American Institute of Professional Geologists
Colorado Section

Reflections on a Geological Career

Fourth Electronic Edition

Edited by
David M. Abbott, Jr., CPG-4570

Papers and Expanded Outlines from

Student Day 2002

October 5, 2002

This fourth electronic edition of *Reflections on a Geological Career* expands on the original edition prepared after the Colorado Section's Student Day in 1996, the second edition prepared jointly with the Arizona Section in 1998, and the third edition of 2000. It includes papers in the handouts distributed during the Student Day hosted by the Colorado Sections on October 5, 2002 at the University of Northern Colorado. Some of the papers have been updated from the 2000 edition, others have not. The oral origin of the papers is obvious and generally makes them easier to read. Like the first three electronic editions, this edition will also be published as a PDF-format document on AIPG's web page, ***www.aipg.org***, to ensure wide distribution and use by students everywhere. Copy freely as long as proper referencing and acknowledgments are made. Thank you.

Responses to an inquiry to AIPG student members sent out in early 2002 suggested that students generally find the contained information useful. We hope it continues to be so. Comments, suggestions, and inquiries about this publication should be sent to:

David M. Abbott, Jr., *DMAgeol@msn.com*

Inquiries about the American Institute of Professional Geologists should be directed to AIPG's national office in Westminster, Colorado, *aipg@aipg.org*. AIPG can be reached at 303-412-6205.

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CONTRIBUTORS

(2002 addresses)

David M. Abbott, Jr., CPG-4570
Consulting Geologist
2266 Forest Street
Denver, Colorado 80207
303-394-0321

Lawrence Cerrillo, CPG-2763
PO Box 728
Evergreen, Colorado 80437-0728
303-674-6484

Trevor R. Ellis, CPG-6740
Consultant
600 Gaylord St.
Denver, CO 80206
303-399-4361

Thomas G. Fails, CPG-3174
Independent Petroleum Geologist
4101 East Louisiana Avenue
Denver, Colorado 80222
303-759-9733

Dawn H. Garcia, CPG-8313
8261 E. Placita del Oso
Tucson, AZ 85750-2928
562-420-2933 ext 22

Gregory A. Hahn, CPG-7122
President
Summo Minerals Corporation
Denver, Colorado 80203
303-863-3925

John B. Ivey, CPG-896
Amuedo & Ivey
15554 West 67th Ave
Arvada, CO 80007-7041
303-456-5848

Thomas Karnuta, CPG-10102
Mountain Engineering & Testing
421 West Sackett
Salida, Colorado 81201
719-539-2312

Susan M. Landon, CPG-4591
Exploration Geologist
Thomasson Partner Associates
1410 High Street
Denver, Colorado 80218
303-436-1930

Gary C. Mitchell, CPG-4771
8811 Eaglesnest Lane
Highlands Ranch, CO 80126-2134
303-812-1540

John W. Rold, CPG-448
Consultant
2534 South Balsam St.
Lakewood, CO 80227
303-985-1996

Laura L. Wray, CPG-7291
3747 South Jasmine St.
Denver, Colorado 80237
303-782-0684

INTRODUCTION

David M. Abbott, Jr., CPG-4570
and
Dawn H. Garcia, CPG-8313

The goal of this document is to provide undergraduate and graduate students in hydrology and geology with some advice and guidance about their chosen profession based on the experiences of the contributing Certified Professional Geologists. The participating professional geologists were drawn from the mining, petroleum, engineering, hydrogeologic, and environmental portions of the geological profession. The academic portion of the profession was omitted, not because it isn't important—it clearly is—but because this is the one part of the profession that students interact with on a daily basis. The participating professionals collectively are or have been employed by the full range of geological employers: local, state, and federal government agencies; academia; large, New York Stock Exchange-listed firms; smaller public companies; large independents; large consulting firms; and as independent consulting geologists.

It's time to think about employment and long-term goals. We hope that you will find yourself in a profession and not just a job. This document will provide you with some ideas about marketing yourself (and hence getting the job) and then formulating your goals (and becoming a professional in your chosen career).

This document consists of outlines and papers prepared by members of the Colorado Section of the American Institute of Professional Geologists for the Student Day held on October 5, 2002, at the University of Northern. It is based on and contains much of the same material included in three earlier versions prepared held in 1996 in Colorado, in 1998 in Colorado and Arizona, and 2000 in Colorado. Some papers have been updated and others have been added or deleted from earlier editions.

The initial papers cover various aspects of geology as a profession applicable to any geological career. These general papers, which conclude with the AIPG Code of Ethics, are followed by papers on petroleum geology, mining geology, engineering geology, GIS and remote sensing, and hydrology. Read these papers at your leisure. The document concludes with a list of references proven by the test of usage over time; these are scruffy, dog-eared books occupying the nearest shelves. These references are grouped by specialty.

The important observations and suggestions made by the various authors apply to all aspects of geologic study and all types of employment. Even though a specific paper draws on experiences in a field which is not one's particular focus, the observations generally apply to all fields. The same themes and suggestions—flexibility, networking, keeping up, adapting, etc.—occur again and again throughout the papers for very good reasons. Plan and execute your careers accordingly.

Tom Fails, CPG-3174, assembled and led the committee that planned and executed the original Student Day in 1996, and deserves much of the credit for it. The others on the committee did lots of work, but Tom got the work started and prompted for completion when needed. Let Tom's example be a lesson to us all. If you want to see something happen, take the lead and do it! If your idea is a good one, you will obtain the support of others.

PERSISTENCE

And finally, recognizing that we do not have all the answers, here are some examples about *why it pays to persist despite the odds*:

- "The telephone has too many shortcomings to be seriously considered as a means of communication." (Western Union memo, 1876).

- "There is no reason anyone would want a computer in their home." (Kenneth Olson, president and chairman, Digital Equipment Corp., 1977).

- "The concept is interesting and well-formed, but in order to earn better than a C, the idea must be feasible." (A Yale management professor in response to Fred Smith's proposing a reliable overnight delivery service. Mr. Smith later founded Federal Express.)

- "If I had thought about it, I wouldn't have done the experiment. The literature was full of examples that said you can't do this." (Spencer Silver on the work that led to the adhesives used on 3M's Post-It notepads).

- "Professor Goddard does not know the relation between action and reaction and the need to have something better than a vacuum against which to react. He seems to lack the basic knowledge ladled out daily in high schools." (A 1921 *New York Times* editorial about Robert Goddard's pioneering work on rockets in space.)

- "I think there is a world market for maybe five computers." (A 1943 statement by IBM chairman Thomas Watson.)

However, although the foregoing are true, remember that the collective wisdom of those in the geological or any other profession is more likely to be correct than not.

YOUR JOB AND YOUR CAREER

Dawn H. Garcia, CPG-8313
1998
modified in 2002 by
David M. Abbott, Jr., CPG-4570

Reflecting on the past six years during which this and earlier editions of *Reflections on a Geologic Career* have appeared, the job market for geoscientists in general and for particular segments within it have varied considerably. Some years have been good and others have been bad; it's been a roller coaster. While predictions of the future are always suspect, predicting more of the same seems safe. Flexibility is the key—prepare for it. Whether the employers are scavenging for candidates or whether there are fewer jobs than ever, you will have to make decisions about jobs. Most of you will decide to (1) stay in school or (2) find a job. This article designed is to help you in option (2), find a job, have a career, and be professionally successful.

Employers and employees are looking for the same things that they've always wanted. Companies want committed workers who can tackle tough problems. Employees want security and stability, a chance to do interesting work, a boss they like and respect, good pay, and good benefits. The challenge is to convince the employer who has the things that you want that you're the employee that the employer wants. Recent employment trends suggest that long-term employment stability is increasingly rare. Be prepared to move to where the available jobs are. You may really like your home town or your college town, but in most cases these are not the towns where the jobs are.

Frequent moving impacts your social life and the lives of your family and can lead to strains that break significant relationships, particularly when a spouse or significant other has his or her own career. Consider these impacts in planning and guiding your career. Flexibility in what you can do can be one solution. Thinking and talking about these issues in advance is important.

Several geological societies including the American Association of Petroleum Geologists and the American Geological Institute periodically publish employment and salary statistics. While these statistics can be helpful, you are an individual with your own goals, dreams, qualifications, and potential. One can pursue a generalist career path or a specialist path. Either can lead to success or frustration. Regardless of your choices, remember to continually market yourself and abilities. You never know when you'll need to use the contacts you make. Active participation in professional societies is an important, if intangible, method of marketing yourself that should not be neglected.

Geologists collectively, regardless of specialty, have consistently worked themselves out of jobs by being very good at what they are asked to do. Ask them to find gold, coal, oil, diamonds, water, pollution plumes, geologic hazards, whatever, and they do so in short order. What was scarce, now is more common. Geologists are also good at working with engineers to extract (remediate in the environmental world) that which they've been asked to look for. The collective ability to find what

we've been asked to look for helps drive the cyclicity in geologic employment. Recognize that business cycles happen and plan for them in your career. If you don't, the cycles will plan for you: you didn't study geology to become a pizza delivery person or UPS driver, but more than one former geologist has become so employed.

YOUR RÉSUMÉ

This essential tool in your job-hunting kit requires your attention. Even if a company isn't currently hiring, you'll be requested to send a résumé. You'll frequently need a current résumé as part of marketing your services for your current employer. A résumé should grab the reader's attention—and you don't want it to be negative attention. Grammar and spelling errors are the kiss of death. That résumé won't be filed anywhere except the round file, a garbage can. You need to construct a resume that's short (one page only, please), accurate and filled with evidence of your accomplishments. Supplemental pages covering detailed experience, publications, etc. can be provided when requested. There are plenty of guides to help you in writing a résumé. You can check out Yana Parker's *The Damn Good Resume Guide* and the AGU web site, which has Peter Fiske's article "AGU Resume Guide" posted. One especially good feature of the AGU web site is the list of action verbs, which helps you use the right buzz terms (e.g., "administered, designed, adapted, negotiated..."). Plus, talk to the folks at your school's career center. You'll want extra eyes proofing your résumé. Remember, a spell checker won't help you use the right word. *Form* versus *from* are the curse of writers everywhere. Also date your résumé, old copies can travel around.

One new twist to résumés is the computer scanning method used by some corporations and web sites. Companies are using types of text-searching software to track résumés and search for skills that match a job description. Since hydrology and geology are small sectors of the work force, it is unlikely that you will be submitting your résumé to companies that use electronic scanning to reduce the number of applications being considered. If you do think that your résumé has a chance of being scanned, be sure to focus your résumé on the job skills and experience requested for the position.[1]

Your résumé should be updated on a regular basis even after you get the job. Not only will that help you keep track of accomplishments along the road, but it will help you focus your career path. When you look at your résumé, see what's relevant to your goals.[2] Having more than one version of your

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[1]. Continuing technologic evolution suggests that résumé s will increasingly become electronic files held both by the individual to who the resume applies, but also on the employer side. This presents both opportunities and dilemmas. An electronic file of résumé becomes important. Finally, having a permanent, personal e-mail address means that you can be contacted promptly regardless of changes in employer or residence.

[2] Some personal stories on résumés are worth repeating. Greg Hahn noted in his oral presentation that he once hired a geology student for the summer because the individual listed "Telling jokes" among his hobbies. The individual's geologic credentials were no better or worse than many others. But in a remote field camp, a good joke teller can be a real asset. Another student seeking assistance with his résumé remarked that he had been an auto mechanic. Again, geologists are fairly common, but geologists who are also skilled mechanics is a real plus in field operations. Foreign

résumé that focuses on different types of jobs can be important. When applying for a specific job, you'll want to focus your résumé on the knowledge, skills, and experience required for that position.

Your résumé is the start of your job search. Don't expect a "cold call" and a résumé dropped in the mail to get you the job. Start networking. This is where professional society participation can be vital. Carry a number of business cards with you whenever you're attending meetings. You may even wish to have more than one business card—it's easy to make them on a computer—for specific uses.

REGISTRATION AND PROFESSIONAL LICENSING

State registration and professional licensing is increasing with each passing year. Plan on taking the National Association of State Board of Geology (ASBOG) examination towards the end of or very shortly after the end of your academic career. Most of the states that license geologists use the ASBOG examination, which is often for comity between states. Even if the state you're currently in or are planning to work in does not currently register or license geologists (for example Colorado), take the exam as soon as you can. If you are qualified, take the Professional Engineer's exam as well. Visit the ASBOG web site (www.asbog.org) for more information about the exam, how to prepare for the exam (sample questions!), and where to take it. Information on the status of the regulation of geology in the various states is maintained on the AIPG web site, www.aipg.org.

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language skills should likewise be listed. And as noted, given the use of scanned résumés, be willing to tailor the resume to the specific knowledge, skills, and experience sought.

SUCCESS FACTORS FOR GEOLOGISTS
OR
WHAT YOU DON'T LEARN IN THE DEPARTMENTS

John W. Rold, CPG-448
Consultant and former Colorado State Geologist
1996

These views result from 46 years of evaluating, hiring, and training geologists and observing the successful and unsuccessful careers of many of my colleagues.

MY DEFINITION OF SUCCESS

- Enjoyment, achievement and fulfillment from your work.
- Achievement of recognition and respect from one's peers and one's self.
- Sufficient income to comfortably feed one's family and educate one's offspring.
- Clarifying your personal definition of success is the first step in achieving it.

HOW TO ACHIEVE THAT DEFINITION OF SUCCESS

- Most graduates today with a Masters Degree from one of the better universities are well-equipped educationally for a geologic career.
- Success, however, depends more on the following factors not listed in a geology curriculum or stressed by most advisors:

    - Communication skills: the ability to **write, read, speak**, and **listen** effectively.
    - Impression of Competency: appearance, actions, posture, dress.
    - Work Ethic: dependability, commitment, initiative, perseverance.
    - Honesty: intellectual as well as fiscal.
    - Ethics: professional as well as personal.
    - People Skills: getting along with people; team player; respected, not just liked.

Even as a student you are building the foundation of a career-long reputation. Fellow students will be career-long contacts, peers, supervisors, and co-workers. Professors can be career-long references, mentors, and peers.

LANDING THAT FIRST JOB

- Recommendations from professors.
- Grades: measure of ability to complete projects and absorb & retain knowledge. Straight As are not necessary but Cs, Ds, and Fs are a real handicap.
- Résumé: stress career goals, outside activities, and work experience.
- Network: professors, previous supervisors, friends and relatives in the business.
- Never turn down the opportunity for an interview.

THAT FIRST JOB INTERVIEW

- First impressions are vitally important. Dress, appearance, composure, firm handshake, eye contact.
- Know the company background. Stress how you could help the company.
- Ask pertinent questions as well as concisely answering interviewer's questions.
- You are also interviewing the company.

AFTER YOU LAND THAT FIRST JOB

Never forget that people are employed by a company only to make a profit or help an organization meet its goals. Whether with oil or mining company, government agency, or consulting firm, these factors will govern your success even more than your geological skills.

Promotions and raises are usually based on:

- Quality of writing,
- Oral presentations,
- Work habits,
- Initiative,
- Creativity,
- Problem analysis,
- Personality, and even
- Appearance more than geological skills.

Top management's early selection of candidates for future management relies on impressions at meetings and brief contacts. All companies and government agencies use formal, periodic appraisals and performance evaluations. Typical evaluation forms rate factors of: quality of work, quantity of work, initiative, creativity, judgment, relationships with people, work habits, effectiveness of supervision (present or expected), and other performance factors (these might include ethics, drinking habits, drug usage, sensitivity to gender or cultural diversity, etc.). Note that only the first two items relate to your geologic education. Admittedly these ratings are

subjective, but they count. Analyze the organization's culture. If you can't fit in, move on. Analyze the organization's and the boss's objectives. Help achieve them. Remember, "the Boss may not always be right, but he or she is always the Boss." Success in any organization depends on pleasing your boss and his or her boss. Establish and maintain a network, you will need it. If down-sizing occurs, use of these factors will help you survive it. If the organization is eliminated, these factors will help you find another job.

These factors are critical regardless of career path. Regardless of your path in a geological, or most other careers, these factors will govern your success.

Management:

- Frustrations with paperwork and bureaucratic procedures and resulting disdain for management stem from lack of non-geologic skills as much as from the problems themselves.
- One does not have to go into management to become a success, but it helps.
- As a supervisor, each subordinate can contribute to your success.
- Satisfaction derives from helping develop subordinates.
- Supervisors fail from lack of people skills, not lack of geologic skills.

Research or Pure Geology:

- Success in research, staff or pure geology depends on creativity, initiative, logic, writing, and speaking ability.

Academia:

- Professors' true success depends on their ability to relate to, communicate with, and inspire students more than on basic geologic skills.
- Professors must work with a bureaucratic maze for space, equipment, and money.
- Professors must work with alumni, industry, grant dispensers, and university hierarchy for program support.

Consultants:

- Consultants must sell themselves, their ideas, their prospects, and their reports.
- Clients must be acquired, nurtured, educated, and satisfied.
- Success factors are probably far more important for consultants than for any others.
- Without clients, consultants starve.

Government:

- Even without the profit motive, agencies must evaluate costs and benefits of people and projects. State and federal agencies must address their missions and achieve their goals or they die.

SOLUTIONS

Success factor skills are acquired, not inherited. They can be attained or improved. Acquisition may not be easy, but it is challenging and stimulating to try. I suggest Toastmasters, Dale Carnegie, and professional society involvement. Many books, tapes, and night courses address personal development.

My experience convinces me that these factors represent a blueprint for achieving your definition of success. However, just as considerable effort must be applied to progress from blueprint to a finished structure, one must exert considerable effort to achieve success. You can and should apply that effort.

SUGGESTIONS FOR A CAREER IN GEOLOGY

David M. Abbott, Jr., CPG-4570, Laura L. Wray, CPG-7291,
and Thomas Karnuta,[1] CPG-10102
1996 (slight update 2000)

This section contains some short suggestions on aspects of various specialty fields. It is followed by longer reflections on a geologic career.

