largely through its Case Histories series, and a valuable series of guidelines and client pamphlets, available free of charge to members (details at http://www.asfe.org). ASFE currently is guided by President W. Jarold Stamford, P.G., of Richmond, VA, only the second geologist to head ASFE since its founding in 1969.

ASFE conducts several correspondence courses as part of its Project Manager Training Program, a 90-h educational experience. ASFE issues CEU credit to prepare rising career professionals to manage consulting projects as well as branch offices. The senior author is a 1976 graduate of the Institute of Professional Practice and can speak from first-hand experience of the highly positive aspects of this training. See the web-site address above.

ASFE and the American Society of Civil Engineers (ASCE) also sponsor the new Foundation for Professional Practice, designed to bring professionalism issues to students and practitioners. A number of ASFE materials will be repackaged as FPP materials, for distribution to ASCE members.

ASFE also has issued its new *Daily Field Report Guide*, stressing that engineering geologic specialty, the site sketch. As with all field visit reports, the guidance stresses that we identify Who? What? When? Where?

America's National Society of Professional Engineers (NSPE) now recognizes the new trend toward employers' requiring their staff to self-educate. NSPE has three forms of assistance available to its members (http://www.pepp@nspe.org):

1. Downloadable contract documents for your next project.
2. Self-study continuing education courses on video tape.
3. Financial management tools to plan your workload.

3.15. Daubert decision and expert testimony

"Junk Science" provisions entered the American legal system with the 1993 "Daubert" Federal Court rule (US District Court, in Daubert vs. Merrell Dow Pharmaceuticals (509 US 579). This provisions allows the expertise and competence of technical experts to be challenged by opposition lawyers. The rule was clarified in 1996 (Joiner vs. General Electric (reversed as 78 F. 3d 529; 11th Cir.) and further clarified by the US Supreme Court in 1999 (Kumho Tire vs. Carmichael; 119 S. Ct. 1167). This rule means that parties to litigation have the right to ask the court to exclude incompetent testimony. North American litigation technical experts can count on an attempt, on the part of the opposition, to remove them from testimony. Ironically, in our field, the more competent the expert the greater the tendency of the opposition to attempt removal, on fear of the consequences of competent testimony.

Presuming the reader needs to be competent to offer testimony in their specialty, such opinions should now meet the following criteria:

1. Backed by a body of relevant published literature that has been subject to peer review; and,
2. Expert must be able to address the limitations of the subject methodology;
3. Demonstrate some means and fact relating to test the worth of the opinions being offered.

For the practitioner, this is yet another sterling reason for making the effort to publish peer-reviewed papers as evidence of their personal competence.

4. Industry

Continuing the obvious morphological transformation of the New Millennium, industry is no longer a safe home for any professional person not keyed to continual upgrading of personal technical and managerial skills. Here is evidence of the turmoil that has become normal.

4.1. Industrial transformations

Hercules (formerly Hercules Powder), one of the two the 1912 US Supreme Court-ordered trust-busted spin-off sons (with Atlas Powder) of DuPont (Powder), came to an ignominious end by environmental-litigation bankruptcy late in 2000 (Engineering News

Record, 2000). We cite the demise of Hercules only to provide a gage on the severity of industrial change that will continue to affect the practice of engineering geologists who are the characterizers of sites, old and new.

4.2. Corporate environmental deaths

Just as the Clinton Administration was leaving Washington, DC, early in 2001, two more venerable old American A/E firms declared bankruptcy because of court penalties from human-health liability related to former design adherence to the use of fibrous asbestos in heat-shielding of boiler systems. The companies are Burns and Roe and Babcock and Wilcox, both one-time premier players in the nuclear power circuit, the downturn of which already has claimed several other old names familiar as employers of engineering geologists.

4.3. The new energy market

The year saw a frenzied transformation in the traditional US electric and gas industry, from recognizable names, into dot.com names made up of phonetically sounded capital letters. In particular, the mix now extends routinely between North America and the UK. The UK electric generating network, with far more localized generating stations also was experiencing expansion planning and construction. Concern should be given to the high probability that such transitions will lead to continued efforts to avoid liability for historic discharges and dumping of toxic wastes associated with the manufacture of gas and generation of electricity.

4.4. Electricity shortfalls

Many senior members of the profession literally "cut their teeth" on the scramble to construct nuclear power plants in the 1970's (e.g. Hatheway and McClure, 1979). California was the center of huge protests from the environmental community. In fact, so intense were the debates that much of the regulatory framework for energy projects came from California, not least the rule of not more than one instance of displacement on a "credible" fault in 500,000 years.

California again was the scene of energy turmoil. An abnormally cold winter threw North America into a 2001 power-supply frenzy, particularly in the US and particularly in California. The two California giants, Pacific Gas & Electric (established, 1906) and the Southern California Edison (1894), had suffered through the new State utility deregulation and had sold much of their electricity generation capacity to various firms from around the globe. Roving blackouts became the norm in January and utilities in a number of States were rushing to construct new generation stations; not nuclear, of course, due to the short time for increasing production.

Out of this bleak situation came a brisk level of activity at year end, especially by the "competitive power industry" made up of about 80% of corporate names unfamiliar to the reader. There is something of a mad rush to gain permits to build new electric generation stations as well as to locate and create new land disposal facilities for the air pollution control-device (APCD) solid wastes.

Thankfully for engineering geologists, the assignments are standard site characterization work.

Important in the transformation was the new identity of the post-WW II technical research arm of the gas industry. The former Gas Research Institute (GRI) and the Institute of Gas Technology (IGT) merged, remaining in Chicago, Illinois as the Gas Technology Institute (GTI), becoming a new for-profit competition to environmental engineering consulting firms.

4.5. A resurgence of nuclear power?

A new trend appears with the announcement that Exelon (merger of PECO Energy of Philadelphia and Unicom, of Chicago) was considering application for two new reactor units at existing nuclear power. We have here the example of France, with 58 reactors in an area the size of America's Texas.

Ironically, the engineering geologists involved in the initial siting and construction period (1960–1980) have nearly all retired from active practice, though the special geologic techniques utilized in siting and licensing are now all part of our standard technologies. Site characterization is the specialty body of this knowledge and we have it awaiting the call to go to the field.

We predict a constant return to nuclear power for electricity generation. America no longer plays a

leading roll, its specialty A/E firms all having been decimated by the downsizing of the 90s.

4.6. New Japanese nuclear-plant seismic-withstand provisions

Japan's National Nuclear Power Safety Committee made a firm decision to revise the ''Inspection Guidelines for the Earthquake-proof Design of Nuclear Power Generation Reactors'' established 23 years ago. This decision was brought about by the parameters of the 2000 Western Tottori earthquake, which exceeded the critical value underpinning present guidelines. The Committee will base its revisions on structural responses to larger earthquakes, recent earthquake research, and results of earthquake-proof engineering studies.

The present (1978) nuclear-plant siting guidelines define the following geologic requirements:

- Reactors must be constructed on a hard basement rock free of active faults, and must safely withstand an earthquake caused by an adjacent active fault; and
- Reactors constructed in regions far from known active faults must be able to withstand a 6.5-magnitude earthquake epicentered in the crust, directly below the reactor.

The 2000 M7.3 Western Tottori earthquake occurred in a region without known large active faults and the magnitude was far larger than the 6.5-threshold cited in the guidelines. In response, future reactor seismic-withstand design must consider a design earthquake of a magnitude of greater than 6.5 as occurring just below the reactor.

The present guidelines limit nuclear plant sites to areas of hard basement rock of Tertiary or earlier age. However, considering the relative geologic youth of Japan, the proposal will include suitably dense Quaternary strata and solidified Tertiary-aged conglomerates.

Evaluating the earthquake-proof ability of existing nuclear power plants is another problem. Civil legal action is pending against the Hamaoka Nuclear Power Station (Shizuoka Prefecture) and the Shimane Nuclear Power Station (Shimane Prefecture) by residents who feel insecure about the earthquake performance of these facilities. Hamaoka Station lies in the interpreted focal region of the supposed ''Tokai''-type design earthquake, whereas a geologically ''capable'' fault has been shown to exist in the vicinity of Shimane Station.

Strong criticism of the present guidelines was followed the 1995 Mj = 7.3 Southern Hyogo (Kobe) earthquake. The Agency of Resources and Energy published a ''safety statement'' on nuclear power stations' ability to withstand large earthquakes after its site characterization review of all Japanese nuclear power sites. At the same time, the National Nuclear Power Safety Committee also announced that the present guidelines must include earthquakes as powerful as the historic Southern Hyogo earthquake. The Committee required new assessments of the seismic design provisions for all nuclear power stations.

5. Universities

Most observers of higher education believe that universities typically are not the scene of change. Such is not the case and the profession must take notice of negative changes that will affect the quantity and quality of incoming graduates. Practitioners have the right to comment and to question, although university administrators are not likely to heed critics who do not come bearing financial gifts.