GENERALLY

If you love geology, then be a geologist!!

- Be the best you can be—excel in your studies, go the "extra mile" in all your geologic endeavors.
- Demonstrate initiative by volunteering for activities and/or organizing them.
- Develop a networking list and maintain it by communicating with friends, colleagues, and contacts as often as possible.
- Enroll in continuing education classes to enhance your knowledge base and develop new contacts.
- Solicit advice from professionals about skills you might want to develop.
- Consider becoming involved in legislative policy issues.
- As a beginning geologist, you may not have the experience of your older colleagues. However, you are likely to be far more current on the latest literature, models, etc. in your area of interest and you are even more likely to be comfortable around computers. These skills are important! Get a job using the skills you have and start acquiring the skills and experience you need.
- A lot of unemployed oil geologists went into environmental geology, particularly groundwater geology and contamination. Oil and water are both fluids found in rocks. In addition, you may find the insight needed for a current problem. For example, the outer hydrothermal alteration halo around the Mt. Emmons molybdenum deposit at Crested Butte is defined by mapping the coal ranks in the Crested Butte district (the real, historical mining industry in the area). But most metal mining folks don't know much about coal geology and this halo only was identified after the discovery was made.
- Basic accounting may be your most useful non-geology course. Take it!

[1] Editor's note: when this paper was written in 1996, Tom Karnuta was a Candidate for Certification (CFC) rather than a CPG. This point is mentioned because, as Karnuta demonstrated, those who are relatively new to the profession can make worthwhile contributions to the profession. It's a matter of getting involved. Getting involved requires active interest and inquiry. You may have to try more than one organization or committee to find a fit, but there is a place for you if you look.

- Know one or more foreign languages; you are very likely to work outside the US.[2]
- Periodically check the course catalog and degree requirements from the place you graduated, or from similar institutions. What are they offering—and more importantly, requiring—that you don't have on your transcript? Plug the holes to keep your job, or at least be as qualified as more recent graduates.
- Network, Network, Network: join local professional organizations like AIPG. Get involved; attend monthly meetings, ask questions, meet people. This is probably the best way to get into the local professional scene. The contacts you can make while attending these meetings will be useful throughout your professional career.
- As an independent geologist I am in constant contact with individuals I have met and worked with over the past few years. I don't have the ability to walk over to a co-worker and ask advice on the best type of drilling for a job or the best type of sampling profile. However, I can get the answers to these types of questions from friends that work at large firms or have more experience.
- Always keep a good networking channel open, and start setting yours up ASAP.

MINING

Study all kinds of geology. Ores are found in sediments, igneous rocks, and metamorphic rocks. In the 1970s, most mining geologists were looking for uranium but in the 1980s and 1990s, gold and diamonds were the "hot" minerals. Today, everyone is trying to hang on hoping that low metal prices will increase. You need to be able to do many things to stay in the industry. Industrial minerals generally are overlooked as a specialty, but people use a lot of them.

Economics is important, that's why the field is often called economic geology. Take some courses.

You should take the MSHA safety training for surface and/or underground mines (40 hrs to start in each). Anybody working in or around active mines, including on environmental projects, has to have this training and likewise will have a leg up on any other applicants who do not yet have it. Also, for both OSHA and MSHA, emphasize that the annual refresher must be taken and the training certification maintained. Otherwise, the employer or site owner can be fined and the person causing the violation (if not a site-owner employee) could get fired or at least banned from the work area.

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[2]. One of the more student interesting comments at the 1st International Professional Geology Conference in Alicante, Spain in July 2000, was a question asking if Spanish petroleum companies were more likely to higher foreigners who had better English language skills that a Spaniard did. They are worried about their English, we our Spanish; both are right. (D.M. Abbott, 2000).

ENGINEERING/ENVIRONMENTAL GEOLOGY

Traditional undergraduate geology programs generally offer a limited background in engineering and environmental geology. However, any good program will give you the knowledge needed to get started in these disciplines. You will never regret sticking it out for a few more years and getting a masters degree. A graduate degree will give you additional knowledge, experience and confidence during your job search.

Course work and experience in soils is highly recommended. Having the ability to classify soils and determine shrink/swell potential in the field will be mandatory. In addition to soil classification, learn what a percolation test is and how to administer one. Karnuta has made a fair amount of money over the past few years pouring water into a hole and watching the level drop.

Take a 40-hour OSHA course in Hazardous Waste: Character Health & Safety. This training is required if you are going to work on a possible hazardous waste site. Although many companies will pay for this training once you are hired, if you already have it when you interview you are one up on the other applicants. This training will also give you the ability to work on a part-time basis as a contractor while you are looking for a full-time position.

Once you get a job, take the time to meet your county commissioners, county administrator, county planning board, county sanitarian, and local building inspector. These individuals will be reviewing all geologic information concerning subdivisions. A good knowledge of what these individuals like to see in a geologic report will be helpful when you prepare a report for your client. Although county employees can not give a developer recommendations on who to use for a geologic report, they can make sure a sample of one of your past reports is shown to the individual.

Take the time to meet local surveyors. Surveyors are often the first individuals contacted by individuals looking to subdivide property or conduct a building project. The surveyor's recommendation will often land you the contract without even having to bid.

PALEONTOLOGY

Macropaleontology is not a field in which you will make a lot of money—most positions are in universities and museums and are scarce. Get into professional paleontology only if you really love the field. If you also enjoy a more economically promising field of geology, do that for a living and volunteer at the local museum; they welcome unpaid professional help. Nevertheless, enjoying what you do is very important. And studying ancient environmental evolution is very important in testing current hypotheses of what is happening today.

Micropaleontology and palynology are used in the petroleum business for stratigraphic correlation in the Gulf Coast and many other Tertiary basins and there are industry positions for these specialties. Palynology is also used in coal exploration, but this not currently a large or growing

field. It may be that a paleontologist with skills in biology, archeology, and/or geology can find work doing environmental site assessments. But this will require real marketing effort on your part.

Many current paleontologists come into the field via biology and therefore don't possess detailed skills or knowledge in stratigraphy and environment of deposition interpretation. These skills are very much needed. Good professorial mentoring and publishing good, recognized papers while you are still in school will make a big difference in your ability to land one of the scarce paleontologic jobs.

Also consider the route of popularizing paleontology for the public if you have the writing skills. Robert Bakker has made a lot of enemies within the profession because of his failure to operate and publish within the accepted channels (he's also generated a lot of good science by getting others to do research to refute his ideas) but he and Stephen Jay Gould are rich paleontologists because of their writing skills.[3] The public is really interested in the subject. If you can write well, or explain things well, this may be a way to accommodate your scientific interests and economic needs.

PETROLEUM GEOLOGY

- Pursue excellence in all your academic assignments—your record is more important than your specialty.
- Cultivate friends, colleagues, and professors who can provide advice and offer strong recommendations.
- Enhance your creativity while developing your geologic skills and knowledge.
- Build an eye-catching resume (high GPA, significant honors and awards, jobs, internships and special projects).
- Be selective in your choice of people who write recommendations for you.
- Develop clarity in what you want to do but determine how flexible you will be regarding job assignment, location, size of company, nature of job, etc.
- Gather these data through informational interviews with professional geologists.
- Practice your oral presentation and interviewing skills.
- Pursue any opportunity to work with professional geologists in order to determine whether your interests and skills are compatible with what an industry or company is seeking.

[3]. If you've read Gould's professional papers on snails, you are in a distinct minority of Gould's readers.

THE GEOLOGIST: PAST, PRESENT, AND FUTURE

Susan M. Landon, CPG-4591
Independent
1996[1]

INTRODUCTION

I had never seen a well log before the day I walked in the door at Amoco. The petroleum community has frequently expected trained petroleum geologists to be ready for hire from the university when the company needs one. That is not a practical expectation nor is it necessary. What should a graduate in geology know to be prepared for a career? What will that career be?

Predicting future trends in the geologic profession is easy; these trends will be erratic. Trends in employment, trends in enrollment, and numbers of degrees granted document cyclicity. The question is how do we effectively deal with the cyclicity of our profession. Several sources were used to develop this background information including the AAPG Annual Survey of University Geology Departments, the American Geological Institute, and a conference on career opportunities in the geosciences hosted by the National Research Council in December 1994. Many of the conclusions from these comments are my personal opinions. Our profession, geology, is subjected to the cyclicity of several industries that employ us and, to a degree, support research and education in geological sciences. The traditional employers (petroleum, mining, environmental, academia, government, etc.) experience changes in hiring levels relative to markets and politics. Environmental geology is a career opportunity driven by government regulation. Through time, though, new graduates with degrees in geology will be necessary in all of these areas. The big questions are:

- How many graduates and at what degree level will be adequate? and
- What kind of education should these students receive?

OBSERVATIONS AND RECOMMENDATIONS

Undergraduate Education: my personal opinion is that there can never be too many undergraduate majors in geology. An undergraduate degree in geology from a liberal arts institution should be considered as an excellent background for a broad spectrum of careers beyond geology. Individuals receiving a degree in geology with a sound education, ability to communicate, an understanding of

[1]. Editor's note: this paper has been modified by the deletion of out-of-date employment statistics. The American Association of Petroleum Geologists periodically publishes information on employment, especially in the *AAPG Explorer*. Search the AAPG web site, www.aapg.org, for current information.

the scientific method, and an appreciation for the earth and its processes, will be able to pursue a variety of career options ranging from attorney, member of the diplomatic corps, law officer, congressman, rancher, primary or secondary school teacher, insurance agent, to mystery writer—to name only a few. (I remember the guy I graduated with who had a double major in geology and music. He is now a gynecologist.) Therefore, our society should continue to encourage young people to study geology and other sciences at the undergraduate level. We need to be realistic in career counseling as these undergraduate students contemplate their future.

If an individual plans to pursue a career in geology, the best possible curriculum would be one that provides a strong, well-balanced foundation in the principles of geology. Specialization is not appropriate at the undergraduate level. An incoming college student has a minimum of six years of collegiate studies, *i.e.,* an MS degree, before contemplating a career-level job.

Graduate Education: A masters degree will continue to be the degree of preference for industry. What should that student learn while working for that degree? First of all, that student should continue to gain a sound, comprehensive geological education that began at the undergraduate level. The student should not become so limited in scope as to prevent flexibility in career opportunities in geology. A student should be encouraged to work on a thesis topic that is of personal interest because the student will learn more in the process. We have many successful geologists in the petroleum industry who completed thesis topics ranging from metamorphic petrology to environmental controls on coral growth rates. It is not mandatory for a student to do a subsurface thesis to be qualified for a position in the petroleum industry. The important lesson is gain the ability to identify a problem, conduct research on the problem, and document the results of that work to resolve the problem.

A PhD will continue to be required for university-level teaching and most research opportunities. This is, of course, a level at which specialization must occur. This is also the degree that is the subject of much of the controversy regarding the appropriate number of degrees that our universities should be granting in most areas of study. Anecdotal information on the increase in number of PhD candidates indicates that lack of employment opportunities and returning industry unemployed are probable causes. A significant number of new PhDs end up in post-doctoral positions with little hope of a meaningful career opportunity. How the system can balance the number of degrees granted with the number of opportunities is beyond the scope of these comments but should be a concern for the future.

GEOLOGY IS NOT ENOUGH!

Tom Fails, CPG-3174
Independent Petroleum Geologist
2000

Success, or even survival, as a practicing geologist in the early 21st century does not rely on technical competence alone. Geologists are a part of both the geological community and society as a whole. We must include much more than science alone in our professionalism, as discussed below.

Personal Relations

So you think you are going to have a nice quiet career dealing with rocks? **Forget it!** Like it or not, you cannot become a successful, employable geologist by dealing only with rocks; you must deal with the people around and above you as well. In your first job, you will be closest to the rock-emphasis ideal, but even then you must have the ability to sell your ideas, concepts and conclusions to others and to get along with your coworkers. As you become more experienced and move upward a bit in your company, people problems will take more of your time, especially those involving getting along with management and in selling your ideas or prospects internally, or your company's services to clients. Selling? Yes, selling. Most geologists do quite a bit of selling throughout their careers. Further, you will be observed pretty closely as to how you handle yourself in a variety of situations, some geology-oriented, some people-related, from the time you go to work, and especially while in company training programs. As your contact with management and/or clients increases and your recommendations start to involve substantial outlays, you will be evaluated even more closely as to:

- technical competence,
- judgment,
- behavior, ethical or otherwise,
- attitude and work habits,
- reliability,
- loyalty, and
- ability to get along with, and to lead, others.

These evaluations may result in:

- promotion to management or high-level technical staff, or a potentially more effective new hire can be made, **or**
- retention for the moment, until business slows, or
- dismissal.

As a new hire, just out of school, you may be paid more than some coworkers with several years of experience. You may not be aware of this, but they will be and some will try to get information like this out of you if they can. So, be careful! And understand that while most coworkers will become friends (some reliable, some not), a few will resent you more than anything else, especially if they are older, less-well-educated, and stressed by career-related insecurity. So as a new hire—be friendly, but discrete at the same time. Don't brag or act superior—you know a lot less than you think you do at this stage. You are there to learn; learn as much as you can. And, your time belongs to the company, not you! Professional geologists as company employees are on-call 24-hours per day, seven days a week. If the boss tells you to make a log run on a rig 200 miles offshore on Christmas Eve, you will do so or you will suffer. Never loose sight of the evaluations. Good ones result in raises and promotions. Bad ones result in bad assignments, pay freezes and sometimes dismissal.

If you are offered a promotion to management, your days of doing geology will be largely over while your exposure to people problems will increase in proportion. And whether in management or senior technical staff, your main career alternatives, company and office politics inevitably play a role and will affect and involve you. Try to avoid involvement to the degree possible. The better your people skills are, the better off you will be.

POLITICAL ACTIVITIES, BEYOND OFFICE POLITICS

Until about 20 to 30 years ago, geologists had little interest or involvement in political relations activities, whether at the federal, state or local levels. Most geologists used to work for oil or mining companies where only a few high level corporate officers were involved in political relations activities. Now, most geologists work in the environmental, water and engineering geology fields, which directly affect the public's health, safety and welfare. These geologists are thus subject to governmental regulations. Further, they often must compete with registered professional engineers for what is clearly geological work. As a result, geologists must be registered in many states before they can work as a geological professional. Sometimes only environmental, hydro and/or engineering geologists are registered with resource geologists exempt, but **all** geologists must be registered in some states. At present, twenty-eight states register or certify some or all geologists who work or plan to work in that state. In another 8 or so states, geologists are trying to get registration bills passed. Why? So that they can better compete with registered professional engineers. Some registered engineers represent that they are more competent in geology than are unregistered geologists, who are clearly their inferiors. So, if you intend to practice as an environmental, hydro and/or engineering geologist, plan on becoming registered in a state or two just after graduation. Your employer may require it, in part because geology does not recognize state lines. Most Rocky Mountain states do not have registration, but it's coming, possibly even in Colorado.

State legislators are mainly lawyers, business people and teachers. They are the ones who write the laws, some registration-related and others geology-related, that control how you make a living, but they usually know little or nothing about geology or geologists. They are willing to learn, but it is up to geologists to educate them. This is known as "horrors" lobbying. Do geologists lobby (*i.e.*, educate) legislators? You bet they do if they are interested in professional survival. A number of experienced geologists, especially those whose work affects public health, safety and welfare, have some—sometimes major—experience in working with legislators, educating them and sometimes trying to influence them. There's nothing wrong with this—it is a part of the democratic process. Lawyers, doctors, engineers, CPAs have known and practiced this for over a century. Geologists are just waking up to the fact that political-relations activities are important to us as well, and will be even more so in the future. If we don't speak up for ourselves and defend our interests as geologists, we risk the possibility of others speaking for us and of our profession becoming increasingly irrelevant and smaller.

Although AIPG certifies experienced geologists as to their integrity and professional competence, we are not opposed to registration in states where a majority of geologists want it. If you become a Student Member of AIPG, we can help you with questions concerning registration in just about any state.

Ethics

This is a subject that you don't hear much about anymore. But ethics are still of great importance. They have to be. Imagine a world where you cannot trust anyone.

With geologists, as scientists and sometimes business people as well, *ethical behavior* is just about mandatory. If you develop a reputation for unethical behavior or just plain dishonesty, your reputation as such will spread widely, and fairly rapidly. As your credibility diminishes, your opportunities and income will diminish as well. Ours is a people business, as discussed previously. You will find that AIPG and most geoscience societies have Codes of Ethics or are adopting them. Familiarize yourself with them and try to adhere to them as you build your career.

NETWORKING

Another area where AIPG can help Student Members is in building a network of geological friends and acquaintances. While still a student, or immediately after graduation, join:

- The national technical society in your geologic specialty. The technical society, through its publications, conventions and short courses, will help you increase your knowledge in, and keep up with, your geologic discipline.

- The local geologic society in your area. The local society provides opportunities to meet and network with other geologists in your area. Attend the meetings, participate in the committees and activities. You will make a lot of friends in the geological community **outside** of your company.

- A national professional geologist organization. AIPG is the only national one that includes all geologic disciplines. Other multi-discipline professional geologic organizations are limited to a single state.

A professional organization will broaden your network of geologists, including those in other disciplines, through meetings, activities, short courses, etc. It is an unfortunate fact of life for geologists that our security of employment is not as great as in most professions. Security of employment doesn't exist for us. You will probably be unemployed—voluntarily or involuntarily—at some time in your career. Numerous present-day environmental and hydrogeologists started their careers as petroleum geologists. As the energy boom of the late 1970s became the energy bust of the mid-1980s, they lost their jobs and were retrained for the jobs they hold today. Recently, with the late-90s bust, it happened again. But with recent increases in oil and natural gas prices, which will not again fall to their 1998 levels, employment opportunities will increase for "oily" types. Until natural gas prices decline below $2.50/MCFG.