In 2001, the finances of the more-favored universities swelled with such gifts as $20,000,000 dedicated to the Geology Department at the University of Texas and of $600,000,000 Intel cofounder Gordon E. Moor (and Mrs. Moor) to California Institute of Technology. Clearly, the time has come for triage amongst the remainder of the struggling world academic system. Meanwhile, lesser-endowed campuses are populated with power-junkie deans promising to flog the shortfall makeup funds from their teaching faculty. These insensitive administrators expect faculty to work 200% (80-h weeks) while being constrained to report at only the 100% level. This is outright unethical appeasement of penurious State legislatures who would rather invest in general social benefits seen to pay short-term dividends at the ballot box.

We can no longer trust that the post WW-II specialty programs in engineering geology are now safely in place. A widespread academic reputation for technical

excellence in engineering and science today has a 15- to 20-year up-ramp to prominence and about an equal time down-ramp to obscurity. This is a ''rags-to-riches'' reality in three decades. Many previous centers of excellence in engineering geology no longer bear close scrutiny. Likewise, new centers of excellence are in the making, although regrettably, with less promise in the ''New Order,'' in which universities are mere businesses.

Within engineering geology, the academic situation is sad at best, yet driven mainly by the energies of our teaching youth. We call on the professional societies to project firm influence, through oversight committees and frequent journalistic comment in review of what is seen to be present and what may be coming along on the horizon.

Since 1990, North American mining engineering departments have moved to capitalize on the obvious need for geologists in the environmental end of the extractive industries. We estimate that as many as 15 universities have now recreated the old (1913–1920) ''geology option'' in mining engineering.

5.1. Washington Accord on engineering education

The general meeting of the Washington Accord (WA) nations was held in South Africa on 21–22 June. These developments are leading to professional licensure qualifications for co-operative worldwide practice.

In addition to the eight member nations and groups (USA, UK, Australia, Canada, New Zealand, Ireland, South Africa, and Hong Kong), provisional groups also attended as observers (Japan, European Federation of National Engineering Associations (FEANI), the Republic of Korea, Malaysia, and Russia). Japanese Accreditation Board for Engineering Education (JABEE) has provisionally joined WA as the first non-English-speaking group. Provisional groups undergo evaluation by the WA Inspection Group. If JABEE is successful, it will be considered for full membership at the next general meeting of the Washington Accord, which will be held in 2003 or 2005.

5.2. Japan initiates continuing education for geological engineers

Continuing education of geological and other engineers will become available through the Joint Committee of Five Academic Societies established in February 2001. This Joint Committee is composed of the Japan Society of Engineering Geology, Association of All-Japan Geological Survey Industry, Geological Society of Japan, Japan Society of Groundwater Hydrology, Society of Exploration Geophysicists of Japan, Japan Landslide Society, and the Japan Society of Geoinformatics. The Joint Committee connects with the Mining and Materials Processing Institute of Japan and establishes an educational field called ''Resources and Geological Engineering, and Related Programs.'' This educational field is composed of three main categories:

1. Development of geosphere and disaster prevention;
2. Development of resources; and
3. Production and resource circulation and environment.

JABEE examines and certifies university curricula related to one or more of the three categories, or to all three comprehensively.

5.3. Geological program accreditation in Japan

Three Japanese Geological programs are to be examined by JABEE for licensure accreditation:

- Resource Course, Department of Earth Science and Technology, Faculty of Engineering and Resource Science, Akita University;
- Geology Course; Department of Earth Science and Technology, Faculty of Engineering and Resource Science, Akita University;
- Department of Geoscience, Interdisciplinary Faculty of Science and Technology, Shimane University.

5.4. Accreditation to have practitioner help

American academic engineering departments must gain and maintain accreditation through the Accreditation Board for Engineering and Technology (ABET). For too long have the visiting inspectors been other academics and, too often, not registered as engineers. Now, the National Society of Professional Engineers (NSPE) is asking its members to volunteer

for training and to serve as visiting evaluators to help ensure that today's university programs are adequately preparing engineering graduates to enter the engineering workforce in the 21st century (Jeanne Iglesias at http://www.jiglesias@nspe.org). Help keep the professors "honest" about what is relevant to the education of geological engineers.

5.5. MIT goes on the internet

Massachusetts Institute of Technology (MIT) has not participated in the education of applied geologists since the 1954, with the unreplaced retirement of Professor Warren J. Mead. Mead introduced courses in engineering geology for civil engineers at the University of Wisconsin in 1916, before coming to MIT. Now, in April 2001, MIT dropped a bombshell, announcing that The Institute will post its faculty course teaching materials on the Internet, a project to take 10 years to complete. The initiative is called Open-CourseWare and generally will include course outlines, reading lists, lecture notes, and assignments. Of course, nothing is said concerning the additional time and effort required of the faculty. Great and reasonable hardships will accrue to those faculty who never update their teaching notes, or who teach the same never-changing undergraduate materials by the decade. This action likely will become a trend with other institutions who are prone to emulation.

Unmentioned is that once the faculty member fulfills the Internet commitment, the instructor becomes fully subject to replacement. This will become another tool of administrative manipulation. Meanwhile, we are told that Third World entrepreneurs are ready to supervise their own MIT instruction in streetside cafes.

6. Societies

Normally, with respect for page limitations, we include only the most exciting and relevant activities of the professional societies. In 2001 we have several items of considerable importance, all relating to events surrounding the American Society of Civil Engineers (ASCE), which will celebrate its 150th anniversary in 2002. Following the lead of its first subordinate constituent "institute", the GeoInstitute (formerly the Geotechnical Division, of which many engineering geologists are Affiliate Members), ASCE formed the Construction Institute and the Coasts, Oceans, Ports and Rivers Institute, recognizing the continued need of specialization by its members. The full-time Director of the GeoInstitute, by the way, is registered geologist Carol W. Bowers, at the Reston, Virginia, headquarters.

7. Technology and computation

Little doubt remains that the wave of technologic and computational considerations will remain with us, for no other reason than such progress is regarded as significant to enhanced productivity of engineering geologists. This is ironical for just as technology and computational advances are thought to bring enhanced productivity, the situation actually is that human expertise is essential to the success of such advances.

7.1. CIRIA: a bright star above Britain

Back in 1963, farsighted leaders of Britain's construction industry formed a unique partnership between builders and technologists: Construction Industry Research and Information Association (CIRIA). For nearly 40 years, CIRIA has shown great value in its handbooks and manuals compiled to address best-practice solutions to problems sensed and submitted by industry. Most of the civil-environmental publications contain geological information or are otherwise valuable to our practice. A variety of membership options are available and all readers are urged to visit the website at http://www.ciria.org.uk.

One of CIRIA's most useful activities is its traveling workshop on Contaminated Land Risk Assessment—Good Practice.

7.2. International geological map of Europe and adjacent areas

Geological surveys from more than 40 European nations are in the process of compiling a unified geologic map of Europe (1:5,000,000), tied to GIS controls. This truly is a celebration of the unification of Europe and the institution of democratic gover-

nance. Actual compilation is being managed by the German Federal Institute for Geoscience and Natural Resources (BGR; http://www.bgr.de/karten/IGME5000).

7.3. Computation

One of the all-time surprises in geotechnical computation software has been PLAXIS, the ultimate development of finite-element mathematical approximation of stress distribution and strain deformation of discontinuous masses of brittle–elastic (fractured rock) material. Slipped away from its 1960s finite-element origins at UC-Berkeley, a Delft University consortium now markets PLAXIS. Like all computer simulations, this is only an approximation of postulated deformations resulting from various loading conditions in notched or excavated rock. The strength of PLAXIS lies in the simplicity of its use in parametric analyses, at least whenever real geologic structural and lithologic boundaries are introduced into the supporting conceptual site model. In 2001, the University of California, birthplace of the original mathematical simulations of Hrennikoff (1943) for airframe applications, was back in the picture as the North American partner in PLAXIS.

7.4. Covering yourself for data loss

Loss of electronic data may be covered by your existing business insurance. Take care here, as some insurers are moving to exclude such loss (American Guarantee vs. Ingram Micro, USDA CentCalif., No. 99-185). It is essential to report such data losses immediately.

7.5. Geographic information systems (GIS)

Engineering geologists should view GIS as a means of spatial database management of field data. In 2001, this technology advanced far enough to produce topographic mapping-on-demand from companies that we formerly turned to for aerial photographic imagery and photogrammetric maps. Some vendors offer mapping-on-demand from helicopter-borne platforms and data collection and processing by laser and radar imagery as well as photographic coverage. Six-inch horizontal resolution of aerial images is available, as well as orthorectification for three-dimensional accuracy.

Likewise, satellite images now are widely available commercially, from US military satellites under a 1994 Clinton Administration relaxation of US security controls. Eastman Kodak's website and Solid Terrain Modeling (Fillmore, CA) are sources about what is available.

7.6. New emphasis on satellite imagery for disaster response

Reuters, the historic news and information agency, moved into a satellite imaging service (http://www.alertnet.org) from which response agencies can obtain the latest coverage for action planning.

7.7. Japan revises its earthquake-magnitude computation method

Japan Meteorological Agency has improved its method for calculating earthquake magnitude, Mj. The original calculation method had been used since 1957. Post-1993 main-earthquake epicenters have been systematically shifted and new seismographs installed. For example, the magnitude of the 1995 Southern Hyogo earthquake increased from 7.2 to 7.3, whereas the 6.4 of the 2001 Geiyo earthquake became 6.7.