As you may have to shift from one geologic discipline to another in mid-career, it is a great advantage to already know geologists in your new discipline—they can sometimes literally save your life in a professional sense. In addition, professional organizations are advocates for geology and geologists with the public and with government. Working with, educating and lobbying legislators and bureaucrats, especially at the state level, is one of AIPG's principal purposes and greatest efforts. This is in part because the technical and local societies, due to their nature, rarely try to influence, educate and work with people in government. On the other hand, this is a primary mission and purpose of AIPG. We do not compete with the technical societies—rather we supplement and go beyond their valuable activities. You need membership in both to further your career.

Let me tell you a little about how my network of geologic friends and acquaintances helped me. I left a major company in New Orleans rather abruptly after nine years of exploring offshore Louisiana. I knew a lot about Miocene stratigraphy, offshore operations and salt dome geology but, as I soon learned, nothing about the real oil business. My first independent company job—a real learning experience—collapsed within a year. A Denver company then hired me to produce and sell exploration prospects in onshore south Louisiana. Although the geology was generally similar to the offshore, I lacked any detailed knowledge of the onshore area. Further, things like assembling and controlling a land position on a prospect, scrounging data, properly structuring and then marketing a drilling prospect to the industry, meeting SEC requirements, working with consultants and with other independent companies, etc., were all new to me. These were things with which I had little to no previous experience. The company helped some, but this was their first Gulf Coast venture. Sometimes they would ask me questions for which I had no immediate answers, so I had to get the

answers from others. But it all worked out well. My network of independent New Orleans geologist friends bailed me out time and time again. And of course, I was able to reciprocate from time to time in helping them.

You can't have too many geologists, of all types, in your network. This may sound provincial, but probably every independent geologist at Student Day, or anywhere for that matter, would agree. Geology is too much fun, too challenging, too rewarding to drop out or be forced out. If we stick together and help one another, more of us will survive—and perhaps prosper. Your profession is like your family—it will help if it can when nobody else will do so.

GEOLOGISTS IN THE POLITICAL ARENA; A NECESSARY PART OF PROFESSIONALISM

Gary C. Mitchell, CPG-4771
2000

Geologists are a very independent breed. Historically they have paid little attention to the political arena since geology is not controlled by political boundaries; state line faults do not exist, and basins are not defined by political subdivisions. The primary focus of geologists in the past was natural resource development. At that time, most governments encouraged development of natural resources, and the geologists could work independently of governments. Most geologists worked in the field, often in remote areas, and did not pay a lot of attention to what was happening in government bodies tens or hundreds of miles away. That was the past.

Today is a whole different story. With expanded environmental knowledge and concerns, an exploding population demanding increasing quantities of natural resources throughout the world, and increasing population densities in areas of natural resource extraction or subject to geologic hazards, government is very much involved in the careers and lives of geologists. This shift has been more rapid than the recognition by geologists that they need to be involved in the political process. In the last few years, some geologists have become aware of the issues that need geologic input throughout all levels of government. Legislative and regulatory bodies are creating a wide variety of laws and regulations that significantly impact the work of geologists. The impacts have been both positive and negative. Following the examples of other commonly accepted professions (accountants, doctors, lawyers, engineers, educators, etc.), geologists must be involved in all levels of the political process in all levels of government if geology is to be recognized as a true profession.

Although there are many examples, one from Colorado will illustrate the need for political involvement by Professional Geologists in all the fields of geology. Expansive soils and dipping bedrock seriously damage houses and cause great economic hardships for owners. These problem result from the expanding housing development along the Front Range corridor that started after World War II and continues today. The Legislature has seen many homeowners and developers attempting to pass legislation dealing with swelling soils. Jefferson and Douglas counties have had to deal with the problem. For the most part, geologists have had to increase their contribution to the solving of the problem because attorneys, engineers, developers, homeowners, and government officials were not geologists and these entities did not have geologic knowledge necessary to solving the problems of building on expansive soils. Education of these groups is essential and professional geologists are required to perform the training. The Colorado Geological Survey has one of the best swelling soils groups in the country and has published several excellent references on swelling soils, particularly for homeowners. Professional geologists have given testimony before the Legislature, at the county level, and in lawsuits regarding the issues of swelling soils. The professional geologists had to learn about the political process for the legislation, both for and against homeowners; the

power of big lobbying groups; the tactics of attorneys for both sides, and the amount of education that was necessary for state legislators and bureaucrats, county elected and appointed officials and employees, and the general public. The measuring of outcrops 30 or 40 years ago in the current Roxborough State Park area is different than dealing with swelling soils issues involving hundreds of homes built in the same area today and hundreds more to be built tomorrow.

Some of the other geologic hazards and issues requiring participation of professional geologists where legislation; federal, state, and local bureaucratic rulemaking; and public health, safety, and economic welfare are seriously affected include: landslides and slumps, rockfalls, flooding, subsidence (including mine subsidence), earthquakes, surface ground water supply and quality, uranium waste, naturally occurring radioactive material (NORM) sites, and natural resource exploration and development.

Perhaps the biggest challenge for professional geologists is educating the public, politicians, and bureaucrats regarding the impact of geology on their lives. Geology needs to be included on the front end of legislation rather than after a major incident. Professional geologists need to take the initiative to involve themselves in the process rather than "waiting to be asked." Many members of the public, and many of the legislators (primarily composed of lawyers, accountants, business people, educators, etc.) and bureaucrats are intimidated by the science of geology and they are hesitant to appear to not know about something in front of the public. In much of my testimony in front of legislative committees, the members of the committees ask geologic questions of lawyers, bureaucrats and public citizens, none of whom are professional geologists, and refrain from asking professional geologists the geologic questions. In the last session of the Colorado legislature, there were two members that had undergraduate degrees in geology. One member had never worked in geology and the other was one of the casualties of the mid-80s oil bust and left geology. Since they had geology degrees, they knew about geology, and they were not afraid to talk to professional geologists. That was a welcome change.

Getting to know legislators and bureaucrats on a personal and professional level is vital to gaining standing for professional geologists. Meeting legislators outside of the Capital building is important, as well as meeting bureaucrats outside of their offices. Building relationships with legislators can begin early in the election process. Caucus meetings are a good place to start and make you known to members of the public and to candidates. If you find a candidate that you want to see elected, assist them with their campaign. To some donating may be an evil, but donations to candidates will get their attention and the contributor will be remembered. Also, going to other organizations' meetings with legislators and state officials present offers an opportunity to meet them where geology is not the topic of the moment and, if it comes up, can be discussed without some of the intimidation atmosphere of other venues.

An area where politics is influencing geologists more and more is licensing. Thirty of the states have some form of licensing and/or registration, three states have definition acts (including Colorado), and only seventeen states have no licensing, registration, or definition statute. Thus licensing and/or registration is potentially a political issue in twenty states, including Colorado. There is a lot of

emotion within the geologic family regarding this issue, both for and against. The bottom line is that licensing and/or registration will come up if you are working in a state without it. It is far better to be active in the process rather than ignoring the issue until a bad bill is passed because geologists ignored the issue too long, or a good bill was amended into a bad bill by others who oppose the concept or the recognition of geologists as professionals.

Geologists must get involved in the political and bureaucratic process if geology is to be considered a profession. Too many laws and regulations involving geology are put into effect lacking the necessary input from professional geologists. Professional geologists have to make themselves known and available to the law makers and rule makers to be included on the front end of the processes rather than trying to go in after the fact and change what was done due to ignorance or by design and the lack of professional geologists' input.

Two good references discussing these issues are:

Fails, Thomas G., 1995, Political relations: The Colorado experience during the nineties: *in* 1995 Annual Meeting Proceedings: American Institute of Professional Geologists, p. 81-87.

Graf, Lynn D., 1995, State Section Government Affairs Programs: *in* 1995 Annual Meeting Proceedings, American Institute of Professional Geologists, p.91-100.

Editor's note: these papers were part of the proceedings of the 1995 AIPG Annual Meeting in Denver. Copies of these papers may be obtained either from Gary Mitchell or David Abbott.

PROFESSIONAL GEOSCIENCE ETHICS: ELEMENTS WITH EXAMPLES

David M. Abbott, Jr., CPG-4570
Compiler of the *Professional Ethics & Practices* Column
2002

This paper summarizes the PowerPoint™ presentation made at Student Day 2002. It differs in approach from the following paper on professional ethics and serves as an introduction to the fundamental moral underpinnings to discussions of professional ethics. The two papers differ but are complementary.

Let me begin the discussion with a question about professional ethics that affects those of you in the academic world.

Is it ever okay for a professor to have sex with a student?

While the general rule is that professors should not be sleeping with students, the question asks if there are any exceptions to general rule. The question presumes that the relationship is consensual and that both parties are legal adults. Let me ask some further questions to explore the main question.

- Does it make a difference if the student is not in the professor's class?
- Does it make a difference if the student is not in the professor's department?
- If both the student and professor are both in their 30s and were publicly dating before the beginning of the course?
- What if the professor and student are married?

While this is not yet the place for detailed discussion of these questions, I hope that they have demonstrated that there may be some exceptions to the general rule. With this thought in mind, let's turn to some moral and ethical fundamentals.

GENERAL MORAL AND ETHICAL PRINCIPLES

If you look in the dictionary, you will find that *ethics* is defined using "morals" and *morals* is defining using "ethics." Clearly the two words are closely related. I differentiate morals and ethics by using "morals" for generally understood but informal, that is not formally codified, descriptions of behavior and "ethics" to refer to formally adopted codes.

The difference between general morals and ethics and professional morals and ethics is applicability. General morals and ethics apply to all people all of the time. Professional ethics apply to those who practice a particular profession and address the responsibilities and behaviors applicable to that

profession. Certainly there is overlap between professions. And professionals are expected to follow the general moral principles as well in addition to their professional responsibilities.

General moral principles fall into two distinct categories, rules and ideals.[1] Moral rules generally take the form "Do not ..." and are relatively few in number. Moral rules apply to all people all of the time. The moral rule, "Do Not Kill," is an example. While some object to the negative approach to of the rules, this approach is practical. There are a relatively few number of things that we are prohibited from doing and an infinite number of things that we can do. Moral ideals are statements concern actions that are held to be morally desirable but which cannot be fulfilled with respect to all of the people all of the time. An example of a moral ideal is "Feed the hungry." None of us has the resources to feed all the hungry people in the world. We do receive recognition for following this precept to the extent that we can but are not viewed as immoral because we don't feed all the hungry.

Bernard Gert, in his *Morality: its Nature and Justification* (1998), suggests that there are a limited number of general moral rules that are recognized by all societies that we know about. He further suggests that every rational person (excludes children and the mentally challenged) knows these rules even though they are not formally written down (although they may be included in formal statements). They are:

1. Do not kill.
2. Do not cause pain or injury.
3. Do not disable.
4. Do not deprive of freedom.
5. Do not deprive of pleasure/the pursuit of happiness
6. ***Do not deceive.***
7. Keep your promises.
8. Do not cheat or violate rules of conduct.
9. Obey the law (includes theft)
10. Do your duty.

I've emphasized rule 6, "Do not deceive," because this rule covers the most grievous moral and violation a physical scientist can generally commit in his or her professional capacity. Lying about or faking one's data and other forms of deception lead appropriately to professional shunning.

In Rule 5, I've added "the pursuit of happiness" to Gert's "do not deprive of pleasure" because the pleasures Gert discusses are not hedonism per se; I believe that Jefferson's phrase better captures the concept. The statement of Rule 9, "Obey the law," has the parenthetical "(includes theft)" because there are some truly communistic societies in which there is no concept of ownership, which is required in order for theft to occur.

Gert also recognizes that there are well-recognized exceptions to each of these moral rules. For example, exceptions to the "Do not kill," rule include self defense, the military, the police, and

[1]. This discussion of general moral principles is based on Bernard Gert's *Morality: its Nature and Justification*, 1998, Oxford University Press. I recommend this book to anyone interested a thorough discussion of the subject.

capital punishment. Capital punishment is not a universally recognized exception. Many believe that it is morally wrong and oppose its imposition. This demonstrates that there can be legitimate moral disagreements about whether a particular exception to a moral rule is allowed.

Other examples of exceptions to moral rules include our willingness to let doctors perform surgery. Clearly major surgery causes injury. But we believe that greater harm is avoided by undergoing the surgery than would be the case if the surgery was not performed. Likewise, it is permissible to deceive a knife-wielding thug who asks if you know the location of an intended victim.

Gert describes in detail the process for determining whether an exception to a moral rule is allowed. Unfortunately there is not time for that discussion today. However, a return to the question about professors sleeping with students provides some guidance into the process.

When determining whether an exception to a moral rule is allowable, the first question is, "What moral rule has been violated?" In the case of a professor sleeping with a student in an consensual relationship between adults, the problem is a form of conflict of interest. The student may be viewed as being liable to receive preferential treatment from the professor. This can be viewed as harming the interests of the other students. If one or both parties are married to someone else, the promises made in the marriage vows may have been broken.

Assuming that neither the student or the professor are married to someone else, the next question is whether the perceived harm to other students exists. If the student is not in the professor's class, the professor's students can't suffer this harm. If the relationship is public, that is other people including members of the professor's department and other students know about the relationship, steps may be taken to ensure that all are treated fairly, particularly where the relationship openly existed prior to the beginning of the class. In the case where the professor and the student are married, I suggest the preferential treatment the student receives by having access to reference materials and the ready ability to ask questions outside of class may be balanced by the expectations that the student will do well in the class, which may or may not be the case. This case could be debated for a long time, and the answers will depend on the rules of the particular school among other things, but we must move on.

INTEGRITY

Stephen L. Carter, in his 1996 book *Integrity*, notes that "Integrity is like the weather, everybody talks about it but nobody knows what to do about it. ...[I]ntegrity is like good weather, because everybody is in favor of it." Carter states that true integrity requires three steps:

1. *Discerning* what is right and what is wrong;
2. *Acting* on what you have discerned, even at personal cost.; and
3. *Saying openly* that you are acting on your understanding of right and wrong.

Carter continues, integrity "conveys not so much a single mindedness as a completeness; not the frenzy of a fanatic who wants to remake the world in a single mold, but the serenity of a person who is confident in the knowledge that he or she is living rightly." Further, "Integrity...is not the same as honesty...it is clear that one cannot have integrity without also displaying a measure of honesty. But one can be honest without being integral."

For example, a professional who believes in ethical professional practice can honestly express that opinion but unless the professional also acts ethically, particularly where there is personal risk, he or she is not acting with integrity. A general professional ethical principle states that when faced with an unethical situation, the professional must either work to see that the situation is corrected or resign. When you are supporting a family, resignation comes at a potentially significant cost. But integrity and professional ethics may require the resignation.

Mohandas Gandhi and Martin Luther King, Jr. provided us with examples of integrity in action. They disagreed with certain laws and in their efforts to change those laws were willing to publicly break those laws and willingly suffered the consequences of breaking those laws, including imprisonment. In doing so, they demonstrated their ethical beliefs and acted with integrity. The tax protestor who openly declares that he will not file a tax return and willingly undergoes the consequences differs from the tax cheat who hides the failure to file an accurate return. The penalty for each may be the same, but one demonstrates integrity the other lacks.

PROFESSIONAL ETHICS AND CONDUCT CODES

Professional ethics and conduct codes are codified statements issued by professional societies and professional regulatory (licensing) bodies. They differ in that professional ethics codes can be written solely for professional guidance and aspiration (essentially equivalent to moral ideals), for example, the AGI *Guidelines for Ethical Professional Conduct*, or as a mix of rules that are enforced and aspirational guides like AIPG's Code of Ethics. Codes of professional conduct consist solely of rules that are to be enforced and are therefore essentially equivalent to moral rules. Regulatory bodies tend to have codes of conduct. A particular professional may be subject to several codes due to membership in several societies and by being licensed by one or more states. Fortunately, most of the geologic codes are pretty similar.

The major topics of geoscience ethical guidelines and codes are:

- protect the public's health, safety, and welfare, including financial welfare;
- advance geoscientific knowledge;
- advance the geoscience profession;
- relations with colleagues and employees;
- relations with employers or clients; and
- relations with students.

The foregoing list differs from the moral rules outlined by Gert. The list focuses on relationships between the ethical professional and various categories of other individuals or groups. This is functional arrangement and focuses on the types of ethical problems that have commonly arisen over the years. However, as demonstrated by the following outline, it is possible to map a relationship between the topics of professional ethics and conduct codes and the general moral rules. Note: this is just an initial example outline; other valid mappings will occur to you.

- Protect the Public's Health, Safety, and Welfare, Including Financial Welfare
  - geologic hazard issues
    - do not kill, disable, or cause pain
    - do not deprive of pursuit of happiness—a place to live
  - financial welfare: mining and oil and gas frauds (theft by lying)
  - provide the natural resources on which society depends
  - do not deceive the public about geoscientific issues

- Advance Geoscientific Knowledge
  - do not deceive anyone about what we know
  - do not cheat by failing to appropriately recognize the work of others

- Advance the Geoscience Profession
  - do not deceive
    - honesty and integrity
    - accept responsibility for work done
  - do not deprive of freedom or the pursuit of happiness
    - acknowledge the contributions of others

- Relations with Colleagues and Employees
  - do not deceive
  - do not kill or injure
    - provide a safe working environment
  - do not deprive of the pursuit of happiness
    - provide for professional recognition
    - provide for professional development
    - provide appropriate compensation

- Relations with Employers or Clients
  - do not deceive
    - avoid or resolve conflicts of interest
    - represent employers or clients honestly
    - work only within areas of professional competence
  - keep our promises
    - safeguard confidential information
    - work diligently

- Relations with Students
  - do not deceive
    - accurately describe job prospects within the profession
    - accurately appraise student abilities—avoid grade inflation
  - do not kill or injure
    - provide a safe working environment
  - do not deprive of the pursuit of happiness
    - provide for professional development
    - provide appropriate compensation—students are not slave labor

Let me conclude by providing another brief case history.[2] A state university professor has been retained as a private consultant. One day, the professor visits the project field site as part of his consulting contract. The professors is observed driving a state university vehicle. Should the professor be using a state vehicle while engaged in private consulting work? Are there any circumstances that might change your view of this situation? In considering this example, think about what ethical and other rules the professor may be violating. What should penalty, if any, should the professor face?