Mj is calculated from the maximum amplitude of a seismograph record. The Japan Meteorological Agency decided to adopt the moment magnitude, Mw, which is used internationally, in addition to the Mj.

8. The environment

We all must allocate as much time as possible to following and understanding of environmental science, technology and regulatory controls that influence our practice.

8.1. A wearied USEPA

The US Environmental Protection Agency (USEPA) entered its 31st year of existence with a new Administrator, Christine Whitman, former Gov-

ernor of waste-ridden New Jersey. Ms. Whitman takes over from lawyer Carol Browner, an 8-year veteran of the Democrat Clinton Administration and former staffer of 2000-year presidential candidate, US Vice President Albert (''Al'') Gore. The agency administers the mammoth SUPERFUND program for cleanup of uncontrolled hazardous waste sites, itself in its 20th year of enactment and 15th year without official 5-year reauthorization by the Congress. Browner's tenure was marked by many advances in environmental regulation, mainly in air pollution control. Also a hallmark of the Browner administration was a constantly diminishing attention to environmental restoration. Like the ''Energizer Bunny'' of television adds, USEPA marches forward, but not with the complete energy of the Bunny.

USEPA has now almost completely converted to web-distribution of its technical literature, as pdf-type downloadable documents. No longer can we complain about accessibility to the regulatory background literature. The responsibility now is all ours! National compliance-assistance clearinghouse websites are:

http://www.epa.gov/clearinghouse
http://www.epa.gov/superfund/sites/rodsites/index.htm

Under traditional Green criticism, the US Republican administration of George W. Bush has been anxious to give at least the appearance of adherence to environmental imperatives. The Democrat-controlled Senate wishes to continue Federal control of cleanup of uncontrolled hazardous waste sites (UHWSs; ''dumps''), while the Administration wants to fund the States to conduct the basic enforcement. USEPA moved forward in August to name two more derelict Montana mining districts in the Little Belt Mountains where at least 142 mines have been shown to be leaking heavy-metal contamination.

8.2. Groundwater protection

Protection of ground water is a widespread environmental-agency activity, generally supported by a separate unit engaged in monitoring public drinking water quality. Three much-heralded issues were prominent in 2001.

8.3. ATSDR reviews health threats for top SUPERFUND species

The Agency for Toxic Substances and Disease Registry initiated (Sep. 2001) health-threat reviews of 10 compounds. Among these are ethylbenzene and xylene, common components of gasoline and of the light oils of historic manufactured gas plants, along with pentachlorophenol (PCP) from post-WWII-era wood preservation sites and the 75 cogenors of dioxin.

8.4. Arsenic in drinking water

It behooves engineering geologists to have awareness of the general fate and transport of Priority Pollutants (USEPA term) in drinking water. One of the last acts of the Clinton presidential administration was to lower the long-established MCL (maximum concentration limit) of this element from 50 to 10 ppm. This rule was struck by the Bush administration but restored in the House, with a formal directive to USEPA to implement this new Primary Drinking Water Standard by Feb. 2001.

8.5. MBTE in gasoline

Introduced in the early 1990s, methyl *tert*-butyl ether (MTBE), the ''oxygenate'' additive in motor-fuel gasoline, has shown up as a general groundwater contaminant, primarily in California, but also in Arizona, Colorado, Connecticut, Illinois, Iowa, Michigan, Minnesota, Nebraska, New York, and South Dakota, all of which have banned its use (http://www.ngwa.org/position/mtbepos.html).

8.6. Solid waste

In 2001, the American solid waste industry was dominated by three national firms, in the following general rank, by decreasing size; (1) the reorganized Waste Management; (2) Allied Waste Industries (Scottsdale, AZ), which now controls the pioneer second American national firm, Browning–Ferris Industries (BFI), and; (3) Republic Services (Ft. Lauderdale, FL) which controls several smaller consolidated competitors operating on regional bases.

Probably as many as 200 graduate engineering geologists and geological engineers remain in the

technical staffs of these companies. Most of these professionals are engaged in environmental compliance, but, regrettably, relatively few are seen and met around our professional societies.

Sanitary landfill space in the urban world is so valuable that the Los Angeles County Sanitation Districts (LASCD) has committed $80,000,000 in purchase arrangements for two mega-fill sites in the California desert. Known as the Eagle Mountain and Mesquite projects, the two landfills literally will be visible from the moon. LACSD is a regional combination of 25 agencies and 78 cities and unincorporated areas, created as a world's first modern wastewater treatment plant in 1924.

It is likely that even more money will be involved, as the individual developers have already spent some $30,000,000 each on the two projects, each of which will cost $35,000,000 to $40,000,000 to construct. With design capacities of 20,000 tonnes per day each, fed by unit trains (100 cars each) of the Southern Pacific (now Union Pacific) Railroad, each of the landfills will have 100-year lives. Needless to say, engineering geologic studies have been the center of permitting activities to date. Eagle Mountain intends to fill the abandoned WW II iron ore pit of the former Kaiser Steel.

The new Waste Management (WMI) has capitalized on its previous program of methane gas recovery at its maturing landfills. Houston-based Reliant Energy has been formed to take advantage of the Texas energy deregulation law of 2000, as well as US Internal Revenue Service Code (Section 29) code tax credits, to generate an initial 44 MW of landfill electricity. WMI also will bring six of its newer Texas landfills into this system.

Demolition debris disposal from the 11 September terrorist aircraft-bombings in New York City and Alexandria (The Pentagon military headquarters), VA made huge demands on the east-coast solid waste disposal infrastructure. At the time of the attacks, BFI was in the process of developing a rail transfer system to move garbage to South Carolina and Georgia at an initial compensatory rate of 1000 trucks per day, via train. The trend likely will continue.

8.7. RCRA enforcement

The Resource Conservation and Recovery Act of 1976, as amended, is the basic US waste management law. PCBs (polychlorinated biphenyls) are again in front of our eyes. These are the long-chain chlorinated polymers that were invented in the US in 1928 to serve as heat-resistant electrical coatings and heat-transfer compounds. There are many chemical congeners, many of which are carcinogenic, and the basic compound saw extensive use as an agricultural pesticide because of its persistence and its neuro-toxicity to insects.

8.8. Environmental site assessment

Environmental Site Assessments (ESAs) clearly are here to stay. Even where not required by law, institutional lenders universally require that proposed brownfield construction sites be reviewed for potential environmental impairment.

ESAs have been a magnet for many unqualified and poorly qualified practitioners. Naturally, your authors believe engineering geologists to be basically qualified to conduct such assessments. Nevertheless, it is the client who bears the responsibility to select a qualified individual for such work. In this direction, the American Society for Testing and Materials (ASTM) remained in the forefront in its marketing of services to provide applicable training for environmental site assessors. ASTM (2001) was marketing "Environmental Site Assessments for Commercial Real Estate" training on CD-ROM, with the appropriate ASTM Standards (http://www.service@astm.org). Geologic imperatives nearly always are neglected or miss-developed and miss-applied.

8.9. Property condition assessments (PCAS)

A market has emerged for this type of background-search and walk-about survey. There is little of intrinsic connection to engineering geology but the techniques of observation and recording are familiar to us. This line of work will become subject to priced competition and it will therefore be somewhat burdensome, with relatively high risk of liability to those who offer such professional services. Nevertheless, it is necessary that our practitioners know of its existence.

As defined by ASFE, the PCA is "a fundamental due diligence process conducted to identify nonlatent construction defects and components of systems whose

remaining useful life appears to be less than what one ordinarily would expect.'' This, of course, refers to the usual concept that an engineered commercial or public utility structure or facility has a nominal life of 50 years.

PCAs came into being in the late 1980s, after the US Congress established the Resolution Trust Corporation to take control of failed Savings and Loan institutions. The PCA is a ''snapshot'' of property condition made before basic loans are established. According to ASFE, the normal scope of work for a PCA includes:

- Property background information
- Preliminary review of documents
- Site observation (walk-through)
- Cost estimation for items of repair
- Report preparation.

ASFE may be contacted at http://www.john@asfe.org.

8.10. Voluntary cleanup program (VCP)

VCP, a concept eagerly embraced by USEPA in 1993, originated in California as an outcome of its frustrations related to cleanup of industrially blighted ground. Later, the Browner EPA took notice and incorporated VCP as a national program. In 2001 there was an increased traffic of VPC permits sought by industry for lands which they knew to be underlain by truly threatening concentrations of hazardous substances. The authors see draconian measures in this trend, in which inadequate or incomplete site and waste characterization studies are conducted as the basis for the voluntary program, as accomplished through a downgraded risk assessment and a general trend toward ''containment'' of wastes and then redevelopment for some high-value subsequent land use.

For some waste groups, VCP can be made to work, but generally only with naturally degradable, non-chlorinated petroleum hydrocarbons. For semi-volatile organic compounds (SVOCs), most of which (like polycyclincal aromatic hydrocarbons; PAHs; coal-tars and sludges) do not naturally attenuate and exhibit toxic lifetimes measured in geologic time. Hence, the containment strategy moves such sites into a permanent condition of ongoing contamination of literally every particle of groundwater passing the characteristically immobile SVOCs, which also typically are dense non-aqueous-phase liquids (DNAPLs). A case in point, known to the senior author, is the cluster of three former manufactured gas plants (1867–1909; 1867 coal-gas works and the huge carburetted water gas plants of Stations A and B) at Front and Gillis Streets, Kansas City, MO. As a group, the three plants, two of which suffered disastrous explosions in the years 1884 and 1885, lay at the edge of the historic Missouri River, now a portion of the floodplain altered significantly by gas works purification box waste residuals dumping and Corps of Engineers channel modifications. The responsible party asks to be allowed to grade and contain huge masses of leaked, spilled, discharged, and dumped plant wastes and to redevelop the site, leaving the SVOCs, along with cyanides and heavy metals, in place in the near-surface groundwater environment.

8.11. ''Brownfields''

USEPA's grass-roots program of minimal funding ($200,000) grants to initiate local response to inner-city cleanups of blighted industrial ground began in 1993 in Cleveland, Ohio. The Congress now has released a report (http://www.com-notes.house.gov/brown/brown.htm) charging lack of effective management of the program, in which many engineering geologists have been performing site and waste characterizations. Since 1993, outgoing USEPA Administrator Carol Browner pumped $322 million into the program, of which more than $200 million has made it to States and local governments. The investigating Congressional committee estimated there to be 425,000 potential brownfield sites in the US and that 116 of these have been remediated to date by the Federal program. The States are given good marks for remediation at a faster rate than the USEPA. As a matter of terminology, note that ''brownfield'' refers to any contaminated urban industrial site, while ''Brownfield'' refers only to those relatively few sites selected for funding in the Federal program.

A prime example of Brownfields redevelopment is the Hackensack, New Jersey Meadowlands, a vast former swamp and uncontrolled dump west of New York City. Overseen by the Corps of Engineers, a major 85-ha shopping mall will be allowed. The

process has been fraught with bitter fighting amongst special interest groups as well as the agencies.

Late in the year, the US Congress passed H.R. 2869 and S. 350 as a Federal Act to provide a 5-year plan to give states up to $200 million per year to clean up brownfields sites across the country. The bill also includes provisions sought by President Bush to exempt innocent developers from fiscal responsibility if toxic waste is found on a site after it is purchased. Federal Superfund law still would apply, however, placing fiscal responsibility on those who dumped at the site. There also is a brownfields-to-parks provision to encourage communities to reclaim land for public use. As with all other UHWS assignments, engineering geologists are particularly well qualified to conduct site and waste characterization. In all cases, it is imperative to related site industrial operational conditions with the present-day waste ''sources'' as such relate to site geologic conditions, in terms of interpreted fate and transport for each of the contaminants of concern (COC).

8.12. State "brownfield" programs

While waiting for Congressional action, the State of New Jersey, with the greatest number of American UHWSs, has created its own brownfields office in the New Jersey Economic Development Authority (NJEDA). Late in 2001, NJEDA approved 13 new grants to 11 towns and cities for municipal environmental brownfields cleanup projects totaling nearly $1.7 million. The projects are carried under the Hazardous Discharge Site Remediation (HDSR) program and are located in Bayonne, Buena, East Brunswick, Glassboro, Linden, Marlboro, Perth Amboy, Plainfield, Scotch Plains, Trenton and Woodbridge. The average paltry grant of $130,000 will be suctioned off by planning and administrative control, while the waste will merely be camouflaged and left on site.

8.13. Underground storage tanks

Many young North American engineering geologists continue to enter the profession with duties related to remediation of leaking underground storage tanks. Quick site and waste characterization are demanded due to the priced-competition that is rampant in this field of work. We learned in 2001 that the US has more than 743,000 such tanks, including more than 100,000 that are not yet in compliance with leak-detection measures. USEPA has moved the ultimate compliance date to January 2003. Added to those active today, USEPA counts 400,000 tanks as having leaked and undergone remediation since 1985.

9. SUPERFUND

The SUPERFUND law was set up, as with all major American legislation, on a program of 5-year review and renewal. The present condition remains frozen in time from 1990, when SUPERFUND was to be reauthorized, but such has never come to pass and the Congressional doles out money to meet demands by the month. Times Beach, Missouri, an National Priority List (NPL) site since the second round of nominations (Feb. 1983), the nation's most notorious dioxin site, was removed from the list in mid-year. The dioxin came from chemical still bottoms mixed and sprayed as dust palliative by used motor-oil dealer Russell Bliss. of St. Louis.

Regrettably, UHWSs, discovered and investigated as part of the Federal SUPERFUND Act, are no longer required to be retained on the CERCLIS (list) of known or suspected locations of orphaned toxic wastes. Since about 1999, No Further Remedial Action Planned (NIFRAP'd) sites are eligible for removal from CERCLIS, but fortunately, are retained on another companion list. The senior author believes this to be a crises situation, in which flawed site and waste characterization as part of the RI/FS (RFA/CMS) process, has led to NIFRAP-removal of UHWSs that will constitute ongoing exposure and future renewed discovery.

The US National Park Service accorded Fresno, California its rightful place in history as the world's first (1934) modern trench landfill, and the site was placed on the National Register of Historic Sites. Six months later, the order was rescinded on disclosure that landfill was a SUPERFUND NPL site.

Late in 2000, USEPA ordered General Electric (founded in 1905 by Thomas A. Edison) to remove more than 2.03 million m^3 of sediment-disseminated PCBs from a 64-km reach of the Hudson River, in New York State. This SUPERFUND National Priority

List (NPL site) was named in 1984 and GE is alleged to have discharged the 566,800 tonnes of raw wastes between 1940 and 1977. The main threat here comes, as with gas works tar residues, through contamination of fish as part of the human food chain. GE responds that the $500,000,000 remediation plan is unnecessary due to apparent PCB contamination adsorption to clay minerals of the river sediment. This counter argument again begs the question of ''containment'' as a ''do-nothing'' alternative under which the threat to be transferred to future generations and the whims of developers and active geomorphic processes. PCBs were banned in the US in 1979.

Early release (Jan, 2001) of a National Academy of Science (NAS) report on dredge-treatment of PCB sediment contamination, offered eleven recommendations for consideration of USEPA in its RCRA enforcement orders. NAS chose risk assessment to identify is recommended cleanup technologies. Risk assessment is nearly always flawed by adoption of incomplete geologic site characterization, especially when the toxics are sequestered in river sediments of Recent age.

In August, USEPA Administrator Christine Todd Whitman declared that the dredging cleanup would indeed commence. Bank-to-bank and hot-spot dredging will be employed, as well as two pore-water drying facilities and at least one bankside disposal site for dewatered sediment.

America met the chemical and munitions needs of World War II with huge buildups of petrochemical plants at Houston and along the Louisiana reach of the Mississippi River, particularly at Plaquemine. Today, this site receives attention as ''Cancer Alley'' by the Greenpeace movement, as triggered by the March 2001 discovery of vinyl chloride in the Plaquemine public water supply.

9.1. Former manufactured gas plants (FMGPs)

The year opened with perhaps more coal-tar activity than in the past decade. The sounding cannon, so to speak, was a journalistic disclosure of the circumstances surrounding the $105,000,000 punitive damages awarded against the Wisconsin Electric Power for its decade-ago widespread dumping of cyanide-laden gas purifier box wastes (Milwaukee Magazine, Jan, 2001). Citizen protests of possible dumped gashouse wastes under homes at Oak Park, Illinois led to utilities ComEd and NiGas to probe across the street from the original plant site of the Cicero Gas Company's 1894 Rew-process oil gas generators at the community Barrie Park. Sure enough, toxic gashouse wastes were encountered. Costs of the cleanup are reported to have risen from some $4 million to perhaps $50 million. The area is a cancer cluster.

New Jersey previously was thought to harbor the largest number of commercial FMGPs (exclusive of industrial gas producers and other such sites). Now, the New York Department of Environmental Conservation estimates some 300 sites Statewide, with an additional 129 (Hatheway, http://www.hatheway.net) in greater NY City alone.

Independently, co-author Hatheway has increased his list of UK towne (British spelling) gas plants to more than 1300, which is some 300 sites more than are admitted to exist by British Gas, the responsible-party, Prime Minister Thatcher successor to the nationalized gas industry.

9.2. More negative surprises from USDOE

We have been preconditioned not to expect news of radwaste cleanup progress from the USDOE. Particularly bothersome has been the continued National Laboratory involvement in applied geologic studies, conducted in the usual DOE vacuum without involvement, participation or even as much as peer reporting to the profession. In 2001, the National Labs are under enhanced scrutiny by the Year-2000-formed National Nuclear Security Administration (NNSA) formed by the Congress to rectify the ''Chinese'' spy scandal of that year. The nine National Laboratories, created beginning in 1942 to build the ''bomb'', and yet remaining in the post-Cold War era, are now struggling to remain on their government teat, but in a variety of roles purporting to be in the national interest, to include environmental science. We do not expect the effort to gain as much as a ''clue'' toward the effective application of scientific theory to real environmental remediation programs, at least certainly not in vacuo.