I would welcome you answers to these questions and others raised in this presentation, or others cases that come to your attention. I even welcome good questions. These are the types of questions and answers that go into my *Professional Ethics & Practices* column in AIPG's monthly, *The Professional Geologist*. Feel free to contribute. Anyone can provide interesting questions or commentary. Write me at dmageol@msn.com.

[2]. This case history was suggested by John Rold.

PROFESSIONAL ETHICS

David M. Abbott, Jr., CPG-4570 [1]
1998

WHAT IS A CODE OF PROFESSIONAL ETHICS?

The 1997 Presidential Conference on *Ethics in the Geosciences* [2] began by discussing the purpose and function of a professional code of ethics. The conference report stated, "*Ethics* is a system of belief that is articulated, codified, and philosophical in nature; *morality* is intuitive right and wrong, spiritual, and universal."[3] While other definitions of *ethics* and *morals* exist, for purposes of this discussion, a professional code of ethics is a formal document applicable to the professional group involved. More specifically for this discussion, professional ethics refers to the AIPG Code of Ethics. Other geoscience societies have their own codes of ethics that differ from the AIPG Code. However, there is more fundamental similarity than difference in the various geoscience society codes.

Ethics Professor Bernard Gert of Dartmouth College told the *Ethics in the Geosciences* conference that his job as a professional ethicist was not to know anything in particular. Rather his job was to ensure that we were precise and clear about the topics under discussion, and that we be logical and consistent in the development and application of our codes of ethics. Professor Gert also pointed out that there is general consensus among the world's ethical or moral systems on fundamental issues. There is general agreement that dishonesty, theft, etc. are unethical. However, in detail there are exceptions. Gert used the example "Thou shalt not kill." Exceptions to this general principle include self-defense, armed forces in times of war, certain actions by police, capital punishment, and the like. Just what the exceptions are varies from society to society and even within a society. Currently in the United States, capital punishment may be imposed in certain limited cases. But there are many U.S. citizens who view capital punishment as immoral or unethical in all circumstances.

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1. The first three sections of this paper are taken from Abbott's Introduction to *Geological Ethics and Professional Practices 1987-1997*, 1998, David M. Abbott, Jr., editor, American Institute of Professional Geologists, 202 p.

2. The 1997 *Ethics in the Geosciences* was a Geological Society of America (GSA) Presidential Conference which was cosponsored by the American Association of Petroleum Geologists (AAPG) and the AAPG Division of Professional Affairs, the American Institute of Professional Geologists (AIPG) and the AIPG Foundation, the GSA Foundation, and the U.S. Geological Survey. The National Science Foundation awarded a matching grant.

3. Horton, Heidi, 1997, Report on the Conference on *Ethics in the Geosciences*, 23 p. Copies distributed to co-sponsoring organizations and participants.

Mark S. Frankel of the American Association for the Advancement of Science discussed the basic functions of a professional code of ethics at the *Ethics in the Geosciences* conference. Based on Frankel's comments the conference report concluded:

> "Codes of ethics are the means by which professional disciplines are able to express their shares beliefs and values and to define their goals. An ethics code specifies the way a society wants its members to act. The function of codes is to:
>
> - serve as a consensus of a community's opinions (that is, an expression of the highest common denominator of values for the profession);
> - serve as an enabling document that provides direction and allows informed choices, thereby leading members to less of a moral dilemma and facilitating habit to do the right thing;
> - reflect ethics of action and character;
> - reaffirm the professionalism of a group by allowing for professional socialization that gives a grounding and identification;
> - provide a public image of discipline and accountability, serving as a basis for defining expectations, and gaining public trust and support;
> - serve as an educational tool to deter unethical behavior and uphold group integrity;
> - provide support against unreasonable demands on professionals of that society;
> - serve as a source of public policy; and
> - provide a supportive climate for whistleblowers."[4, 5]

Frankel went on to say that a code of ethics can serve three purposes:

- *aspirational*: provide a statement of professional aspirations, a statement of core values,
- *educational*: provide specific guidance and education regarding ethical principles, and
- *regulatory*: provide minimal or specific standards of conduct for enforcement of standards.

The AIPG Code of Ethics addresses the aspirational and regulatory purposes fairly well. Like most ethics codes, including the Ten Commandments, it is fairly short and therefore additional material, such as that included in AIPG's *Geological Ethics and Professional Practices. 1987-1997* and presentations like this one, is needed to further address the educational purpose.

Professional ethics codes are no different than societal ethical standards (laws). There are general principles, and there are exceptions. For example, geological codes of ethics generally state that employer's or client's confidential information must be kept confidential. But there is an exception when the public health, safety, and welfare and other legal, professional, and ethical obligations

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4. Horton, Heidi, 1997, Report on the Conference on *Ethics in the Geosciences*, 23 p.

5. Regarding whistleblowing: this, like many ethical topics can be controversial. Yet in the context of this statement, the idea is that a whistleblower who has correctly and ethically exposed himself or herself to the adverse consequences of whistleblowing ought to be able to look to the professional society for support and encouragement.

demand otherwise (Standard 3.2).[6] Discussion of what circumstances constitute a valid exception to the general principle is just one part of the necessary, on-going process of educating one's self and one's professional colleagues about professional ethics.

THE SCOPE OF PROFESSIONAL ETHICS

A professional code of ethics usually applies only to the members of a profession or group. An interesting example of a code intended to apply beyond the adopting group is the Ethical Guidelines for Statistical Practice drafted by the American Statistical Association (ASA).[7] The ASA recognizes that members of many professions use statistical methodologies and urges all of them to subscribe to and support the ASA Guidelines regardless of their membership in ASA. An interesting question is whether the code of ethics of a particular group such as AIPG can or should be applied to all members of a profession, in this case the geosciences. Where various groups within a profession have similar provisions in their respective codes, there may be firmer grounds for this 'extraterritorial' extension.

The contents of a professional ethics code reflect the concerns of the profession. For example, the medical, biological, and social sciences deal with living research subjects and their codes of ethics contain sections dealing with the ethical treatment of research subjects. Such sections do not exist in geoscience ethics codes because geoscientists deal with non-living rocks.

Ethics codes can change in response to the wishes of the membership. The AIPG Code of Ethics has changed in the past and undoubtedly will change in the future. Currently consideration is being given to several specific changes. However, changes should be made thoughtfully, and if the code is well-developed, infrequently.

WHAT ARE PROFESSIONAL PRACTICES AND HOW DO THEY RELATE TO PROFESSIONAL ETHICS?

Professional practices involve the specific ways particular professional activities, sampling for example, are conducted. Particular practices are not normally regarded as having the moral character of professional ethical provisions. Yet there can be an ethical aspect to sample collection. For what purpose am I taking this sample? Is the sample I'm collecting representative of what I'm sampling? Have I selected and executed the appropriate sampling method? Can the samples collected three years ago for one purpose be appropriately used for another?

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6. References to the AIPG Code of Ethics in this paper will use the shorthand of simply cited the particular Canon(s), Standard(s), and/or Rule(s) involved without the preceding "AIPG Code of Ethics."

7. The ASA Guidelines are available through the ASA web site, <www.amstat.org/about/ethics.html>.

The licensing of geologists provides a different example. Whether licensing of geologists should or should not occur in a particular jurisdiction is not an ethical question per se, although ethical considerations may be part of the debate. However, once licensing is established, then since ethical practice includes practicing in compliance with all applicable laws and regulations (Standard 2.1), compliance with licensing becomes an ethical issue.

Recognizing the overlap between professional ethics questions and professional practice questions, in launching the monthly *Professional Ethics &Practices* column in AIPG's *The Professional Geologist* I wrote, "I've titled this column 'Professional Ethics & Practices' because although different, professional ethics and practices tend to be closely related subjects. Good professional practices can be employed to avoid ethical problems. Consideration of ethical issues often prompts suggestions for good professional practices.

"For example, [while employed by the U.S. Securities & Exchange Commission[8]] I read a lot geologic reports, some professionally done, some not so. I'm surprised at the number which are undated. Even more reports omit a description of the scope of work performed. Reports lacking such basics are more frequently the subject of inquiries into professional competence and are more easily misused by the unscrupulous. The suggested professional practices, namely dating your reports and including a scope of work are obvious results of such reviews."

Professional practices include procedures, policies, guidelines, and standards. Some of these have been formally adopted by a group such as AIPG or American Society for Testing and Materials (ASTM), some have been published, some are informal, and some are the 'rules of thumb' known to practitioners in a particular field or district. Procedures, policies, guidelines, and standards are different things.

Procedures specific the way something should be done, such as AIPG's Disciplinary Procedures. Policies specify approaches to a particular task. AIPG's Policy on Environmental Investigations and Audits and Policy on Appraisals of Mineral and Related Interests are in this category. AIPG's Policies and Procedures are subdivided into those relating to the professional activities of geologists generally and those relating to the administration of AIPG's internal functioning.

Professional guidelines and standards are often more formally proposed and adopted. The ASTM, the American Petroleum Institute (API), and the International Standards Organization (ISO) are among the best known organizations in North America promulgating guidelines and standards

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8. When the *PE&P* column began in 1995, I was the Regional Geologist at the Denver office of the U.S. Securities & Exchange Commission (SEC). I became a private consultant in 1996. My job with the SEC included review of filings for compliance with the full and honest disclosures principles of the federal securities laws and the investigation of and, where warranted, assistance in the prosecution of mining and oil and gas frauds. One of the reasons for this footnote is to alert students to the existence of geoscience jobs in seemingly unlikely places. Although there are very few (at the moment 3) geoscience positions at the SEC, geoscience jobs exist in many government agencies, in the lending departments of some banks, etc.

affecting geoscience practice. But other organizations publish guidelines and standards affecting particular aspects of geoscience practice. Government laws, rules, and regulations can contain guidelines and standards as well. As with many ethical issues, debates over the need for and specifics of various guidelines and standards can be vigorous and last a long time. I've been involved in debates over the definition of mineral resources and reserves and requirements for determining that resources and reserves exist at generally understood levels of assurance for over ten years now.

THE AIPG CODE OF ETHICS

AIPG's Code of Ethics is very similar to the codes of other geological societies. It has 5 major parts.[9]
Some of provisions of the AIPG Code of Ethics are things any professional should be doing. For example the provisions concerning maintaining and improving your professional skills. Others are more direct: disclose conflicts of interest, advise against illegal activities and report them if they occur. Some provisions can and indeed may require loss of employment: resign if illegal or unethical practices are conducted despite your objections and advice to the contrary. This can be a real problem when you've got kids, a mortgage, and the situation doesn't seem that clear. These are the situations demanding integrity, which is following your ethical beliefs even when they may result in personal harm.

Application of ethical concepts takes some real thought and consideration. It is not the obvious stuff that's a problem. Illegal dumping of hazardous waste or falsifying data are not ethically debated issues. What's right and wrong is clear.

Let's look at some ethical issues involving students and faculty. Some of the following situations are fairly black and white issues and some are shades of gray. The gray areas are where the difficulties of ethics come into play. These situations are for you to ponder.

1. Professorial consulting: does the use of school offices and equipment constitute unfair competition to the private consultant offering similar services who has to provide his or her own office and equipment? Is there a difference between the consulting work of an engineering geology professor, who has many colleagues in private practice, and the paleontology professor, who is the only expert on Ordovician trilobites in the state?

2. I was once asked by an investigator for the District Attorney's office in Golden, Colorado about my familiarity with a magnetometer. When I asked why one was needed, I learned that two Central City, Colorado men were missing and were presumed murdered, and that reportedly they had been buried in their pickup truck in an mine dump. Could a

9. The full AIPG Code of Ethics follows this paper.

magnetometer find the truck? I suggested that the investigator contact the Colorado School of Mines Geophysics Department because this sounded like a great lab exercise with a real, rather than made up, purpose and would bring the whole range of geophysical methods to bear on the problem. The investigator did as suggested. (Unfortunately, the bodies and pickup were later found down a mine shaft on a different property.) From an ethical viewpoint, does this situation differ from the situation above? A geophysical consultant lost a job. Was this a legitimate, if unconventional learning experience? Is it ethical for one government agency, CSM, to help another, the local police, free of charge?

3. Graduate students teaching courses: you pay the same tuition for a full professor or a graduate student. Are students being short-changed by this practice? When thinking about this consider these situations:

   - Who's the expert: one of my fellow graduate students was the only person I've met who did phase diagrams for fun. The professor asked him to teach the phase diagram parts of metamorphic petrology because the professor knew the graduate student had greater expertise and understanding of the subject.
   - Teaching assistants are routinely used as lab instructors in order to (1) reduce student:teacher ratios, (2) help graduate students finance their education, and (3) provide education methods training to those graduate students who will become professors. Does this practice present an ethical problem like the previous situation?

4. Companies often sponsor thesis research to answer a variety of questions. Does this method of obtaining information result in unfair competition for consultants? Do school requirements that the work be published make a difference? If students didn't do this work for far less cost than hiring a consultant, would the work be done?

Reflection on the issues presented should result in the realization that the situations can be complex with varying degrees of desirable and undesirable consequences for various people with differing stakes in the situation. Answers have not been provided because I don't have all the answers. I am interested in your answers. Please feel free to contact me at *DMAgeol@msn.com* with your ideas.

AIPG CODE OF ETHICS

(Adopted December 11, 1989, with modifications adopted October 4,1998)

PREAMBLE

Members of The American Institute of Professional Geologists are dedicated to the highest standards of personal integrity and professional conduct. The Institute's Code of Ethics comprises three parts: the Canons, which are broad principles of conduct; the Ethical Standards, which are goals to which Members aspire; and the Rules of Conduct. Compliance with the Rules of Conduct is mandatory and violation of any Rule will be grounds for disciplinary action by the Institute. Under the Bylaws, the Institute may also impose discipline for legal violations and because of the suspension or revocation of registration or licensure, among other grounds. Disciplinary action may take the form of private admonition, public reprimand, suspension of membership, or termination. The Code of Ethics applies to all professional activities of Members and Adjuncts, wherever and whenever they occur. The title "Member" where used in this Code of Ethics shall include Adjuncts. A Member shall not be relieved of an ethical responsibility by virtue of his or her employment, because the Member has delegated an assignment to a subordinate, or because the Member was not involved in performing services for compensation.

CANON 1. GENERAL OBLIGATIONS

Members should be guided by the highest standards of personal integrity and professional conduct.

Standard 1.1. Members should pursue honesty, integrity, loyalty, fairness, impartiality, candor, fidelity to trust, inviolability of confidence, and honorable conduct as a way of life.

> **Rule 1.1.1.** By applying for or by continuing Membership in the Institute, a Member agrees to comply with and uphold this Code of Ethics.

CANON 2. OBLIGATIONS TO THE PUBLIC

Members should uphold the public health, safety, and welfare in the performance of professional services, and avoid even the appearance of impropriety.

Standard 2.1. Members should observe and comply with the requirements and intent of all applicable laws, codes, and regulations.

Rule 2.1.1. A Member shall not knowingly participate in any illegal activities, or knowingly permit the publication of his or her reports, maps, or other documents for illegal purpose.

Rule 2.1.2. A Member shall neither offer nor make any illegal payment, gift, or other valuable consideration to a public official for the purpose of influencing a decision by such official; nor shall a Member accept any payment, gift, or other valuable consideration which would appear to influence a decision made on behalf of the public by the Member acting in a position of public trust.

Rule 2.1.3. If a Member becomes aware of a decision or action by an employer, client, or colleague which violates any law or regulation, the Member shall advise against such action, and when such violation appears to materially affect the public health, safety, or welfare, shall advise the appropriate public officials responsible for the enforcement of such law or regulation.

Standard 2.2. Members should be accurate, truthful, and candid in all communications with the public.

Rule 2.2.1. A Member shall not knowingly engage in false or deceptive advertising, or make false, misleading, or deceptive representations or claims in regard to the profession of geology or which concern his or her own professional qualifications or abilities or those of other geologists.

Rule 2.2.2. A Member shall not issue a false statement or false information which the Member knows to be false or misleading, even though directed to do so by an employer or client.

Rule 2.2.3. A Member shall avoid making sensational, exaggerated, and or unwarranted statements that may mislead or deceive members of the public or any public body.

Standard 2.3. Members should participate as citizens and as professionals in public affairs.

Rule 2.3.1. A Member acting in a position of public trust shall exercise his or her authority impartially, and shall not seek to use his or her authority for personal profit or to secure any competitive advantage.

Standard 2.4. Members should promote public awareness of the effects of geology and geological processes on the quality of life.

CANON 3. OBLIGATIONS TO EMPLOYERS AND CLIENTS

Members should serve their employers and clients faithfully and competently within their overall professional and ethical obligations.

Standard 3.1. Members should disclose any actual or potential conflicts of interest which may affect their ability to serve an employer or client faithfully.

Rule 3.1.1. A Member shall disclose to a prospective employer or client the existence of any owned or controlled mineral or other interest which may, either directly or indirectly, have a pertinent bearing on such employment.

Rule 3.1.2. A Member having or expecting to have beneficial interest in a property on which the Member reports shall state in the report the fact of the existence of such interest or expected interest.

Rule 3.1.3. A Member employed or retained by one employer or client shall not accept, without that employer's or client's written consent, an engagement by another if the interests of the two are in any manner conflicting.

Rule 3.1.4. A Member shall not accept referral fees from any person to whom an employer or client is referred; however, nothing herein shall prohibit a Member from being compensated by the employer or client for consultation, or for other services actually performed.

Rule 3.1.5. A Member shall not offer or pay referral fees to any person who refers an employer or client to the Member; however, nothing herein shall prohibit a Member from compensating the person giving the referral for consultation, or for other services actually performed.

Standard 3.2. Members should protect, to the fullest possible extent, the interest of an employer or client so far as is consistent with the public health, safety, and welfare and the Member's legal, professional, and ethical obligations.

Rule 3.2.1. A Member shall not use, directly or indirectly, any confidential information obtained from or in the course of performing services for an employer or client in any way which is adverse or detrimental to the interests of the employer or client, except with the prior consent of the employer or client or when disclosure is required by law.

Rule 3.2.2. A Member who has made an investigation for an employer or client shall not seek to profit economically from the information gained without written permission of the employer or client, unless it is clear that there can no longer be a conflict of interest with the original employer or client.

Rule 3.2.3. A Member shall not use his or her employer's or client's resources for private gain without the prior knowledge and consent of his or her employer or client.

Standard 3.3. Members should serve their employers and clients competently.

Rule 3.3.1. A Member shall perform professional services or issue professional advice which is only within the scope of the education and experience of the Member and the Member's professional associates, consultants, or employees, and shall advise the employer or client if any professional advice is outside of the Member's personal expertise.

Rule 3 .3.2. A Member shall not give a professional opinion or submit a report without being as thoroughly informed as might be reasonably expected, considering the purpose for which the opinion or report is requested.

Rule 3.3.3. A Member shall engage, or advise an employer or client to engage, and cooperate with other experts and specialists whenever the employer's or client's interests would be best served by such service.

Standard 3.4. Members should serve their employers and clients diligently and perform their services in a timely manner.

Standard 3.5. Members who find that obligations to an employer or client conflict with professional or ethical standards should have such objectionable conditions corrected or resign.

CANON 4. OBLIGATIONS TO PROFESSIONAL COLLEAGUES

Members should respect the rights, interests, and contributions of their professional colleagues.

Standard 4.1. Members should respect and acknowledge the professional status and contributions of their colleagues.

Rule 4.1.1. A Member shall give due credit for work done by others in the course of a professional assignment, and shall not knowingly accept credit due another.

Rule 4.1.2. A Member shall not plagiarize another in oral and written communications, or use materials prepared by others without appropriate attribution.

Standard 4.2. Members should be accurate, truthful, and candid in all communications with others regarding professional colleagues.

Rule 4.2.1. A Member shall not issue (a) false statement(s), (a) misleading statement(s), or (a) sensational, exaggerated, defamatory, and or unwarranted statement(s) regarding a professional colleague. Differences of opinion occur and statements regarding opinions should be restricted to and based on logical and scientific principles and should be made in a respectful and professional manner.

CANON 5. OBLIGATIONS TO THE INSTITUTE AND THE PROFESSION

Members should continually strive to improve the profession of geology so that it may be of ever increasing benefit to society.

Standard 5.1. Members should strive to improve their professional knowledge and skills.

Standard 5.2. Members should cooperate with others in the profession and encourage the dissemination of geological knowledge.

Standard 5.3. Members should work toward the improvement of standards of geological education, research, training, and practice.

Standard 5.4. Members should not only uphold these standards of ethics by precept and example but also encourage by counsel and advice to other Members, their adherence to such standards.

Standard 5.5. Members having knowledge of a violation of these Rules by another Member should bring substantiated evidence of such violation to the attention of the Institute.

CONTINUING PROFESSIONAL DEVELOPMENT: AN INCREASINGLY IMPORTANT TOPIC

David M. Abbott, Jr., CPG-4570[1]
Consulting Geologist
1998, updated 2002

Continuing Professional Development (CPD) and continuing education are something all of us will be hearing more and more about in the years to come. Increasing demand for public recognition and regulation of professions is leading to formalization of a once informal process. Geologists have long recognized that their science is constantly evolving and requires continual study long after one has left formal academic training. The AIPG Code of Ethics, Standard 5.1, states, "Members should strive to improve their professional knowledge and skills." Other geological ethics codes state much the same thing. What is new are proposals for programs requiring some minimum level of continuing education and professional participation to meet and maintain certification and licensing requirement. A proposal for requiring a minimum amount of continuing professional development was recently adopted (2002) by AIPG (see the May, June, July, and August/September 2000 issues of *The Professional Geologist* and continuing discussion in future issues). These proposed programs commonly include maintenance of a CPD logbook. Although the exact form of these minimum maintenance standards varies between professional societies and other groups, you can be prepared for them. Get into the habit now of maintaining your personal professional activities logbook. When the time comes, the information in your logbook will contain the information you need.

WHAT IS CONTINUING PROFESSIONAL DEVELOPMENT?

"Continuing professional development is the systematic maintenance, improvement, and broadening of knowledge and skills and the development of personal qualities necessary for the execution of professional and technical duties throughout a practitioner's working life" (Geological Society of London, 1998). While continuing education comprises an important part of CPD, but there is much more. CPD includes:

- less formal learning, like reading and study of papers in the journals published by the technical societies to which you belong;
- acquisition of knowledge about fields and technologies needed to do your work (accounting, law, regulatory requirements, computers, technical writing, etc.);

[1]. Thomas G. Fails, CPG-3174, Co-Chair of AIPG's Task Force on Continuing Professional Development, contributed to this paper in a variety of ways. He and I have discussed CPD issues a number of times over the years; he provided me with a copy of the Task Force's results to date; and he provided valuable comments on the initial draft. Fails' advice, comments, and encouragement are gratefully acknowledged.

- participation in professional and technical societies, particularly managerial and organization work for these societies;
- participation in programs for teaching the public about geology and its impact on their lives; and
- participation in the political process to ensure that geology and geologic issues, conditions, hazards, and processes are properly recognized (this is distinct from political activities not involving geologic science).

Generally, each of the items above covers activities beyond what you do in the strict performance of your job. Certainly there will be training programs required for your job, and these do count as CPD. But the idea is that commitment to one's profession requires more than the bare minimum required for keeping one's job.

Consider the common characteristics of prominent geologists, the one's you most admire. They have kept up with their profession, they act ethically, and they serve their profession in a variety of ways. These prominent geologists demonstrate what continuing professional development is all about. You can emulate them and become prominent. Reading the citations and replies of those who receive the medals from our professional and technical societies will confirm that the medallists achieve a great deal of personal satisfaction from doing so.

YOUR PERSONAL PROFESSIONAL ACTIVITIES LOGBOOK

Although CPD has been a part of the profession for many years, it is in the process of becoming more formalized in response to our evolving regulatory environment. In the near future, all of us will be expected to produce evidence that we have engaged in some minimum amount of continuing education and other activities in order to maintain our professional certifications and licenses. Other professions have had such requirements for some time; now it is geology's turn.

Because this is a new requirement for geologists in North America, no one can tell you exactly what kinds of activities will 'count', how much each activity will count for, etc. Regardless of the details, you will first need the data record of what you have done. I have now filled out CPD logs for AIPG (draft version), the AusIMM, and the Geological Society. All are different in detail, but I keep the basic data in a spreadsheet (you could use a database). The most important fields are the date(s) of the activity, its formal title, a description of what was done, the actual hours spent on it. Be sure to include publications, professional talks, service on professional organization committees, company training courses, informal training that you may undertake, and professional reading (the titles, etc.). Take a look at the proposed CPD requirements in the June 2000 issue of *The Professional Geologist* (available on-line for AIPG members, including student members). AIPG adopted a formal program of CPD in 2002 and the new requirements should appear in *The Professional Geologist* shortly.

Maintenance of a professional activities logbook has been part of British geology for some time, although it has not been a common part of North American geologic practice. The logbook records

the dates, hours spent, and summaries of the various activities you engage in. Summaries of projects you work on, the people involved, client names, etc. should also be included. In summary, it is a thorough professional diary. It is far more than a resume, which is customarily kept to a page or two, and a publications list. However, with a good professional activities logbook, preparing a résumé or filling out a detailed job application will be easy.

The Australasian Institute of Mining and Metallurgy (AusIMM) has instituted a formal logbook program for those seeking Chartered status from AusIMM.[2] The Geological Society of London is instituting a similar program for its Chartered Geologists. AIPG is in the process of developing its own CPD program and it will probably institute a logbook program. The following outline is based on the components of the AusIMM logbook with minor modifications.

1. **Professional Practice:** summarize work done on each significant project including the dates of the project, scope of work individually performed, etc. One item to include in the summary of each project is a description of what activities one was responsible for and the degree of professional judgment and responsible charge one had. Did one have responsibility for interpreting data collected? Did one have and exercise the authority to determine where data would be collected, where the next hole would be drilled, etc. Responsible charge does not necessarily mean that one is "Supreme Project Manager;" it means that one has and exercises professional responsibility in performing one's assigned tasks on a particular project.

   The summary of the projects you work on can describe a great deal about what you did without disclosing employer or client confidential information. Nevertheless, some confidential information may creep in—project locations may be viewed as highly confidential, at least for a period of time. Be sensitive to the need to protect your employer's or client's confidential interests as you are preparing a professional activities log which you are keeping for a career. Reports of professional activities to a professional society as part of a periodic reporting requirement should not disclose confidential information.

2. **Continuing Professional Development Activities**
   a. Technical conferences: dates, title, name of sponsoring organization and venue, names of author(s) and papers presented, and actual hours spent attending technical sessions.
   b. External and internal short courses: dates, title, name of sponsoring organization and venue, and hours spent participating
   c. Other technical or professional society meetings: dates, title, name of sponsoring organization and venue, names of author(s) and papers presented, and actual hours spent attending technical sessions.

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2. Chartered status is similar to Certification by AIPG and others in the U.S. in terms of requirements. However, because of differences in the legal status of chartering organizations in countries like Australia and the United Kingdom, Chartered status also has characteristics of state or provincial licensing in the U.S. and Canada.

d. Distance learning: state whether material was written, video, audio, and/or computer-based along with date(s), actual hours spent, name of supplying organization, and title of material.
e. Private reading of professional and technical publications: dates, title(s), author(s), publication, and actual hours spent.
f. On-the-job skill enhancement: date(s), description of activity, actual hours spent.
g. Formal education: dates, course title, name of institution, actual hours spent in class, labs, and on associated formal research projects. This category includes not only scientific courses but also other courses useful to the practice of one's profession like law, accounting, computer science, economics, etc.
h. Preparation of papers presented to or published by professional or technical societies: list of publications and presentations.
j. Participation in the management and running of technical and professional societies: describe activity and actual hours spent.
k. Other relevant information: this is a catch-all category; describe activity, dates, and actual hours spent.

If you have the data described above in your professional activities logbook, or professional diary if you prefer, you will have the information required to complete the formal forms required by the various organizations and jurisdictions you currently belong to and those you may subsequently join. The various components of the professional activities logbook can easily be kept current in a spreadsheet or word processor table.

Like it or not, CPD requirements will be a part of the future for most North American geologists. All of us need to get into the habit now of maintaining a thorough professional activities logbook—those of us with gray heads as well as students. The contents will be useful in a variety of ways, many of them unexpected.

Adaptation from

SURVIVAL FOR PETROLEUM GEOLOGISTS: ADAPTION TO CHANGE

Tom Fails, CPG-3174
Independent Petroleum Geologist
2000

I've been involved in oil and gas exploration and development since 1955. My personal resources would have allowed retirement in the mid-'70s, but I'm still heavily involved. Why? Because for me, even after 45 years, petroleum exploration is the most challenging, exciting, diverting, rewarding and downright enjoyable way to spend my professional time. If you can enjoy a career similar to mine, you will be fortunate indeed. The following, taken from AIPG's magazine *The Professional Geologist* (April '95) describes what I believe are necessary qualities for a successful, fulfilling career in petroleum geology. Unfortunately, not all geologists are as fortunate as Digger.

If you are determined to follow a particular star (petroleum geology) for 20, 30 or more years and to survive emotionally and financially, let along prosper, you must begin with academic training heavily laden with the basics of stratigraphy, structural geology, economics, English, physics and chemistry. Doses of geophysics, field mapping, psychology and basic engineering can't hurt. Among engineering courses, materials and hydrodynamics are especially useful for petroleum geologists. Computer literacy is a must as well. A Masters degree is usually necessary for all but the most basic jobs (mud logger, jug hustler, rig hands). Try to get some practical summer experience on a drilling rig, field party or seismic crew if you can. Once you are employed as an explorationist, your time is your employer's not yours. Be prepared to continually update your technical background in whatever specialty you develop expertise in, to broaden your focus exploration-wise (new basins, new countries, new approaches, concepts, and techniques) and above all, be prepared to seek, accept and capitalize on the opportunities created by **change**. And, be flexible: be prepared to move occasionally, sometimes outside the US, master a foreign language or two, change employers, undergo unemployment, perhaps go out on your own and, above all, learn to get along with people. All while retaining your integrity, optimism, sense of humor and ensuring that your spouse and family are comfortable with an anything-but ordered lifestyle. Twenty years ago, I was counseling petroleum-oriented student geologists that they should be reconciled to probably spending part or all of their career on the Gulf Coast. Now, the international area is more-likely than the Gulf Coast, which remains probably second on the inevitability scale. Sorry, if you don't like the sound of this, you'd better stay out of the oil patch, or consider leaving if you are just starting out.

When "old fossils" pontificate like this on oil patch concerns, there must be a reason. The reason is professional survival! Let me tell you about a petroleum geologist whose oil patch experiences I know fairly well, as they help illustrate the continual changes which affect explorationists and the adjustments and attitudes necessary for professional survival. Lets call him Digger. Digger entered

the exploration game in the mid-'50s, armed with undergraduate and Master degrees in geology plus two summers of field party experience. He was employed by a major oil company and sent to the Gulf Coast after completing the company training program. A Rocky Mountain boy, Digger wasn't happy about the prospect of Gulf Coast living, but as the alternative was West Texas and as the offshore division office to which he reported was the most active in the company, he went along. And he became happy there. The work was interesting, challenging and exciting and Digger eventually became responsible for multi-well exploration programs. Although he was involved in three major discoveries, this did nothing to forward his career, which appears to be typical of most majors. After ten years with this company, Digger concluded that he was not cut out to be a big company employee and resigned to enter the independent oil patch. Digger had learned a great deal about Miocene regional geology and salt dome exploration, but, as he soon realized, very little about the oil business. He did recognize the necessity for excellent technology, flexibility and adaptation to change, however. His next job aborted after a year, typical of many independent companies. He then opened a Gulf Coast office for a Rocky Mountain exploration company, which proved to be aggressive, innovative, technically sound, very well managed but chronically short of capital, also typical of independent companies. And ultimately, successful. However, this job didn't look overly promising at first. The late 1960s were difficult times for US explorers. Exploration capital was scarce and the company's operations were at break-even levels. Nothing new in this, but still in stark contrast to the booming 1950s and early 1960s. The majors were going overseas and Digger's company soon followed, developing prospects in the North Sea area, Australia and southeast Asia. As a part of this, Digger spent six years in Europe, managing company operations there and dabbling in North Africa and the Middle East. Once again- flexibility, opportunity and change were accepted and exploited, but on a larger scale and with greater risk, as the company had little previous foreign experience and limited capital. However, it worked. The company made several major discoveries and the shareholder-employees were able to sell out, profiting handsomely. Well, you may say, Digger was lucky. True to a degree, but luck seems to come most often to those who best prepare themselves for it, seek it, work for it and often find it.

Digger declined several employment opportunities in Europe and the US, preferring to return home and play the independent geologist game. Once again, flexibility and a modicum of experience in a different environment—a change in direction and emphasis. Digger did relatively well as a Gulf Coast independent, generating and selling prospects but not finding anything big until the mid-1980s, when the boom became a bust and destroyed more than half of the US exploration industry. Change again, but this time for the worst—how could an experienced explorationist survive and prosper in this environment? In Digger's case, by forming a partnership, which purchased and renovated a producing property on the Gulf Coast. Doubling the production rate proved to be easy and, with increased oil and gas prices, a three-well drilling program was planned. In a period of collapse and rapid change, flexibility, experience, self-confidence and reputation paid off, as they did for many experienced independents during these very hard times. But, even as things improved during the late 1980s, prospects had less potential and were harder to sell in a highly competitive environment. Gas prices remained low and capital was scarce. What to do? Exploration had changed in the North Sea area as well. Everything was offshore—the onshore was picked over and appeared hopeless, with very little activity. However, large tracts of acreage could be obtained for small work

commitments. And by looking for niches—types of plays successful in the US which had not been tried onshore in western Europe—attractive prospects could be found, acquired and turned on favorable terms. But changes were necessary as well. "During the past ten years, I've learned and used a technology of which I knew absolutely nothing fifteen years ago," says Digger. That's what is known as capitalizing on change! Niche opportunities are harder to find now in Europe, as competition increases. Digger tells me he has new Gulf Coast plays in mind, as well as a follow-up program on an abandoned Roman gold mine in Europe. In one case, a return to Digger's exploration roots, but something completely different in the other. Flexibility, adjustment to change, capitalizing on new technologies, exploitation of the opportunities provided by change, resiliency and persistence continue to keep Digger happily involved in the exploration game. These necessary qualities have worked pretty well for this individual—they may work for you as well.

RECOMMENDED REFERENCES AND ACTIVITIES

As petroleum geology is now so varied, it is difficult to cite particular references. Hold on to your petroleum geology, sedimentation, structural geology and geophysics texts when you leave school. Join AAPG, AIPG and your local geological society. Participate in their activities. Build friendships with geologists outside of your company through these activities. Once you start to specialize, obtain the specialized references relevant to your specialty. Try to attend at least one short course per year if your employer so allows, and a regional or national geological convention. If your employer won't cooperate, consider doing them on your own. Read the Explorer and Oil & Gas Journal regularly. Stay informed, learn, innovate, stay flexible, grow! References? You will know what is needed when the time comes.