DOE's ''poster-child'' cleanup activity of the 16 major ''dump'' sites, the Rocky Flats ''plant'', a former cold war nuclear bomb trigger works, was declared by the US General Accounting Office (GAO; http://www.gao.gov) as over-budget and behind schedule.

This is on account of the special 1997 declaration by DOE of special efforts to accelerate the cleanup from the preposterous target year of 2070 to the more comforting year of 2006. DOE now finds the "contamination and technical problems to be overwhelming…" Has anyone questioned the quality of the original site and waste characterization efforts?

9.3. Long-term stewardship

Here the USDOE has proposed a new program of spending relating to potential funding activities for many of its own sites that are now admitted to remain contaminated with hazardous or radioactive wastes for up to thousands of years. The program is explained at http://www.em.doe.gov/lts and a progress report was due to the Congress by December 2000.

9.4. DOE's culm conversion project

DOE never misses in its efforts to convert tax dollars to paper studies. While the Agency is sitting on perhaps five dozen untouched former coal-tar sites, from its coal-gasification days, it has issued a $7,800,000 grant to Waste Management and Processors of Gilberton, Pennsylvania. The town is anteing-up $4,000,000 in matching funds for the pilot study for a $300,000,000 culm-to-diesel fuel plant in nearby Frackville. Culm is a regional term for coal-preparation wastes, rich in sulfur. We hope that DOE does its homework this time and does not allow discharge of heavy metals and PAHs to the environment http://www.ultracleanfuels.com) which typically contaminate its dozens of forgotten coal-gasification test sites.

9.5. Low-level wastes (LLW)

A prime example of this stewardship program is that of the Green River Uranium Mill of the former Atlas Corporation of Denver. The actual mill site, at Moab, Utah, was operated profitably from 1956–1984. On declaration of hazard, as one of 24 UMTRCA (Uranium Mill Tailings Radiation Control Act of 1978) in 1983, the firm went into bankruptcy after posting a $6,000,000 remediation bond. Now, 18 years later, supervision of this LLW site moves from the Nuclear Regulatory Commission to the USDOE, which is happy to assume the cleanup, under an enhanced ($300,000,000) budget, likely to meet DOEs voracious propensity for spending. Completed remediation work, with 17,000 wick drains, will be scrapped and the pile transported for 16 km to a high-ground landburial not subject to low-frequency flooding from the nearby (230 m-distant) Colorado River. The turnabout largely was affected by departing Interior Secretary Bruce Babbitt, once a geophysicist, as a sop to Utah for having suffered significant unpopular recent public land withdrawals under the Clinton administration.

California's Low Level Radioactive Waste Disposal Project was the one ray of hope in the American struggle to manage its high-volume, low-level waste (LLW). Most of the profession regionally was pleased with the remote desert site at Ward Valley. Now politicians have killed the site, through Federal government channels.

The 1-mile^2 reservation, in Bureau of Land Management custody, selected by the State, US Ecology, and its consultant Harding Lawson Associates (now Harding-ESE-MacTec) was withdrawn late in the Clinton administration by outgoing Interior Secretary Bruce Babbit. To make the "kill" complete the strike team, led by California Senator Barbara Boxer, has also seen fit to disband the State LLW siting team. Even the industry lobbying group Cal-Rad Forum, seems to have disappeared. Senator Boxer employed statements from three US Geological Survey geologists who are unknown in engineering geological circles.

The real truth seems to be that the site was geologically and environmentally ideal and located in the drainage basin for Danby Dry Lake, 62 km SSW, and 35 km west of Needles, in a typically remote and desiccated portion of the Mojave Desert (boyhood home of your senior author). We thank Frank Kresse for supplying this final word.

9.6. High-level waste repository

Another year passed in the world without notable progress in dealing with long-term management of high-level nuclear waste (HLW).

9.7. Japan comes to grips with its HLW constriction

Japan has begun to feel the constriction of dealing with HLW as it wishes to designate new sites for

nuclear power stations. Under these conditions, the Ministry of Economy, Trade and Industry has now moved to estimate energy income and expenditures to promote energy conservation and the use of renewable energy sources, in the event that no new nuclear power station can be brought online to generate electricity before fiscal 2010.

In the current "Perspectives of Long-term Energy Supply" (June 1998), the Ministry stated that 16 to 20 new nuclear power stations would be needed by fiscal 2010 to stabilize amounts of CO_2 discharge to the 1990 level. However, the electric companies in Japan have reduced the number of new nuclear power stations from 20 to 13 in their present power supply plan. This change necessitates a review of the CO_2 discharge reduction directive.

In reviewing its energy policy, the Ministry is developing two different scenarios for the future: In one scenario, no new nuclear power stations come online in the next 10 years, and in the other, 13 new nuclear power stations come online by fiscal 2010.

Coincidental with its impending HLW management constriction, the Japanese national Nuclear Waste Management Organization (NUMO) was established only in 2000, under the sponsorship of ten electric power generation companies and the Japan Nuclear Cycle Development Institute (JNC). NUMO has started to examine the geological and social conditions necessary for selecting disposal sites for high-level nuclear wastes. Siting conditions will be announced at the beginning of fiscal 2002.

9.8. Yucca Mountain HLW repository in US

America's designated HLW Repository is at Yucca Mountain, Nevada. Yucca Mountain is the sole proposed high-level nuclear repository in the United States. The repository concept relies on the philosophy of multiple barriers, both engineered and natural, each of which impedes the movement of radioactive contaminants, in worst-case escape from the repository to enter the groundwater regime. In 2001, DOE admitted to another escalation in projected cost, this time an additional 26%, for a grand total of $57.7 billion on scheduled completion in 2010.

The proposed repository was selected by Congress for political reasons (lack of voting population in America's least populous State) and is slated for construction in the unsaturated zone above the regional groundwater surface, in Tertiary-aged tuffaceous rocks. The Deep (Uppermost) Aquifer, below the repository horizon, is a shallow tuff, and at approximately 2-km depth is an extensive Lower Carbonate second aquifer of allegedly high secondary hydraulic conductivity. Several points of potential discharge from these aquifer systems are the springs on the east side of Death Valley and at Amargosa Valley, lying some 60 and 90 km regionally down-gradient from the Yucca Mountain stratigraphic section.

USDOE has focused on repository design, while the remaining stakeholders of the State of Nevada and the two closest down-gradient counties have chosen to embrace a scenario of eventual canister failure and release to the vadose zone housing the repository. DOE has finally recognized its opposition and is funding their concerns by establishing an Early Warning Drilling Program.

This year the oversight Technical Review Committee urged DOE to increase funding for related regional hydrogeologic research. Funds are being provided to the USGS and the counties of Nye (NV) and Inyo (CA). When will this all come to fruition, so as to put an end to on-site nuclear waste storage at nuclear power plants?

At the heart of the problem are the high-level technical critics of the program, who have no faith in the geologic subtleties for which they do not have an intrinsic appreciation. Subject radionuclides, if such were to become released to the natural environment, would have radioactive threat lives of some 300,000 years. In the meantime, the taxpayer continues to pay the DOE consumer electricity surcharge while the nation's reactors are forced to continue to store their spent fuel rods in on-plant cooling ponds. Regrettably, the US has been studying the HLW repository problem since 1957.

Ironically, while the US has been in the forefront of geologic waste management, several other nations have actually made more practical progress. Worldwide, HLW repository programs are underway in Europe and Asia, including China, Finland, France, Germany, Japan, Sweden and Switzerland. In the opinion of the authors, Sweden, Canada and the US probably are at the most advanced stages of their geologic proof work characterizing the ability of the host ground to contain the deteriorating radionuclides.

10. Underground construction

There literally is no ground more in need of pre-construction geologic assessment than the "underground." The challenge is as always, dealing with certain engineers who have come to think of themselves as the ultimate source of geologic input. There is no question but that the "underground" is the most difficult of all areas of practice to break into for geologists. Taken as a class, the "tunnelers" are insular and particularly self-reliant, generally not wishing to let go of any geologic responsibilities. The proofs are in litigation, mainly in the form of variable site conditions claims. Even here, the circle of "approved" experts is tight and access is difficult.

10.1. Tunneling

Tunneling is an area of special importance to engineering geology. Considering that all tunnels are constructed in the geologic environment, it is certain that success comes to the owners and developers only when geology is strongly heeded from the very beginning of the recognition for need, through selection of basic design and mining methods, construction, operation and maintenance. Once constructed, tunnels seldom are abandoned, and their lives quietly project into hundreds of years. Furthermore, once in place, societal infrastructure is subject to disruption if the geologic implications of modifications, mitigation, and improvement are not heeded.

Sadly, "tunnel geology" is perhaps the most frail and insecure of our academic insecurities. Young members of our profession exhibiting a profound interest in joining the ranks of tunnel geologists are frustrated from the very beginning. In the active teaching career of the senior author, only a tiny percentage of our graduates were placed in tunnel geologic assignments. The advice was then and is now, simplistic; take any professional posting you can, with a commercial consultant firm that has demonstrated both prominence and excellence in the recognition and application of geology to tunneling. These firms are so few, internationally, representing perhaps two or three firms per continent, and their numbers have lately shrunken due to corporate mergers.

Within the literature, CIRIA (2001) (London) has issued its Special Report 200; Building Response to Tunneling; Case Studies from Construction of the Jubilee Line Extension.