If you end-up working in the Gulf Coast salt dome province, a good basic reference on salt dome geology is:

Exploration and Exploitation of Coastal Salt Basin Diapiric Structures in the Lower Pliocene through Eocene Trends: Geology and Techniques. by Fails, O'Brien, and Hartman, Houston and New Orleans Geological Societies, 1995. Cost of a copy is $28.00 plus $5.00 shipping and handling (check payable to NOGS). To order a copy, contact:

NOGS Publications, NOGS
234 Loyola Bldg, Ste. 932
New Orleans, LA 70112-2016

GEOLOGISTS AS INDEPENDENT CONSULTANTS IN THE MINERALS INDUSTRY

Trevor R. Ellis, CPG-6740
Ellis International Services
2000

INTRODUCTION

Many geologists in the minerals industry have become independent consultants through necessity due to being laid off, or being confronted with unsatisfactory career paths within the corporate world. Some geologists may have actually had long-term plans to become independent consultants, but none of my colleagues in the minerals industry fit that category. Whichever way one gets to be an independent consultant, having the right personality, qualifications, and experience will make earning a living at it a lot easier.

In preparing this paper, I interviewed two other independent consulting geologist colleagues. Although I have expressed opinions, experiences, and perceptions of what the real world is like out there that are largely mine, they very closely match those of my colleagues. Those two geologists are responsible for proposing much of the structure and content of this paper. I will attempt to be blunt in putting forth my perceptions and suggestions, as I don't think being wishy-washy helps anybody. This is not sour grapes. I love my field of work.

The following is the career path which I propose to become a successful independent consulting geologist in today's minerals industry. It closely matches my own, which makes it easier to present. I have been an independent consultant since 1983, so I can claim to have been either a success or a survivor, which to my eyes in this field are the same thing. I began work as a contract international exploration geologist on graduating in 1970.

THE FIRST FIVE YEARS AFTER GRADUATION

Initially, I suggest getting five years of experience working internationally after graduation, in exploration and/or mine geology. This is the easiest time, as generally you don't have the ties to a home base that will probably come later.

Most international assignments that I see in exploration are three months on, one month off back home, with long hours of work expected. This is generous compared to what I had in my early years.

With regional exploration, it helps to be self reliant, self confident, a loner, willing to eat anything, able to put up with discomforts, and not mind risks. Learn vehicle and small motor repair and

maintenance. Learn first aid, survival skills, knots, climbing skills. No OSHA standards apply when you are working in a place like Papua New Guinea. You are often responsible for your and your crew's safety or even survival.

Develop a love of foreign cultures and enjoy learning a foreign language. You may end up living for months at a time, in camps and huts, with members of cultures, tribes, and religions you previously knew next to nothing about. I spent two field seasons living with my ten constantly changing native carriers in the jungles and mountains of Papua New Guinea. You have to be your own judge of whether this is something that you will enjoy. Many geologists find they cannot hack it. Women geologists may need to have their work environment structured somewhat differently than sleeping on the floor of a hut in the middle of 30 Indonesian Moslem men, as I sometimes did.

You must be able to accept the dangers of working in foreign countries, with strange diseases, driving on their roads, and possibly working with helicopters. These dangers are real, and can cost people their lives. On two exploration projects I worked on, covering 18 months in Indonesia, we lost four helicopters, killing six employees. Each accident had a lesser developed country factor as its primary cause. One disease, which physicians here have never heard of, had me within 24 hours of death from total kidney failure.

You need to develop a thick skin and be easy going when working for foreign management. They generally have different styles to the USA, can be much more blunt, and have a different level of temperament. Let things wash off you that you may not otherwise, and treat it all as a fun learning experience.

Think seriously about what you are going to do about romance in a foreign setting for months at a time. This is real life. You may even have a true love back home, which could make things more complicated.

LATER YEARS

In later years you will become either an expert in a specific field, or a generalist like me. Experts get paid higher rates, but can quickly end up delivering pizza when demands change. A generalist can quickly put on a different hat as demands shift. I have retreaded myself many times in my career as demand changes, generally in about three-year cycles. Sometimes it takes additional education.

As an independent, you can work as a contract geologist for project management, or as an independent "expert" for doing evaluations, giving independent geological reports, and providing expert witness testimony in legal disputes.

ATTRIBUTES OF A SUCCESSFUL INDEPENDENT

The personality and skills needed to be a successful independent consulting geologist are:

- A loner, self reliant, self confident, risk taker;
- Quick learner, self educator;
- Strong computer skills, some accounting ability;
- Willing to work long hours, helps to be able to go without sleep to meet deadlines; and
- Helps to have some marketing skills.

DISADVANTAGES OF BEING AN INDEPENDENT CONSULTANT

It can be a lonely existence working in the home office all day long, by yourself, or in that hotel room by yourself at night. Technical assistance is not readily available. To some extent you build a network of associates, but its not the same as having the expert down the hall at the corporate office.

Generally your annual income will be low compared to mid- and late-career corporate positions. In addition, you have to buy and supply everything—computer (maybe two or three), software, fax, communications services, office supplies, publications and reference books, and the business car.

Your income will be cyclical, "feast or famine" prevails in independent consulting. In a real sense, you are perpetually unemployed, looking for more work.

Keeping yourself employed may require long stints away from your spouse and children. These days, it may be in countries that speak other languages than ours, often with names we have difficulty pronouncing, let alone locating on a map.

You are responsible for your own continuing education, but likely can't afford the time or money for much. Rarely can you afford to travel to another city to acquire it, as the corporate geologists do. So, you have to rely more heavily on the literature. I find myself often using textbooks for bedtime reading.

You can't afford a benefits package equivalent to that typically provided for corporate positions—insurance and retirement plans. You definitely don't receive paid vacation. Liability insurance and insurance for errors and omissions can be a problem area for the independent geologist. If you are doing just straight geology, errors and omissions coverage can be affordable, but if you mix other subjects in there, such as environmental remediation, economics, computer programming, etc., I have found that the cost becomes prohibitive.

Since you can't afford to retire, you will die with your boots on (modified from Gordon "Bud" Presley).

ADVANTAGES OF INDEPENDENT CONSULTING

As an independent consultant, you are your own boss. Generally nobody, except for maybe your spouse, is keeping a close eye on you and your work. If you don't like who you are working for on your current project, you will soon be on a new project with new personalities. You generally get to choose your own hours of work. Night owls and very early risers love this aspect. To some extent you can even choose where in the world you want to work, turning down that assignment in the Philippines without getting your boss irate. Since you have geared your life style to lean and mean, a couple more months without pay while waiting for a new assignment doesn't phase you.

You get to work on many challenging, and sometimes adventurous assignments if you have the aptitude to take them on. You are exposed to much more diversity of projects than in the typical corporate environment.

You have flexibility around family life with your office in the home. I have worked this way since 1983 and find it a major attraction of my life style. Even if I am putting in a 20-hour work day, I am there for my children going to and coming from school, for the sick child, for meals with the family, and for reading the bedtime story (unless of course I am in the field).

Tax deductions are an important aspect of independent consulting. It is a two edged sword. You can deduct most things related to your work that you spend money on—the business computer and its software, and the gasoline for your company car. The IRS does not get much money out of me. But, tax deductions take time and mental energy to track, and the IRS audits me regularly.

THE IDEAL SITUATION FOR AN INDEPENDENT CONSULTANT

The ideal situation is to be independently wealthy and have a spouse who looks after your business. I regret that neither is true for me.

FINDING WORK

Your work will mainly come through your friends and associates—those who know you well enough to feel comfortable with you. As in independent consultant, you are perpetually unemployed, so you are always searching for a new job. Circulate at society meetings. Present an occasional paper about your current field or topic of work, so that your peers think of you as an expert in that niche.

You should make occasional cold phone calls or mailings to help broaden the reach of your continual job search. Limited paid advertising can help. I have found that occasionally surprising things come out of these methods. At the least you end up talking to some people outside of your regular circle, and at the most you may end up with a long term contract with a new client.

THREE BOOKS TO TAKE IN THE FIELD

- The Australasian Institute of Mining and Metallurgy's *Field Geologists' Manual*.
- A dictionary of geology
- A recent book on the geology of the commodity you are working on.

CONCLUSIONS

Independent geologists in the minerals industry generally lead a lean existence compared to their peers in the corporate world. The feast or famine cycle reigns in our environment. We are in a sense, perpetually unemployed, always searching for the next job. However, the rewards of variety of assignments, being your own boss, and to a large extent choosing your own day to day work schedule, are very important to those of us working as independents.

CAREERS AS GEOLOGISTS IN THE MINING BUSINESS

Gregory A. Hahn, CPG-7122
President
Summo Minerals Corporation
1996

INTRODUCTION

Pascal speculated that "had Cleopatra's nose been shorter the whole face of the world would have been changed" We need to recognize the crucial role of the accidental and trivial in determining the turning points in history, including our own.

EMPLOYMENT OPPORTUNITIES FOR GEOLOGISTS WITHIN THE MINING SECTOR

- Metals Mining
  - mine-level geology
  - exploration geology
  - head office geology
- Industrial Minerals
  - (same as above)

Additionally, both of these sectors offer opportunities domestically and internationally.

KNOWLEDGE: THE ROUTE TO EMPLOYMENT

In the mining industry you will be hired for what you know and the contribution that knowledge can make to the overall company effort. Your career will grow as you amass experience in many areas:

- geographic diversity (Nevada Great Basin, Northwest Forests);
- varied geologic environments (sediments, volcanics, intrusions);
- cultural diversity (foreign assignments, Spartan accommodations);
- language diversity (conversant, not fluent); and
- breadth of exposure (mine, exploration, engineering, environment).

ENTHUSIASM IS THE KEY TO A START IN THIS BUSINESS

What you are marketing is your enthusiasm, your drive to succeed and excel, and your determination to make an impact and a contribution. Your largest single asset is your youthfulness, and your seemingly endless reserve of energy which we desire to tap.

Success in this business is 90% perspiration and 10% inspiration.

A DESIRE TO TRAVEL OR WORK IN REMOTE AREAS IS REQUIRED

Mining geology, whether exploration or production, is frontier work. Work in the mining sector takes place primarily in remote areas, whether the work is domestic or international.

You should find personal pleasure in the great outdoors. This is where you will spend all of your time, whether during work or play.

WHAT SHOULD YOU KNOW TO GET STARTED

- Surveying: Can you run a gun? Turn an angle?
- Engineering: Do you know rock or soil mechanics? Mining terms? Do you understand equipment? Scheduling?
- Metallurgy: Have you had a class in it? It is helpful!
- Hydrology: Do you understand groundwater flow? Do you know simple tests or measurement procedures?
- Geochemistry: Do you know simple principles of chemistry?
- Geophysics: Have you had any experience with field equipment?
- Drafting/drawing: A neat presentation is worth a lot.
- Computers: Do you know spreadsheets? Databases? AUTOCAD?

OTHER SPECIAL SKILLS WHICH MAY HELP

- Presentation of an immaculate notebook from field camp.
- Presentation of a special project (field mapping or research).
- Special non-technical skills (I hired one summer geologist because his hobby was telling jokes).
- Willingness to work shifts (swing or nights on drills).
- Drilling: You will get to know drill rigs very well in this business.
- Flexibility: Be flexible! Your first job may not match with your goals or ambitions. Take it and do the best you can at it.

BUSINESS CYCLES

All commodities go through price cycles driven by the laws of supply and demand. When prices are high company revenues are up and companies have the cash to do additional exploration or development work. More people are hired. When prices are low company revenues are down and cash may be in short supply. This is when programs get cut, layoffs occur, or offices shut their doors. This is a normal part of any business; it is not unique to mining.

LARGE COMPANY VS. SMALL COMPANY

It is probable that most of you will get you start with larger companies. They have the need/ability to hire more people. You will be a small fish in a big pond.

Smaller companies generally do not hire recent graduates. In the smaller companies you will be hired for the experience and knowledge you gained with the larger companies. You will be a bigger fish in a smaller pond.

COMPENSATION

Larger companies generally pay slightly better than smaller companies. In smaller companies you will probably be granted stock options in the company, which allow you to purchase shares in the company at some time in the future but at a price fixed today.

ENJOY YOUR JOB!

Life is too short not to enjoy your job.

WHAT CAN YOU EXPECT TO DO

Metal Exploration:

- Sit a drill rig 10-12 hours per day 10-14 days straight and log the cuttings or core, to be analyzed later in detail.
- Generate cross-sections based on drill data.
- Sample outcrops, bag the samples, carry them around, and get them analyzed.
- Lay out sampling grids (surveying) and sample soils or conduct geophysics.
- Reconnaissance mapping and prospecting, including stream sediment sampling.
- Write monthly reports to your supervisor.
- Write annual reports on the project to which you are assigned.

- Attend regional and national conferences and read professional journals: keep up with advances in the business and sciences.
- Geologically map areas of interest at a variety of scales, depending upon the level of interest (1"=10 miles to 1"=10 ft.)
- Work with State and Federal agencies to obtain permits to explore.

Mine Geology

- Supervise blasthole drilling in pit or underground and sampling of drill cuttings (#20-ft spacing of drill holes)
- Map geology in pit or underground in detail (1"= 10-20 ft). Know the geology of your orebody better than anyone else in the world.
- Communicate this knowledge to the exploration geologists working for your company.
- Work closely with mining and blast engineers and possibly metallurgists to get them to understand and incorporate the geology of the deposit in their work. This may require geotechnical and mineralogical investigations on your part.
- Calculate ore and waste boundaries and prepare dig or muck maps for the engineers, shifters, and miners. Calculate ore reserves.
- Understand hydrology in the mine area and communicate this knowledge to management and engineers.

Pithy Comments Section

- Genius is seeing what everyone else has seen but thinking what nobody else has thought.
- When everything appears to be going wrong, question your most fundamental premises.
- Always consider the Principle of Least Astonishment: what is the simplest explanation for the observation or phenomenon. *[Editor' note, this is also known as Occam's Razor, "It is vain to do with more what can be done with less."]*
- Major new discoveries are usually found where nobody else is looking. (Recent examples: Voisey Bay Ni-Cu, NWT diamond fields, South Pacific islands gold deposits, Olympic Dam Cu-Au-U giant).
- When presented with the opportunity to chose between luck and intelligence choose luck every time.
- This is a democracy. You each get a vote. There are 90 of you. But I am the boss and I get 100 votes.
- Success in this business is 90% perspiration and 10% inspiration.

HIGH-TECH FOR GEOSCIENTISTS: A ROCK HAMMER AND NOTE PAD ARE NOT ENOUGH ANYMORE

Douglas C. Peters, CPG-8275
Peters Geosciences, Golden, CO

James A. Russell, CPG-7338
Summit Data Services, Golden, CO
2002

Geologists who work in industry will invariably learn new skills and expand their knowledge of other related professions. Knowing skills not normally associated with the geological profession enhances the individual's worth to current or potential employers.

The geosciences, particularly geography/cartography, geology, and geophysics, are increasingly using "high-tech" equipment and computer programs in order to better understand earth processes both on the surface and in the subsurface. Where those entering the profession do not already have backgrounds in such technology, employers are having to train employees on specific techniques or programs to be able to become the most productive they can be in their new setting. In some cases, hiring depends on potential employees already having a working knowledge or even proficiency in such technologies.

GEOGRAPHIC INFORMATION SYSTEMS (GISS)

Additional skills not normally taught in geology departments include the use of GIS. A "geographic information system" is generally defined to be a means of spatial data (anything that is referenced to one or more X,Y, and/or Z coordinates in space) analysis and referencing that is capable of both database functions and cartographic displays, typically interlinked so that changes in one data format are immediately reflected in the other.

Most GIS teaching programs, if a given college even has one, usually are run out of the Geography department, but can be found in diverse departments such as Forestry, Information Sciences, and Engineering. The most popular and widespread GIS programs in the geosciences at present (in 2002) are ArcGIS™ (product of Environmental Systems Research Institute) and MapInfo™ (a product of MapInfo Corp.). AutoCAD™ (product of AutoDesk) and related or similar CAD (computer aided drafting) programs are used by many companies for mapping and site data management, with or without additional database capabilities or software, but often do not have the same full functionality of true GIS programs.

GIS, with a seemingly ever-expanding base of applications, provides a means of analyzing and displaying field data to company managers, knowledge of land issues such as ownership and permitting, and potentially other skills specific to a company's business. These other skills may include knowledge of engineering economics or operations research techniques. Examples of how these various skills can come together are described by the following project.

A geologist who works for a company that specializes in industrial minerals was asked to develop and manage an exploration project in the southwest. This project required that the geologist and his staff examine every known source of data available to determine the potential for any deposits within a corridor between Phoenix, Arizona, and southern California. The most significant constraint on the project was the cost of transportation. Data that needed to be collected included all known geological map data, published or otherwise, exploration drill hole data from government agencies, water well records, and company generated geological data from past remote sensing projects. After thousands of man-hours of work, this data was brought together and analyzed first without the economic constraints imposed by management. Areas of geological potential were defined for further follow-up. Issues addressed included land ownership, distance from major highways, and other issues such as cost of road construction and beneficiation costs specific to certain deposits in areas of potential. The team needed a means of combining all of the geological data and taking into account the other constraints of the project.

A GIS was used to reduce the areas of interest based on the economic and engineering constraints. Areas removed from consideration included Wilderness Study Areas, State Park Lands, and other areas not available for development because of environmental or land use restrictions. A further sort of the remaining available areas of potential was done based upon transportation costs and other engineering factors. The remaining areas of potential were described in great detail to upper management through meetings and in reports that included the data in GIS format. The remaining areas were subjected to further field analysis and exploration drilling.

This project demonstrates that, while geological data can be fundamental to the success of a project, other seemingly unrelated data may need to be considered as well, and the best means of doing so may be through a GIS. A GIS allows sorting through and filtering data based upon these other constraints. Data from many sources can be combined in a clear and concise manner understandable by upper management. Knowledge of GIS techniques by a geologist is important in that it allows for a means of coherently describing collected data and presenting results in a logical and scientific manner to management.

Likewise, electronic data transfer and presentation, particularly within a GIS context, are becoming the preferred means of submission of project data to local, state, and federal regulatory agencies such as the Office of Surface Mining and the Environmental Protection Agency. The old method of maintaining and submitting multi-volume paper reports and stacks of paper maps for permit applications and other purposes is rapidly becoming obsolete and viewed poorly by agencies who prefer the lower cost and ease of electronic submission, filing, and records management.