Certainly, a sleeper in the trade literature is the ongoing publication of World Tunneling (http://www.worldtunneling.com), the UK magazine covering the industry on an international basis, in 10 issues per year. Such coverage is necessary to remain current in the multitude of trends and technologies that are being applied worldwide, under ever-increasing resort to the underground in the face of burgeoning population pressures.

Readers also are brought to the attention of the new British Tunneling Society internet page (http://www.britishtunneling.org).

10.2. Old and new "stars" underground

Parsons Brinckerhoff continues to amaze many of us with its success in the overall field of tunneling, both in site characterization and in design and construction management. It is almost the exception when the competition makes an inroad against their record in gaining new contacts and assignments.

The new "star" appears to be Hatch Mott MacDonald (HMM) with a name larger in the UK than in North America, where they have "made the scene." We hope that HMM now will grace our literature with evidence of their engineering geological expertise.

10.3. International Centre for Geotechnics and Underground Construction (CUC)

"Out of the blue" is the jargon for something unexpected, and this new Swiss consortium is indeed, out of the blue, but into the world of tunneling. Now in its first year, CUC was set up at Sargans. Nearby is the Swiss test-tunnel complex, VersuchsStollen Hagerbach (VSH), where much of the CUC pracitca will be held. Charter-member companies and organizations have pledged to form a Foundation Beirat, or scientific council, to identify and scope the most important areas of technological knowledge for infusion to candidates supplied to the Centre from the industry. We hope that the Foundation Beirat will include an Engineering Geologist! Charles Allen, a London University graduate with two decades of underground experience, will become the Managing Director, and he declares that the "essence of CUC training programs will be a focus on

practical, ''hands-on'' instruction, in actual underground conditions.'' Obviously, instruction will be not only expensive, but intensive, and we welcome this ''out-of-the-box'' thinking toward professional education.

Almost on cue, the University of Montana's new engineering school ''Montana Tech'', the former Montana School of Mines, has initiated (January, 2000) the Northwest Regional Mine Training and Research Facility, in the abandoned Lexington mine tunnel in Butte. Students at Tech, along with tradesmen from the local College of Technology, will benefit from practical training not otherwise available in the region. The funding? Non-peer-reviewed congressional ''ear-marking'' money from the ''pork barrel.''

The International Tunneling Association (ITA) held its 27th annual meeting at Milan, Italy. We were pleased to note that a motion was passed to create a ''syllabus of tunneling courses throughout the world and put them on the ITA website...'' We hope that this comes to pass.

10.4. Laerdal Tunnel, Norway

Hard-rock tunneling connecting Bergen with eastern Norway, became operational, with the world's record tunnel length of 25.5 km.

10.5. Engineering seismology

We take note of an existing, yet equally difficult field to enter; that of engineering seismology, a discipline that cannot be practiced without adroit geologic input. Leaders in this field definitely are not ''born'' and truly emerge only after several decades of grueling practice and heroic dedication to a specialty that is infrequently taught at the universities.

11. The literature

Every day that goes by, each of us obsolesces a bit, while hoping that the incoming experiences of practice will assist in keeping up our capabilities. Yet, it always is the literature that stands besides us, even surrounds us, and sometimes threatens to inundate us. Even with the terrific challenge of keeping current, we can hope to grow and improve by paying close attention to the literature, new and old.

11.1. Trends and changes

We noted a profound change taking place in the manner in which journals are perceived by several leading professional societies, namely, in order of their size in membership: the American Chemical Society (ACS) and the American Society of Civil Engineers (ASCE).

ACS intends to place its entire journal collection (from 1872) on the internet, downloadable as pdf documents, free of charge. In taking this farsighted step, costing a million dollars, the Society moves forward as the custodian of its own literature. The Royal Society of Chemistry has announced its intention to follow suite.

ASCE has made its separate journals available to members on a 100-reprint, member-selective, internet-download subscription of $100 per year. ACS has placed its ever useful Environmental Science and Technology on the internet. ACS further convened its annual conference of editors and deemed that electronic preprints (http://www.pubs.acs.org/cen/preprint/html) would not later be considered for formal publication. ''The term 'preprint' generally refers to a draft of a scholarly paper that has not yet been formally peer reviewed.'' ACS allows preprint posting at personal author-websites.

We were pleased to note and now to recognize the renewed commitment of Thomas Telford of London, historic British technical publishers, in putting the environmental and geotechnical world into print.

11.2. Outstanding literature

Our attentions were drawn this year to several outstanding publications (Table 3) relating not only to the fundamentals of engineering geology, but to the changes and challenges which we now face.

Earthquake Engineering Research Institute (EERI; Oakland, CA, USA) has taken its ''Learning from Earthquakes'' series of topical reports forward to CD format, with website archival. Engineering aspects of the structural behavior of buildings and the infrastructure is the thrust of EERI, so geologists have to be tolerant of limited engineering seismologic content.

Table 3
Outstanding engineering geologic literature noted in 2001

Citation	Details
Noe et al. (1997)	Sets geologic concerns directly in front of home buyers, home owners, developers, realtors, urban planners and code administrators. GSA Engineering Geology Division, Burwell Award for 2001
Geological Society of London (2000)	Fine example of classic geologic literature highly suited to the generic learning needs of engineering geologists.
Smith (1999)	Complete editorial revision of the 1986 GSL handbook
Freidrich (2000)	Serves as handbook of geologic evidence for the creation and destruction of one of the world's great explosive volcanic events ca. 1645 BC, Santorinis. Provides a crash course in site characterization potentials for work in explosive volcanic terrane.
Hamel and Adams (2000)	Nepal Geological Society, Journal, vol. 22, pp. 257–268
Ambraseys and Adams (2001)	Continues Ambraseys' outstanding career work in defining regional seismicity on the basis of recorded events.
Earthquake Engineering Research Institute (2000)	International cooperation of a form that could not have been met, even by the United Nations. This effort shows that those who work in the field of engineering seismology must be members of EERI.
Hustrulid et al. (2001)	A welcome handbook of state-of-the-art practice largely influenced by Van Zyl's role as a practitioner-in-demand.
Hustrulid and Bullock (2001)	Largely the fruit of Bullock's highly active retirement years survey of the present status of underground technology in North America; Seasoned by Bullock's recent teaching.
Aston (2002)	Provides integration of law and requisite technologies for application by geologists involved in planning and conduct of site and waste characterization.
Viljoen and Reimold (2000)	A technical historical account of applied geology.
Groshong (1999)	A replacement for various out-of-print texts on three-dimensional visualization of geologic bodies and geologic structure.
Geological Society of London (2001b)	Important revision of the classic geological handbook of aggregates.
Geological Society of London (2001c)	Latest trends in land-surface evaluation.
California Division of Mines and Geology (2000)	One map brings forth historic earthquake epicenters for instant appreciation of regional geologic associations.

Typically these reports are richly illustrated and images are transferable to the reader with the provision that the photographer and EERI be cited on use. The effort is underwritten the US National Science Foundation and the Federal Emergency management Agency http://www.eeri. org/Publications/cdroms.html.

12. World environment

Under the guise of environmental protection, US President William J. Clinton, in the last days of his second term in 2001, again played ''Grinch'' and summarily removed new roads and logging from uses of more than 25% of all Federal lands. As in his previous, late 1999 moves, Clinton struck from the eastern capitol of Washington, by Executive Order, without the benefit of Congressional Action.

Meanwhile, the US Forest Service (USFS), now clearly under Green management, continued to close off previously logged public forest lands and continued its policy of deactivation of major portions of the forest road system, stemming from the great era of timber production for the world (1910–1980). Logging on Pacific Northwest Federal forests has been slashed by about 80% during the 1990s. USFS has a $8.4 billion-dollar backlog on maintenance of its forest road system, nationwide. Forest geology and geotechnical engineering peaked in the early 1970s when the USFS was the only Federal Agency to return money to the Treasury as a result of revenues on its carefully planned and controlled logging. Each timber sale was accompanied by a geological plan for minimization of erosion damage to forest grounds. Then a bright spot for as many as 150 engineering geologists, the goal was to place a geologist and a geotechnical engineer in each of the

National Forests supporting active logging. Now the USFS is down to an estimated 25 geologic professionals, nationwide. We predict that this level of career geologic employment will stabilize at the present level, unless the Bush Administration opens up logging. In any case these exciting outdoor positions are worth spending the effort to search out by individual National Forest.

13. Public safety activities

The public-safety function of engineering geology is one of the few ways in which actual earth science conditions and predictions are incorporated into societal development and public safety projects. We comment each year on this ongoing struggle toward keeping people safe in the context of the constructed environment as it is affected by geologic constraints.

13.1. AEG brings forth policy on seismic-withstand design

The Association of Engineering Geologists (AEG) moved in 2001 to consider a policy statement regarding the manner in which geologic data should be incorporated into the selection of earthquake ground motion for seismic-withstand design. The Association is highly concerned that the forthcoming predictable return of a maximum credible event may be soon expected at major population centers such as San Francisco, Los Angeles, St. Louis and Boston, to name a few dangerously positioned American cities. AEG's Board of Directors feels that the use of probabilistic design has encouraged a "what number do you want" attitude in some circles. It is felt that reliance on probabilistic selection for design will lead to disastrous losses of life in these and other cities, especially under the current international situation in which the deliberations relating to methodology of selection of design ground-motion parameters are not disclosed to the public or to its leadership. Many members practicing in engineering seismology believe that this is a matter of ethics and that such is not being addressed by the Earthquake Engineering Research Institute, the leading professional association in seismic-withstand design.