State and federal geological surveys and oil & gas agencies are rapidly moving toward maintenance of their geologic maps, drilling information, and other spatial information in GIS formats. Many new and planned map-oriented publications of the U.S. Geological Survey (USGS), for example are being produced only on CD and generally with on-disk GIS capabilities for data viewing and manipulation. All new federally funded geologic mapping at 1:24,000 scale in the United States has been mandated to be produced either in both paper and digital (i.e., GIS) formats or just in digital format. The use of this technology as a data transfer and display tool quickly will reach the point where new strictly paper maps will be anomalies in an otherwise digital world.

Nonetheless, GIS is just a tool of the trade, and increasingly so. GIS as a field of study unto itself has given way to its broad use in many disciplines and by all types of users (private, academic, nonprofit, and government). Students are encouraged to gain classroom and, if possible, working knowledge of GIS technology and techniques as a means of broadening their opportunities for employment or further education. Not knowing GIS at all may not keep you from getting a job; knowing how to run a GIS program and analyze data with it could open jobs to you that otherwise would not be available.

REMOTE SENSING

Remote sensing is the study of the earth (or other planets) from a distance. Some geophysicists include traditional geophysics in this definition, but the great majority of geologists and remote sensing practitioners exclude geophysics. Remote sensing involves acquisition, analysis, and interpretation of information through aerial photography and numerous forms of airplane- and satellite-based sensors. These sensors range from photographic cameras manually operated by Space Shuttle and Space Station astronauts to hyperspectral devices that record gigabytes to terabytes of data over various parts of the electromagnetic spectrum and at various spatial ground resolutions. For example, the IKONOS satellite records information in four spectral bands in the visible and near-infrared range of the spectrum at 1-m ground resolution. The airborne AVIRIS (Advanced Visible-Infrared Imaging Spectrometer) sensor acquires information from the high ultraviolet through short-wave infrared range of the spectrum in 244 bands and at ground resolutions of from 20 m to 4 m.

Of particular note is that remote sensing directly provides data only on the Earth's surface! Any conclusions on the subsurface drawn from remote sensing data are either interpretations by an experienced practitioner or involve additional information, such as field studies, drilling, or geophysics, besides just the remote sensing.

The wide availability of remote sensing information really began with the concerted effort by the U.S. Department of Agriculture (USDA) and the USGS to develop a set of soil and topographic maps (respectively) for the country in the 1930s and 1940s. These were the first full sets of aerial photographs for the United States and have been added to by USDA, USGS, and numerous other agencies and companies for the past 60 years. Such photographic information provides an invaluable

pictorial and historical record that can be used for change analyses of various kinds and even determination of man-made environmental impacts for specific sites.

High-resolution satellite photography began in the early 1950s with the advent of spy satellites, such as the CORONA series. These early satellite data have now been declassified and can provide historical records for many areas of the earth outside the U.S. More recent intelligence satellites, with ever better spatial resolutions, remain classified and inaccessible without special security clearances.

The Landsat series of satellites, started in 1972, began the accessibility to global information by the general public. The first three satellites had ground resolutions of 80 m and collected data in the visible and near-infrared. These satellite data provided the ability to do general crop analyses, water body identification and monitoring, geological analysis for structures and coarsely defined mineralogy, and numerous other applications that were difficult to impossible when using only photographs, even if the view of the Earth was a bit fuzzy.

Ground resolution improved to 30 m with the Landsat 4 satellite, and the spectral range included the short-wave infrared and a even band in the thermal infrared (albeit at 120 m resolution). The expanded spectral capability meant that finally mineral assemblages, such as iron oxides, clays, and carbonates, could be detected. This was a major leap forward for mineral exploration worldwide and for geological mapping in general. The Landsat 4 and 5 data continue to be widely used by explorationists because of the global coverage, low cost (from the USGS), and well-understood image processing technology.

Following the later years of the Landsat program, and a change in government policies governing the allowable minimum spatial resolution for U.S. civilian satellites, remote sensing has somewhat diverged into the “better spatial detail” and “better spectral detail” camps. Several high-spatial resolution commercial satellites have been put into orbit or attempted because of the wide variety of potential uses for data with resolutions in the 1-m or less range. These applications have mainly been for military and other government purposes, such as change analysis or city mapping at lower cost than is possible with purely on-ground mapping. Such data also come at a much higher price than past Landsat data. Geologists have not generally embraced these high-quality spatial data both due to the cost compared to historical Landsat data and due to limited needs in geology for such high resolution.

The “better spectral detail” side of remote sensing has been of much greater interest to geologists because, with the advent of the AVIRIS hyperspectral sensor, we now can map individual minerals and ground chemistry! Such information has the potential to be terrifically useful for environmental, agricultural, and exploration analyses, to name a few applications. Airborne systems tend to be high cost for data acquisition, so there has been a push, primarily by NASA, to develop satellite hyperspectral sensors that ultimately would make high-quality, worldwide data affordable and more attractive for geological studies. A commercial company also attempted to orbit a hyperspectral satellite for dual civilian and military use, but that launch failed. The Hyperion sensor on the Terra

satellite is the current star in this progression of technology, although data from the sensor still are of limited coverage and availability. Nonetheless, the future is bright for an explosion of uses of hyperspectral data, in geology and elsewhere, if the coverage and cost issues can be addressed by an unrestricted satellite sensor.

The basic point of this discussion and brief historical review is that remote sensing data can be an important part of geoscience studies. The high-spatial resolution sensors and aerial photographs already are so much a part of many GIS databases, particularly for cities and land management agencies, that remote sensing is almost synonymous with GIS in some circles.

Students should take the opportunity, if available, to learn some of the basics of remote sensing data and technology, regardless of what department teaches the subject. Image processing is the computer technology side of the equation and learning some of it may be possible as part of remote sensing classes. At the graduate level, this technology can serve as a key part of investigations and mapping of a thesis area. Jobs specifically in remote sensing are not abundant, but knowledge of the technology and some experience in its use could make you an invaluable part of a team doing exploration or environmental investigations and can lead you in investigative directions that your peers might not even conceive of following.

GEOLOGICAL MODELING

The modern realm of computerized geological modeling generally involves a detailed understanding of how the software in question works and how to vary internal parameters and input data to produce the best and most useful result from the modeling. This means that much of the knowledge you may need is program specific and can only be gained through hands-on use of a particular package.

Most geological modeling that is widely available is geared toward sedimentary geology and petroleum exploration. These modeling packages also can be used for hydrological and environmental studies, although that can involve different software from the petroleum side of the field. Most of these petroleum-oriented packages also allow or involve input and modeling of geophysical data. This is a great aid in multi-disciplinary or team studies for evaluating oil and gas reservoir properties or better defining where and how to drill to best access petroleum accumulations, particularly in challenging structural or stratigraphic situations.

For the most part, companies will expect new employees to learn modeling skills on the job, unless you did modeling as part of graduate work. Those who have these skills in advance of the job hunt definitely will find they have an advantage over their competition and will move more quickly into the teams working on petroleum field assessment or development.

To date, there has been limited cross-over between modeling and GIS, although the ability to work with true 3-D data is an ongoing goal of the GIS software companies. Remote sensing may provide

an image backdrop for a geological model, and perhaps some input data for geologic structure and constraining the model at the surface.

ENGINEERING GEOLOGY AND ITS POTENTIAL FOR THE RECENT GRADUATE

John B. Ivey, CPG-896
Amuedo & Ivey, Inc.
2002

This paper is essentially an update of similar presentations given in 1996 and in 2000 for the first and second Student Day programs. These remarks are based primarily on personal experience in an industry career. Other professionals may perceive the potential referred to differently; however, I think that these remarks are still timely.

Herein the use of the masculine pronoun is generic and is inclusive of both masculine and feminine genders.

BACKGROUND

Engineering geology essentially is applied geology. The application of this branch of geology is primarily made to civil engineering worksalthough a number of other applications are made, particularly to geologic hazards. These include such activities as:

- Site studies (surface and underground)
  - power plants
  - damsites and reservoirs
  - industrial facilities
- Routing studies
  - power transmission lines
  - highways and access routes
  - railroads
  - tunnels
  - canals
  - pipelines
- Hydrologic studies
  - water supply
  - water disposal
  - liquid and solid waste disposal
- Materials exploration
  - natural and quarry aggregate
  - riprap
  - common earth fill
- Geologic hazards
  - landslides
  - avalanches
  - rockfall
  - mudflows
  - expansive rock and soil
  - radioactivity
  - seismicity.

A consideration of the above factors affects various aspects of industry and society, including:

- Agriculture
- Construction
- Government
- Mining
- Municipalities
- Oil and gas operations

Power generation
Real estate development
Transportation
Utilities
Water supply and disposal.

The engineering geologist determines the effects and limitations that geology can impose on construction, and conversely, the positive or adverse effects that construction might have on the geology. The usual routine is for engineering geology to be used first in pre-feasibility and feasibility studies, next in design studies, and, finally, in construction and maintenance. In this range of activities it is important to maintain accurate records including reports, maps, and other diagrams so that one's successors can refer to previous work as necessary.

As a profession, engineering geology usually appeals to one who is detail-oriented, although he should be well versed in the regional geology of the site he is investigating. In certain types of projects such as power transmission line, highway, and railroad routing; and in damsite/reservoir projects, the engineering geologist makes studies of a more regional nature, much as do the petroleum and mining exploration geologists.

There can be a considerable amount of overlap in the practice of engineering geology with other aspects of geology. This makes it important for the student to become familiar with other geologic subjects, and particularly with field geology.

HOW TO PREPARE FOR A CAREER IN ENGINEERING GEOLOGY

The best preparation for a career in engineering geology requires a diverse course of study in college. Because the engineering geologist finds himself working with sedimentary, igneous, and metamorphic rocks it is advisable to take those courses that define and describe these rocks and their weathered equivalents. It is also important to have a strong working knowledge of geomorphic principles since most of your work in engineering geology will be focused on the relatively shallow earth environment. Obviously the main emphasis in technical course work should be on geology. Fundamental engineering courses also should be part of the curriculum. They will enable one to better understand forces and processes active in the geologic environment.

Today, the best prepared students of engineering geology will have a well rounded academic experience that includes English, economics, math, chemistry, physics, and biology. Essentially the academically well-prepared engineering geologist will be conversant with all of the sciences. Above all, I would strongly suggest that the student take every opportunity reasonably available to get into the field and observe and study rocks of all kinds in their native habitat. Today, there is a great deal of emphasis in making computer applications for geology. This is a natural phenomenon, but one who aspires to become a geologist should never forget that geology is fundamentally the study of rocks.

In addition to the natural or technical sciences it is becoming increasingly important for scientists and engineers to have at least a basic understanding of business and accounting. Projects are money driven and budget controlled. An understanding of the budget process and its application to projects can be most useful to technical personnel. You will find that virtually everything you do as an engineering geologist is driven by economics and time.

Another important skill that should be sharpened is that of written and oral communication. The best ideas in the world will never come to fruition unless they are communicated to the right people at the right time and in the right place. Above all the engineering geologist will need to be able to communicate with the engineer, the constructor and the public. The engineer generally is most interested in those things which are expressed in formulas. The constructor wants nothing to do with anything that impedes the efficient use of his construction equipment. The public you will face in information meetings and in hearings may not have any, or at best, only limited geologic background. It will be up to the geologist to explain in whatever terms are best understood just what the importance of geology is to a particular project.

The day is coming, if it is not already here, that an advanced degree will be a necessary requirement of employment. If you have the time, and can afford it, seriously consider getting an advanced degree. You are already aware that it is common for scientists to acquire MBAs, law degrees, and engineering degrees after he has had a few years of work experience in his first specialty. It may not be necessary to get additional degrees, but there is good reason to be familiar with business subjects. Eventually almost every engineering geologist is going to be involved in the business world either directly or indirectly. Develop a sense of business!

One final word I would like to say about preparation for entering the profession is FLEXIBILITY. Be ready to accept changes from one project to another, from one part of the country to another, to other countries, and to the different attitudes expressed by different clients—and the list goes on.

WHEN AND HOW TO LOOK FOR A JOB

Today, most large- and medium-size engineering firms have staff geologists, whereas 35 years ago very few of these firms had any staff capability in geology. The need to have in-house expertise in geology has become increasingly important. In order to design, construct, and maintain projects of all sizes, it was found that having staff geological capability was more efficient than not having it.

It is well to start developing contacts with potential employers about the time you have decided to become an engineering geologist. Two primary methods of developing contacts are (1) attendance at professional meetings such as those of AIPG and AEG, and (2) part-time work during the school year and full-time work during the summer months with firms that practice engineering geology.

A good way in which to start one's professional life is to join the student chapter of AIPG if there is one at your school. Joining a student chapter and attending section meetings will provide an

opportunity to meet potential employers. Attendance at section meetings will demonstrate that you are interested in your professional development. Similarly, membership in a student chapter of AEG and attendance at meetings will indicate to the members of that organization that you are interested in the technical aspects of your profession. The contacts established in this manner will form the rudiments of a network that will increase in value with time. In establishing your network, you will automatically become part of others' networks.

Usually, in the latter part of your junior year, you will prepare a resume. This first professional mini-biography will serve as an introduction mainly to those whom you have not met. It also will be a reminder of your interests and background in geology for those whom you already know from professional contacts. Be candid in stating your capabilities; but do not glorify them. The people reading your resume will know that you have little or no practical experience. It is up to you to prepare a resume that will demonstrate a strong willingness to learn how to utilize your geologic knowledge to an employer's benefit. A willingness to apply oneself and learn practical applications of geology will largely offset a lack of experience in entry-level employment.

Indicate your willingness to learn and stress your ability as a team player. You are selling yourself; but in the beginning, without much experience. One of the most important things you have to sell is your willingness to learn from your employer in order to continually upgrade your abilities, thus increasing your worth to the organization.

During times of slack employment in any profession when one makes cold calls on potential employers, it may be difficult or impossible to get past the receptionist. There may be no assurance that your resume will get to the person with whom you want to meet. If you know or suspect that your resume did get to the right party, follow up with a telephone call and ask if you can furnish additional information. In a large organization your resume will probably end up in the human resources department (we used to call it the personnel department), or worse, it may never get beyond the receptionist's desk. How do you get around these problems?

Let's go back to attendance at professional meetings. You will have met people to whom you can direct your resume. You can ask for an appointment to discuss what steps that person can recommend for you to progress to the point he has. You can request an interview, or a meeting to solicit that person's advice on how to go about your job search. Don't be hesitant to seek the opportunity to just discuss the profession, without necessarily requesting a job interview. Basically, you would be asking for some mentoring.

So You Are Employed—How Do You Stay That Way?

In today's job market the outlook is not too bright either in either industry or government, but let's assume that you have found an entry-level job. There are certain attitudes or approaches to your work that should help you maintain that job. The burning desire to practice your chosen profession

has gotten you a job, now you have the opportunity for which you have been waiting. You want to become indispensable to your employer so consider the following.

Learn your employer's work system. It is likely that the procedures used by your employer are not precisely the same as you were taught in college. In order to fit in and be a productive member of your company's team, you may have to "un-learn" some of the procedures you learned in school. Your employer will be aware of this un-learning process and here is where you demonstrate some **flexibility**. It will be well to remember that your employer probably has experimented with most known methods of accomplishing the work for which he contracts. When you have become well established in your position you may find it appropriate to suggest changes, particularly if they will provide accurate results, and be more economic in their application.

Observe how others work—be a sponge. Learn by observation. Be a sponge and soak up all of the procedures you can. Ask questions and demonstrate a willingness to learn from others. I am not suggesting that you stand around all day and watch others do their work. That would not make a positive contribution to your job security. There should be, however, ample opportunity to see how others accomplish their work. Again, take every opportunity you have to get into the field and maintain your close association with the rocks.

Remember why you were hired. If you are hired by a consulting company there are certain fundamental reasons that you were chosen by the management of that firm. The usual train of reasoning essentially is:

- The company needed additional help which your employer thought you could provide;
- You could be hired at a salary level that would contribute to your employer's competitive position in its industry niche; and
- Your employer felt that you had potential to learn and would be willing to at least hire you on a provisional basis.

There are other possible reasons but these are the fundamental ones. If you are hired by an engineering firm or by a government agency, the same reasoning can be applied in the context of that organization's work environment.

How to stay on the payroll. It sounds trite, but the age-old advice to do the best you can is still valid today. In fact it is probably more important to follow this bit of wisdom now than at any other time in the history of our profession. As you work into the routine of your company you will sense if you are a valued employee. There will be raises in salary along with added responsibility. There will be increased benefits within whatever parameters your company has established. On the other hand if you sense that you and your work are not appreciated, then you probably will begin the process of finding another position. Most importantly, if you become dissatisfied with your company don't remain on the payroll and bad-mouth your employer. Your employer will find out if you are doing this, and then you won't need to resign—your employer likely will relieve you of that responsibility,

or at the very least will indicate that continued behavior of that type will provide the opportunity for you to either shape up or seek other employment.

Periodically ask yourself, "If I were the boss, would I keep me on the payroll?" This approach will require you to analyze how you are doing. One of the best talents you can develop is to objectively judge your worth to any endeavor, in this case your job. Along with this self-assessment, ask your employer what further you can do to enhance your value to the company and its clients.

Don't stop learning; make your own luck. You will hear a lot about luck—how lucky you are or how unlucky. Don't fall into the trap says that luck has and will continue to determine your professional life. Lee Trevino, the prominent golfer made a significant statement in this regard. When asked about the role luck played in his professional golfing career, particularly his putting, his answer was, "I find that the more I practice, the luckier I get." The sooner you get started in any endeavor, the sooner your luck will become apparent.

SUGGESTIONS TO HYDROGEOLOGY STUDENTS

Lawrence Cerrillo, CPG-2763
1996

The following comments and suggestions are one man's perspective on the joys and frustrations of being a practicing hydrogeologist. Any similarity to what your career will be is highly problematic.