Being a controversial issue, approval of the Policy Statement is yet pending.

13.2. Professional licensure

After 8 years of issuance of licensure to European Geologists (EurGeol), some 222 individuals carry the continent-wide certification. Continental geologists have not been quick to move toward the license, which was 50% held in the UK and Ireland.

Licensure for geologists in the United States continues to grow. New licensure acts were passed and signed in New Hampshire and Washington State in 2000, and in Texas in 2001.

With these recent additions, 26 states and the Commonwealth of Puerto Rico now license geologists by means of "practice acts." A practice act is legislation that restricts the right to practice geology (with exceptions) to those who meet qualifications criteria administered by a state board. An additional three states license geologists through the weaker legislative form, known as a "title act," which restricts (with exceptions) the right to use the title "geologist" to those who meet certain criteria. For information about licensure for geologists in the United States, and about the widely used ASBOG examination, visit the ASBOG web site at http://www.asbog.org.

13.3. Situation in California

Attempts to "sunset" professional licensure acts are common from legislators and consumer advocates. But in 2001 the California Board for Geologists and Geophysicists faced a strong attempt to weaken its act when it provided a fairly innocent updated version that was to be included in an omnibus bill as "non-controversial."

Controversy arose when the Office of Environmental Health Hazard Assessment (OEHHA) in the California Department of Environmental Protection tried to weaken the definition of geology and the scope of geologic practice. Their presumed motive was to prevent the Board for Geologists and Geophysicists from investigating complaints that some private site remediation managers (called Registered Environmental Assessors II in California) were practicing geology without a license. Compromise language was worked out in draft form, but the level of

controversy remained high. Eventually the sponsoring legislator decided to remove the geology act revision from the bill, so California will continue to operate with its antiquated and much-amended original act (US Summary provided by Robert E. Tepel).

13.4. North American reciprocal licensing of engineers

An accord was reached at Monterey, California, 27 Jul, 2001, between the North American engineering societies, to launch planning for comity of licensing for the three countries (Canada, Mexico and the US). We must not expect a rapid solution; however, a working group is examining the issues of ethics and professionalism associated with comity between the countries and licensing groups.

14. Standards, liability consciousness and loss prevention

Accurate, reproducible fieldwork remains a serious first-level obligation of our profession. Our interest in standardization does not detract from the basic obligation that all of us should strongly integrate our own personal competence into our professional work.

The Connecticut Department of Environmental Protection (DEP) has released a CD entitled, Expedited Site Assessment: The CD. The compact disk was authored by engineering geologist, Dr. Gary Robbins, Professor of Hydrogeology at the Department of Geology and Geophysics at the University of Connecticut. The CD provides technical guidance on conducting three-dimensional site and waste characterizations at underground storage tank sites using direct push tools and field analytical equipment. Technical guidance is provided in a multimedia format with slide presentations, animations, video, simulations and a real-world exercise. For more information visit: http://www.esacd.uconn.edu.

The American Society for Testing and Materials (ASTM; established 1898) has been the historic watchdog for standardization for just over 100 years. In 2001, ASTM came out with multiple new standards as a result of work of its Committee D18 (Soil and Rock; established 1937). While many of us are uncomfortable with the degree of detail that the Society has delved to in prescribing field, lab, and office methods, nevertheless, these standards do carry weight and each practitioner should have awareness of the new scope of coverage (http://www.astm.org). The running objection of many practitioners often relates to tendencies of the ASTM Standards subcommittees to downplay the necessary role of scientific and engineering judgment.

15. Techniques and technology

The best minds in the profession are constantly developing new ways of achieving more and better work, mostly in consonance with the economic pressures of clients who want more for less.

15.1. Site characterization

This term has been with us since the late 1980s, but the growth of acceptance of the term reach criticality in 2001. Now most engineering geologists will be quick to state that site characterization is the basis of their professional practice. No less a supporting illuminary than Professor Ralph B. Peck used our terminology in a speech before ASCE at the Geoinstitute Conference at Blacksburg, Virginia in June, using the title "Site Characterization, Expect the Unexpected" for his presentation.

15.2. Emerging concerns

Methyl *tert*-butyl ether (MTBE), thought to be a godsend in 1990 when it emerged as the technological response to the US Clean Air Act Amendments of that year, was to be added to motor gasoline as a means of further oxidizing combustion emissions. Now MTBE has been found contaminating groundwater supplies far beyond our wildest imagination. California, struggling with its energy crisis of deregulation has banned MTBE by 2003 and has pled to the USEPA for relief, which will not be coming, because of the Bush Administration fear of favoritism with respect to the needs of other States. So, while engineering geologists are tuning up to learn of the fate-and-transport characteristics of MTBE, midwest corn-alcohol will become the oxidizer of choice and we cannot see how such would be polluting to the environment.

15.3. New technologies

The primary method of achieving more work for less outlay is to employ time-saving methods for gathering and testing field geologic information and then to employ the same savings in ways to meet geologic exigencies with more new technologies.

15.4. Naphthalene

Naphthalene (a polycyclic aromatic hydrocarbon [PAH]), the white crystalline nemesis of yesteryear's manufactured gas man, and today our moth balls, has been nominated by The National Institute of Environmental Health Sciences as a suspected carcinogen for further study in the National Toxicology Program.

Naphthalene is present at all former manufactured gas plants and in most crude oils. California environmental agencies are particularly concerned about its solubility in water and its hundred-year usage as a feedstock oil for manufactured oil gas, and its concentration as a percentage-component in kerosene-distillate (KD) diluent oil commonly used as a factory cutting or thinning agent.

15.5. Negative symbiosis of cancer initiation among PAH tar mixtures

Previously, odd numbered PAHs (e.g., 3 and 5 benzene rings) were more frequently known to be carcinogens, and even-numbered PAHs were not listed as carcinogens. Many remediation experts are of us are concerned that coal-tar PAH admixtures may prove to exhibit cancer-causing symbiotic effects. At FMGPs, industrial-waste coal tars are found in assemblages of what generally is conceded as being 500 to 3000 separate PAHs at each of these uncontrolled hazardous waste sites. USEPA convened a workshop on 24–25 October, 2001 to consider "Alternative Approaches to Health Assessment of PAH Mixtures."

15.6. SVOC solvent flooding and recovery

Duke Engineering Services, Austin, Texas, announced that its adaptation of oil-field surfactant flooding has shown promise with manufactured gas wastes, under certain conditions of favorable coarse-grained contaminated soil. The surfactants must be chosen and tested carefully as to the ability to strip contaminants from the host geologic matrix and to release such to removal by other technologies. Duke claims to have affected in-situ solubilities of as much as 10,000 ppm with consequent pumped removal of the mobilized PAHs at approximately 96% for free-phase benzene and 85–90% for multi-compound coal tars.

15.7. Monitored natural attenuation (MNA)

This environmental remediation concept, was developed by consultants for industrial Responsible Parties to hazardous waste sites. MNA emerged in 1990 as the new hope for reducing cleanup cost impacts. Also known as "wait and see," the concept, frequently was pushed into acceptance against regulatory agencies, and has deferred billions of dollars of present-costs into an unknown future. MNA is now used at more than 25% of EPA-lead contaminated groundwater sites.

Informed remediation geologists generally agree that simple fuel hydrocarbons are indeed susceptible to this concept, but not the PAHs ("coal-tar") and chlorinated compounds, which characteristically are long-chain in nature and toxic to bio-organisms. In fact, MNA is broadly regarded as the "Do-Nothing" alternative by many geologists and most environmental critics, such as the National Resource Defense Council (NRDC), of Washington, DC. NRDC proclaims MNA to be the "low-cost, ineffective approach that delays the inevitable need to clean up the site."

Now, USEPA's Science Advisory Board (SAB) has advised the Agency that it should conduct more research on the wait-and-see proposition that natural chemical and biochemical processes will degrade threats to people and the environment. The trouble is, of course, that the "geo" conditions and implications of alleged in-situ natural attenuation generally are lacking in site and waste characterization detail and competence. In addition, SAB agrees with the US National Research Council's 2000 report on MNA, that MNA "will not be effective for solving chlorinated solvent remediation needs at most locations." The SAB report is at http://www.epa.gov/science1/eec00abc.pdf for direct pull-down.

15.8. Dredging

Dredging often is associated with claims for variable site conditions at those sites where virgin ground is encountered for the first time. Such claims are relatively uncommon in maintenance dredging of previously improved channels. Caterpillar, in conjunction with Kress has announced a joint venture to perfect a nonhydraulic, maintenance "dredge wheel" employing a "silt transportation system." The technology is touted to excavate in-place spoil and transport such to the floating support system without agitating and suspending contained contamination. The concept bodes well for environmental remediation of contaminated river sediment.