EMPLOYMENT PROSPECTS

Realization is finally dawning on the general public, mining, oil and gas, food processing, forest products, and nearly any endeavor you can think of, that hydrogeology is important in their planning and operation. Opportunities are sure to increase as world population increases and the demands for water increases. **Do not** limit your interest to environmental issues only.

PREPARATION

In addition to a strong foundation in geology, you will need to have computer, language, writing, communication, and math skills. As a hydrogeologist you are expected to know geology, chemistry, and a myriad of other disciplines. Most important of all after the hard sciences are the writing and communications skills. **Take technical writing and speech courses if available.**

FINDING EMPLOYMENT

One of the oldest and fastest ways to become employed is by referral. Try to get summer employment with an entity that is doing hydrogeology or is doing something related to hydrogeology. Use your parents, friends of your parents, relatives, professors, and anyone you know as a potential source.

CAREER DEVELOPMENT

There are many aspects in any profession and hydrogeology is no exception. You can do more research, environmental, water supply, contamination, legal, or any combination of these and more. Unless absolutely sure, experiment. The best training while being paid is still with the Water Resources Division of the USGS. There are many good computer jockeys, but few well-trained individuals who know how to collect quality data to enter into the computer. The Survey typically provides this training.

Work for different companies, government agencies, industries, whatever for 2 to 3 years each before committing. Do not rush to become a project manager within 2 to 3 years of graduation, and even if offered, try to get a minimum of 3 to 5 years of field experience in a variety of geologic environments before committing to a desk job. Everyday in the field is a learning experience regardless of years of practice.

Try initially to join an environment that allows you an opportunity to learn while you earn. Be sure there are senior people around that you can learn from, and are willing to work with you. Ask your prospective employer to introduce you to the people with whom you are going to work. A good employer will do this without asking.

Keep on learning. Try to continue course work at night or through your place of employment. Ask for additional training opportunities, books, tapes, whatever interests you.

Get involved in technical and professional organizations that afford an opportunity for learning and networking. Learn what networking is and is not.

If after leaving this conference you still have questions, please call at 303-674-6484 and I will try to help. Good luck! Happy dowsing!

REFERENCES YOU HAVE TO HAVE

The contributors were asked to provide a short list of those books they considered essential in their geological practice, the books they use the most. As one contributor put it, "I paused before my bookshelf this afternoon and considered which books I actually touched the most frequently. There were lots of esoteric tomes that impressed me (and, hopefully, visitors to my office), but those on the above list were unquestionably the most worn." You will note that some of the suggested books are old. Publication dates do not indicate lesser worth with age. Some of the older books are particularly valuable, not because of their expositions on new techniques, but because of their excellent descriptions of how to do your job as a geologist. They are recommend because they are still useful. The suggested books arranged by specialty area. The concluding part of this list contains useful web addresses. Many of these sites will lead you to others. Bookmarking useful links is helpful but remember to keep a hard copy of the most useful links for those times when (a) your computer really crashes and burns, (b) you get a new computer, (c) you change software or web browser, or (d) you change schools, jobs, etc. Don't forget that as a student, you can usually received discounted prices on books published by geological societies. And as a member of the societies, you also receive discounts.

GENERAL GEOLOGY

A good Webster's dictionary; and ***use your spell checker! But*** the best spell checker in the world does not distinguish between *from* and *form*. There is no substitute for proof reading.

Glossary of Geology, R.L. Bates and J.A. Jackson, editors: American Geological Institute; you can even get it on CD-ROM. You should own at least one if not more geological dictionaries, and more important, **use them** for both definitions and spelling. However, these dictionaries have their limitations; you may need definitions from other sources (laws, regulations, technical articles, etc.)

Roget's Thesaurus

Suggestions to Authors of the Reports or the United States Geological Survey, 5 ed, 1958, U.S. Government Printing Office. This "old" edition is still the current style manual for the USGS. It has lots of good advice. What's even more fun is to discover the ways in which later editions fail to follow the advice of earlier editions of this classic work. Also, some standards are evolving.

A good style manual: the *Chicago Manual of Style* is the most thorough and it covers items most manuals don't. A more reasonably priced work is *The PC Is Not a Typewriter*. Many people can use word processors but the formatting conventions, which used to be taught in typing class (this was before keyboarding was even thought of and everything taught in typing class

is wrong on a computer), are seemingly not taught. A computer can put out great looking material, if you learn how somewhere. The missing subjects are layout and typesetting, which these books address.

Your text books in geology. Good texts are great references. Most geologic concepts don't change that much with time. Certainly there are times when you will want to update one's texts with newer editions, or more up-to-date presentations of the same topic. However, older texts may still be excellent. For example, Arthur Holmes' tome, *Physical Geology* (1965 edition), is a big heavy, book. It really was a bit much for "Rocks for Jocks." But it was the mandatory review book for many PhD comprehensive exams and is still a great reference for basic geology—Holmes was an early advocate of continental drift and has some historically interesting notes on that topic published before the plate tectonics "revolution." If you can find a copy in a used book store, get it.

Handbook of Mineralogy, Dana; or other, comprehensive mineralogy books.

A good field geology text; Lahey and Compton are the old standbys. The Australasian Institute of Mining and Metallurgy publishes a recent and interesting variation, *Field Geology*, which contains lots of useful tables.

Geological Ethics and Professional Practices, 1987-1997, 1998, David M. Abbott, Jr., ed.: American Institute of Professional Geologists, Arvada, CO, 202 p. Professional ethics is not a topic regularly taught in school yet can be critical to one's career. This book provides a good introduction to the subject and contains discussions of topics whose answers are not always clear.

Introduction to geological analysis, A.R.H. Swan & M. Sandilands, 1995: Blackwell Science, Ltd.446 p. We all use statistics, but should remember to do it correctly.

Statistical Evaluations in Exploration for Mineral Deposits, F. W. Weller, 1998, Springer, 379p.; a good summary of statistical techniques applied to geology.

Geographic Information Systems for Geoscientists: Modeling with GIS, G. F. Bonham-Carter, 1994, Pergamon. 398p.

ENGINEERING/ENVIRONMENTAL GEOLOGY

Virtually every specialty in engineering geology has what would be referred to as "classic" publications. These are far too numerous to list here, but two general works of importance are:

Earth manual, Anonymous, 1974 (reprinted 1980): U.S. Bureau of Reclamation.

Principles of Engineering Geology and Geotechnics, Krynine, D.P., and Judd, W.R., 1957.

Applied Hydrogeology, Fetter, C.W., 1994: Prentice-Hall. If you used this book in Hydro keep it. If you have not taken a Hydrogeology class take one.

Onsite Wastewater Disposal, Perkins, R.J., 1990: Lewis Publishers. Everything you need to know about percolation testing and septic systems.

Description and Sampling of Contaminated Soils, Boulding, J. R., 1994: Lewis Publishers. A good field guide for soil sampling and description.

Soil Water and Ground Water Sampling, Wilson, N., 1995: Lewis Publishers.

Environmental Evaluations for Real Estate Transactions, Gross, F., 1991: Government Institutes, Inc. There are dozens of books on the subject of performing Environmental Site Assessments (ESA). Working on a ESA may be one of the first jobs you will be assigned to when going into the environmental field. Having a good knowledge of what an ESA is and how to perform one will help you land a job.

Local information on the area you are doing most of your work in: USGS maps, state maps, other governmental agencies, local geological societies, etc.

Soil Surveys, U.S. Department of Agriculture, Soil Conservation Service. These are prepared by county and are a wealth of information, not to mention free to the public.

The Environmental Geochemistry of Mineral Deposits: Part A—Processes, Techniques, and Health Issues, G.S. Plumlee & M.J. Logsdon, eds., and *Part B—Case Studies and Research Topics*, L.H. Filipek & G.S. Plumlee, eds., 1999: of Economic Geologists Reviews in Economic Geology v. 6, 583 p. (total; sold only as a set).

GEOCHEMISTRY

Geochemistry in mineral exploration, 2nd ed., Rose, A.W., Hawkes, H.E., and Webb, J.S., 1970: Academic Press, 675 p.

Introduction to exploration geochemistry, 2nd ed., Levinson, A.A., 1980: Applied Publications, 924 p.

Proceedings of exploration '97, Gubins, A.G., ed., 1997: Fourth decennial international conference on mineral exploration, geophysics and geochemistry of the millenium: Prospectors and Developers Association of Canada (Toronto), 1068 p.

MINING GEOLOGY

Mining Geology, H.E. McKinstry, 1948, Prentice-Hall. If you can find a copy, buy it! It tells you what you need to do to be a mining geologist. Some of the specific methods are out of date, but the basic philosophy is not. This is a readable book as well.

Exploration and Mining Geology, William C. Peters, 2d Ed., 1987, John Wiley & Sons. An updated version of McKinstry. Get this book along with McKinstry.

Introduction to Mineral Exploration, A.M. Evans, ed., 1995: Blackwell Science Ltd., 396 p., updated methods on exploration from McKinstry and Peters.

SME Mining Engineering Handbook, 2d Ed., 1992, Society for Mining, Metallurgy & Exploration. All sorts of useful tables and discussions on all phases of mining. Now available on CD-ROM.

Industrial Rocks and Minerals, 6th Ed. 1994: Society for Mining, Metallurgy, and Exploration; if you do anything with these very important, though often overlooked commodities, you need the current edition of this book.

Dana's Textbook of Mineralogy, 4th Ed., (1932), John Wiley and Sons. Everything is rooted in mineral composition, and you can't know them all.

Introduction to Geochemistry, 3rd ed., Konrad K. Krauskopf and Dennis K. Bird, 1995, McGraw-Hill Inc.. What to do with Dana's data when you find it.

Groundwater, R. Allan Freeze and John A. Cherry, 1979, Prentice-Hall Inc. Water in mining is almost as important as ore and waste.

Economic Evaluation and Investment Decision Methods, Franklin J. Stermole and John M. Stermole, 1987, Investment Evaluations Corporation. One of the best references for determining whether your mineral deposit is or isn't ore.

PETROLEUM GEOLOGY

A good petroleum geology text. Some are more chemically oriented, some more geological; all aspects are needed. Remember that development geology is as important as exploration; the first well is only the beginning of most fields and historic recovery of in-place hydrocarbons has been pretty poor (often less than 50%). Extracting additional reserves from old fields is adding an increasingly significant percentage of added reserves. And petroleum engineers don't often care for the geologic details which are crucial to these

efforts. Reservoirs are not homogeneous, isotropic tabular bodies (the assumption required to mathematically prove exponential decline).

Petroleum Engineering Handbook, Society of Petroleum Engineers, 1987.

Introduction to Exploration Economics, R.E. Megill, 1971 (and updated editions), Petroleum Publishing Company. Necessary basic economic knowledge for explorationists, even beginners. Things you need to know even though not geological.

Decision Analysis for Petroleum Exploration, Paul Newendorp, 1975, Petroleum Publishing Company. A broader, more detailed, and sophisticated discussion of exploration-related economic analysis than Megill. Start with Megill for the basics, but you may need Newendorp if you advance into management.

GIS AND REMOTE SENSING

GIS and environmental modeling: Progress and research issues, Goodchild, M.F., L.T. Steyaert, B.O. Parks, C. Johnson, D. Maidment, M. Crane, and S. Glendinning, eds., 1996, Fort Collins, Colorado, GIS World, Inc., 486 p.

Remote sensing for site characterization, Kuehn, F., T. King, B. Hoerig, and D. Peters, eds., 2000,: Berlin, Springer, Methods in Environmental Geology, 211 p.

*Remote sensing principles and interpretation (3rd Ed.)*Sabins, Floyd F., 1997,: New York, W.H. Freeman and Co., 494 p.

Map projections—A working manual, Snyder, John P., 1987, U.S. Geological Survey, Professional Paper 1395, 383 p.

Using imaging spectroscopy to map acidic mine waste, Swayze, G.A., K.S. Smith, R.N. Clark, S.J. Sutley, R.M. Pearson, J.S. Vance, P.L. Hageman, P.H. Briggs, A.L. Meier, M.J. Singleton, and S. Roth, 2000, Environmental Science & Technology, v. 34, no. 1, p. 47-54.

The Airborne Visible/Infrared Imaging Spectrometer (AVIRIS),Vane, G., et al., 1993,: Remote Sensing of Environment, 44, 127-143.

Airborne remote sensing for geology and the environment--Present and future, Watson, K., and D.H. Knepper, eds., 1994, U.S. Geological Survey Bulletin 1926, 43 p.

CAREER STORIES

The following books are not references. They are included because they describe what its like being a geologist, at least during a particular period and within a particular specialty. They are included to provide a background, a flavor to answer the question, "What's it like to be a geologist?". A description of each book is included.

Basin and Range, In Suspect Terrain, Rising from the Plains, and *Assembling California*, John McPhee. These four books comprise McPhee's *Annals of a Former World* and contain reflections on the geology, geologists, and the history of geology as a science and profession. McPhee's writing skills and clarity of presentation made him the obvious recipient AAPG's first Journalism award honoring those who write about geology for the general public. AIPG honored McPhee in 1997 with its Outstanding Achievement Award for his geologic writing.

Free Gold, the story of Canadian mining, Arnold Hoffman, 1947, Associated Book Service, New York. Stories of the various kinds of colorful characters involved in prospecting, developing, and financing exploration. The same types exist today in the mining and oil businesses.

Mountains of Ore and Rivers of Gold; stories of a contemporary prospector, M.A. Kaufman, 1992, Dos Vulturos Company, P.O. Box 14336, Spokane, WA 99214, 509-924-7710. Kaufman's career biography in which he distinguishes prospectors from corporate mining geologists and professors.

Trek of the Oil Finders, E.W. Owen, 1975, American Association of Petroleum Geologists.

Oil on Their Shoes—petroleum geology to 1918, E.S. Blakey, 1985, American Association of Petroleum Geologists. *To the Waters and the Wild—petroleum geology, 1918-1941*, E.S. Blakey, 1991, American Association of Petroleum Geologists. Read at least one of the foregoing to learn just how much modern petroleum geologists owe to our predecessors.

Digging Dinosaurs, John R. Horner and James Gorman, 1988, Workman Publishing Co., New York. This book not only tells the story of Horner's discovery of baby dinosaurs, it contains a fair amount of information on the life of a professional vertebrate paleontologist. It is also a wonderful illustration of how to present a great deal of science in very simple language.

The Greatest Gamblers, Ruth Sheldon Knowles, 1959, McGraw-Hill. Entrepreneurship, science, greed, courage, risk, vision, and a number of colorful personalities all play a role in the founding of the U.S. oil industry. Wildcaters, scientists, prospectors, hunch players, and gamblers all experience success and failure. Possibly the best book on the subject; highly recommended.

Spindletop, J.A. Clark and M.T. Halbouty, 1952, Gulf Publishing Company. Not really about geologists, but a tale of greed, guts, and fortitude in the birth of the Gulf Coast industry.

Tensleep, *A Fall in Denver*, *Mother Earth*, *Only Flesh and Bones*, *Bone Hunter*, *An Eye for Gold*, and *Fault Line* by Sarah Andrews, murder mysteries whose heroine, Em Hansen, started in the oil patch and whose career takes several turns as the series progresses; read for fun. The author, Sarah Andrews, is a geologist and knows what she's writing about. These books also provide and interesting look at various professional ethics situations with more explanation than most case histories provide regarding the motivations of the various parties involved.

The Exploration of the Colorado River and Its Canyons, J.W. Powell, 1895 (reprinted 1961 by Dover Publications Inc.)

The Journals of Lewis and Clark, Bernard DeVoto, ed., 1953, Houghton Mifflin Company.

Roughing It, Mark Twain, 1872, in the Unabridged Mark Twain II, Laurence Teacher, ed.,1979, Running Press.

Angle of Repose, Wallace Stegner, 1971, Faucett Crest Books

Mountaineering in the Sierra Nevada, Clarence King, 1872 (reprinted 1970 by University of Nebraska Press). Informational interviews with professional geoscientists.

The Big Score: Robert Friedland, Inco, and the Voisey's Bay Hustle, J. McNish,, 1998, Doubleday

Hemlo: Inside Canada's New Gold Rush, M. Hart, 1985, Douglas and McIntyre.176p.

Fire into Ice and the Great Diamond Hunt, V. Frolick, 1999, Raincoast Books. 354p. The story of Chuck Fipke, Diamet, and diamonds exploration in the Northwest Territories.

WEB SITE ADDRESSES OF INTEREST

American Association of Petroleum Geologists: *www.aapg.org*

American Geological Institute: *www.agiweb.org (includes career information and job listings)*

American Geophysical Union: *www.agu.org*

American Institute of Professional Geologists: *www.aipg.org*

Arizona Hydrological Society: *www.hgcinc.com/ahs-symposium98*

Arizona Geological Society: *www.state.az.us/gs/ags/index.htm*

Arizona Geological Survey: *www.state.az.us/gs/index.htm*

Association of Engineering Geologists: *aegweb.org*

Association of Exploration Geochemists: *www.aeg.org*

ASTM: *www.astm.org*

Colorado Geological Survey: *www.dnr.state.co.us/geosurvey*

EPA's Compliance Sector Guides: *http://www.env-sol.com/solutions/EPA-SEC.html*

Geological Society of America: *www.geosociety.org*

Groundwater Remediation Technologies Analysis Center: *www.gwrtac.org*

International Standards Organization: *www.ios.ch/welcome*

International Union of Geological Sciences: *www.iugs.org*

National Academy of Sciences: *www.nas.edu*

National Groundwater Association: *www.h2o-ngwa.org*

National Park Service: *www.nps.gov*

Society of Economic Geologists: *www.mines.utah.edu/~wmgg/SEG.html*

Society for Mining, Metallurgy, and Exploration (SME): *www.smenet.org*

Underground Tank Technology Update: *http://epdwww.engr.wisc.edu/uttu/*

U.S. Geological Survey: *www.usgs.gov*

U.S. Fish and Wildlife Service: *www.fws.gov*