15.9. Hot, dry rock (HDR)

In all the world, Japan now is left as the most active in pushing the technology to tap deep-rock energy for application to power generation. The New Energy and Industrial Technology Development Organization has conducted a 2-year circulation experiment at the Hijiori site, Yamagata Prefecture, northeast Japan. Considerable difficulty has come from mineral-precipitation scaling of the boreholes, along with unwanted artificial fracturing of the boreholes, both of which reduce the recovery rate of thermal water. The test site will be closed at the end of the 2002 fiscal year, leaving only the Central Research Institute of Electric Power Industry with an active, long-term circulation experiment at the Ogachi test site, Akita Prefecture, northeast Japan.

15.10. Knowledge management

Since the 1960s, the world of technology has been set upon by decade waves of trendy improvements in the philosophy and conduct of ordered scientific and engineering endeavors. Get ready for the latest. Knowledge Management (KM) is upon us, in the wake of TQM, QC/QA, CPM, The most attractive aspect of KM for many is the fact that it can be performed without going to the field, in the absence of black flies, boggy ground, rain, dust storms, heat, geology-obscuring vegetation, snakes, and vehicle breakdowns. This will appeal mightily to those who have graduated from geology programs that do not teach field geologic mapping as a fundamental technique. As is the usual case in North America, the Washington DC beltway bandits are in place and ready to offer this service to each government agency in a flurry of money spending. The best news for bureaucrats, academic or government, is that each attempt requires that someone be elevated to serve to manage as the Chief Knowledge Officer (CKO).

15.11. Video clips in power point

Power Point (PP), the digital-image visual presentation software, has become highly popular with younger members of the profession. Remember that entry-level people no longer can operate topographical survey instruments, but they do come equipped for computer graphics and visual presentations! Topline digital video cameras and some digital cameras can generate short video clips for the Windows and Mac platforms. We understand that "Dazzle" software (http://www.dazzle.com) provides the means to embed analog video in PP presentations.

15.12. Professional liability insurance

As has always been the case, consultants are best protected by carefully selecting their clients on the basis of quality. For years, ASFE has instructed its members to rate potential clients and to consider not offering their services to clients showing signs of unreliability, either or both in payment of fees and in later generating nuisance suits based on one of the concepts of malpractice.

16. In memoriam

Three giants in our profession passed away recently. We remember them for their achievements as well as their contributions to the profession, each in distinctly different ways.

George A. Kiersch (1917–2001), for the 60 years that he practiced, a man of striking presence to the profession. A native of Modesto, California and a graduate of the Colorado School of Mines, Captain Kiersch served as a combat engineer in the Southwest Pacific Theater of WWII and then went on to a doctorate (University of Arizona), management of

the huge Southern Pacific Railroad Survey of its resources, and was for 20 years Professor and Chairman of Geology at Cornell University. All the while, George was in demand as a top-level consultant. He was doubly registered as a geologist and engineer, but professed to "think" like a geologist. He was present at the founding of the Engineering Geology Division of GSA (1947) and was its guiding light for the rest of his life. He published widely and was a gracious teacher at every encounter. His last paper appeared in this journal as "Development of Engineering Geology in Western United States" (Kiersch, 2001). George passed away shortly later at age 84, on 12 October, 2001, peacefully, of a worn-down heart.

Hugh Wallis Naismith (1923–2001), founding partner of Thurber Engineering, Vancouver (1958), pioneered the profession in western Canada. A BSCE geological engineer (University of British Columbia) with an MS from the old Washington University (St. Louis, MO) curriculum, Hugh had a love for flying (RCAF, WWII) and its natural adjunct, ground-truthed photogeology. He left us with a fine legacy of the written word stretching from his definitive ***The Geology of Southern Vancouver Island*** (1986; with Chris Yorath), to *Suit is a Four Letter Word*, dealing with professional liability. Hugh and his method of practice were well-suited to the rugged terrain of his beloved British Columbia.

Richard J. Woodward, MS, P.E., will be remembered fondly by the geologists with whom he came into contact, primarily as one of the three founders of Woodward–Clyde Consultants (WCC). Though a soils engineer by training, he was instrumental in the West Coast movement (to include Trent Dames and Bill Moore at their firm) to early grants of equality of responsibility and salary to geologists in the profession. "Dick" and two UC-Berkeley instructor colleagues founded the firm in 1950 on their three mutual contributions of $50. WCC was purchased in 1997 by the URS–Greiner combine for $100 million. Dick passed away at age 90 on 6 August 1998.

17. Caveats

As in our past reports, each year we come to sense that there exist certain conditions, situations, and trends that seem, for better or worse, to be endemic of the practice in general. We operate on the principal that it is better to be forewarned of what is facing us than to suffer from the direct and indirect "hits" caused imperfect awareness.

17.1. No-name companies

Worldwide, this was the year that the no-name company fully arrived in industry and finance. The names serve to disguise all manner of former sins and connected environmental remediation legacies. This generally is a safe form of subterfuge, as most consumers are now too young to have an image of the former company. As with Asian automobiles, the names are computer generated, following secret analogs that are made up of sounds thought to instill culturally favorable thoughts to the receiving ears. As with the vanity license plate names, most are of five to seven letters of the alphabet and connote absolutely nothing.

17.2. Congress wants help on minorities and women

In its sometimes helpful manner, the American Congress has passed a Year 2000 Act creating the Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology (CAWMSET). Once created, the movement is to be self-financed, of course, by the professional societies. Our charge is contained in the Commission's recommendations (http://www.nsf.gov/of/cawmset/). We believe that women routinely receive equal opportunity in engineering geology.

17.3. Facilitated workshops

American Federal agencies discovered the "paradigm" of facilitated workshops in the 1990s, as a mechanism of constructing consensus opinions in dealing with volatile public issues. We understand that the February 2001 failed Petrobras drilling tower design was developed by having critical design requirements decided through "facilitated workshops." This has protected the otherwise responsible Brazilian national authorities in the Petrobras case. Those who have dealt with technical workshops know that they resemble committees, but actually are controlled by the workshop "committee."

We find that the USGS employs this social-smoothing method with its regional workshops, held to make critical decisions on the preparation of seismic hazard maps. Some experts would charge that the key decisions and conclusions were in place before the workshops were announced.

17.4. Business simulation gaming

The US Army began indoor wargaming with staff officers and commanders (as opposed to its 1930s field exercises with actual opposing troops) in the 1960s. Civilian historical wargamers took notice and the outcome was a genre of 1970s computer "dungeons and dragons" simulations, based both on science-fiction fantasy and on historic battles. Now, American industry has discovered the decades-old technique and is bringing its large-project teams into simulation workshops. Touted is the degree of sensitivity each player is expected to gain, with regards to team playing with interfacing specialists. As offered by new-age vendors, a typical game can be played in one day and the lessons learned evaluated in another, all in the $17,000–$25,000 range, exclusive of lost productivity on the part of participating company staff.

18. Summary

Year 2001 clearly demonstrated the new sense of conduct of engineering geology and its allied disciplines. Foremost of these trends was the "throw-away" nature of corporate technical specialists after age 50. At the same time, the general softening of applied geological education worldwide, by academic institutions has left the profession with a generally lower average technical competence among younger practitioners approaching "trashout." Out of this situation comes a good life of practice for truly experienced sole-practice experts, especially those who are highly competent in field work.

The other half of the message is equally clear. The profession will enthusiastically embrace those younger engineering geologists who are both energetic and intelligent. The time to prepare for ultimate survivability as a practitioner is the day the student sets foot at the university. And, not all university departments are created equal! Many of today's teaching faculty are short on the practical experience needed to direct and adjust departmental curricula to meet tomorrow's demands, both in terms of technology but in philosophy of practice. A university department is a continually "morphing" entity and 15 years can bring about fundamental changes that do not match the longer-term "goodwill" image earned over decades.

We in practice should be on the alert to identifying potential young replacements and to counsel them on a selection of departments competent to train tomorrow's high-grade replacements. Not to be forgotten are project management and office management skills that pay off to the greatest degree financially. Leaders clearly cannot be "jacks" of all aspects of the profession, and they may have to narrow their technical expertise in order to stay current and competitive.

Acknowledgements

This report is no more or less of substance than what the authors have been able to sense and uncover in a profession enveloped in a swirl of international activity. As a part of this effort, we laud and thank those who have joined us in discussions and who have provided us with prepared contributions for our consideration. We want the reader to know that some areas of coverage have been determined "out of bounds," but only because of the truly impossible task of encompassing them in a fair and complete manner. This missing coverage deals mainly with conferences in general and society activities and officerships in particular. We regret that our nominal manuscript limit cannot afford the nicety of delving into these two areas of coverage.

For the readers at large, we continue to search for additional colleagues who will report on major regions of the globe.

For the Year 2001 report, we are thankful for the detailed review provided by Dr. Judi Ehlen, Vice-Chairman of the Engineering Geology Division of GSA, and for materials and commentary furnished by a wide variety of correspondents and colleges. Among these contributors are: John F. Gartner, J.E. Locat, H. Tremblay, C. Froese, J. Oswell and Dr. Rejean Coutre of Canada, and Oliver Barker of Johannesburg, South Africa.

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