GEOLOGICAL SOCIETY OF AMERICA

PRESIDENTIAL ADDRESS
and
MEDALS AND AWARDS
FOR 1993

1993
PRESIDENTIAL ADDRESS
by
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It is quite an honor for me to have served as your president for the past year. One benefit that the president receives is the short time to indulge the group assembled, at the Presidential Address and Awards Ceremony at the Annual Meeting, with some of his or her ideas, prejudices, and recommendations about anything he or she wishes, all without the benefits and constraints of peer review, but keeping in mind that the purpose of that assembly is primarily to honor that year's medalists. This process occurs every year as the GSA president becomes past president and the vice president becomes president—a kind of transition week. In the words of Larry Sloss, the transition marks the change "from lame duck to dead duck." This forum and transition also serve to relieve the Society of the need to attach disclaimers to the published version of the Presidential Address. To avoid any suspense, I should mention here that this address is intended to build on the theme of the address last year by President E-an Zen on the "Citizen Geologist" (Zen, 1993), and will include several related issues that I consider important.

There probably has been no other time in the history of the Geological Society of America when there have been greater changes that have affected both the Society and all of geological science. Changes occurred during the early history of the Society as petroleum exploration and production became the dominant employer of geoscientists. Other changes have taken place during the 1930s, in times of economic hardship and in the 1960s, when GSA headquarters moved from New York to Boulder (1967). Each placed a different kind of burden on the GSA.

ROLE AND FUTURE OF GSA

The stated purposes of GSA are to advance our science, the scientific growth and development of its members, and the application of geology to the wise use of planet Earth. Three basic roles of the Society can be broadly defined: communication and transfer of information, increased access through member participation and Society outreach, and greater facility through the first two. These roles have remained unaltered through the continuity of Annual and Section meetings, Penrose Conferences, Division activities, support for research, and publications. GSA has steadfastly maintained commitments to these roles, and broadened them into several new initiatives in education, greater public outreach, and addressing environmental problems. A new wing to the headquarters building in Boulder will be dedicated this spring. It is being constructed to provide more space for existing programs—e.g., publications, GSA Foundation, and meetings—and space for new programs.

Today the traditional roles of scientific societies, state and federal surveys, geology departments, and many earth science–related industries are being challenged and debated. Much of the challenge is derived from a major change in emphasis in both perceived needs in training and the real opportunities for employment. As a result, the roles of each will probably evolve, and each of us as geoscience professionals can influence this change by participating—or not—in the processes driving this evolution. I will discuss some of these changes, ask each of us to reexamine the past history of our profession and try, if possible, to map out a strategy for the future. Note that I have not said try to predict our future path, because most of us recall only too well the boom years of the early 1980s in the petroleum industry that were immediately followed by the bust years of the middle and late 1980s, followed by additional, in their terms, "downsizing" of companies and "outsourcing" of many of the traditionally internal means the industry has had of acquiring certain kinds of information, such as paleontological and geophysical data. A by-product of this process is the potential loss of much of the geologic and geophysical data that have been archived for many years, but no longer used, by the petroleum companies. This too was an economic, not a scientific, decision. An effort is underway through the American Geological Institute, sponsored by the U.S. Department of Energy, to recover as much of these data as possible and to create a repository to make the data available for general use by the scientific community and the public.

GEOSCIENTISTS AND THE LIFE-SUPPORT SYSTEM

We live on part of a planet where the life-supporting environment and, consequently, almost all life is restricted to a few kilometers of the surface. As earth scientists we should be able to appreciate this as well as, if not better than, anyone who inhabits the planet. Several issues that have a direct bearing on our daily lives also are quite ably addressed by geoscientists.

Environmental Factors

Is Global Warming Real? There is no question that temperatures have been increasing for the past two centuries. We have also documented the marked increase in CO_2, ozone, chlorinated fluorocarbons, and other gases in the atmosphere. We do not yet know if some natural or anthropogenic event, or events, will change this trend.

Resource Depletion. For both the present and past, we can show that the problem of nonrenewable resources is more one of distribution than of shortage. This will change to real shortages as more underdeveloped countries become consumers.

Fossil Fuel–Related Atmospheric Degradation. Atmospheric degradation by burning fossil fuels has been documented many times over. If we seek alternative forms of energy, as the Clinton Administration advocates—e.g., electric cars—what power source will be used? Solar? Wind? Nuclear?

Poisoning the Environment. We are adding poisons to the environment in the form of organic and inorganic compounds, metals, and radionuclides. In addition, we are having to deal with monotonically increasing volumes of municipal waste—solid, liquid, and gaseous. We are only now learning about the extent and nature of ground- and surface-water contamination, and we are faced with the task of deciding whether cleanup is both wise and cost effective, or if the problems can be mitigated by isolation of the contaminated areas. For example, the only way to totally clean up a ground-water resource involving dense (or light) nonaqueous phase liquids (DNAPLS or LNAPLS) in a fractured reservoir might be to mine out the contaminated zone, a clearly impractical and most costly solution, but it may be relatively easy to isolate the contaminated zone so that it is prohibited from moving with the uncontaminated ground water or independent of it.

Waste Disposal vs. Environmental and Political Considerations

Solutions to many of the problems related to waste disposal and environmental degradation have, unfortunately, for a number of reasons become political issues that prevent our technical capabilities from being utilized. Best known are the seemingly endless problems with siting radioactive waste repositories. We could have had a major repository today in Kansas, and possibly others elsewhere, if the U.S. Atomic Energy Commission in the 1960s had agreed to pay the state a small fee for each canister of waste brought for storage and had agreed to choose an alternative site in Kansas (the site originally chosen, in Permian salt, was in an area of extensive drilling for hydrocarbon exploration and production). The federal government refused and, in the ensuing years, we have spent (probably wasted) billions of dollars making decisions and then reversing them about sites because of public outcry, summarized in the acronyms NIMBY, not in my back yard, and NIMTO, not in my term of office. We cannot even agree on a site for temporary storage of high-level power plant and other nuclear waste (Multiple Retrievable Storage, MRS), so today we have a number of temporary de facto MRS facilities at every nuclear power plant in the United States, and this remains our present, albeit not the best, solution to the storage problem.

Changes in the "traditional" areas of employment of geoscientists—from the petroleum industry, government surveys, academia, and the mining industry to environmental, engineering, and water resources—have justifiably caused many academic departments to reexamine their roles in educating future professionals. Paralleling these changes has been a greater public awareness of continued worldwide environmental degradation and depletion of many resources that, left unchecked, portend a mid–21st century world that may not permit today's developed-country living standards for any of Earth's inhabitants. Moreover, considering the present reality that the developed countries (mainly the U.S.) consume 75% of the world's energy and a proportionally large amount of the world's raw-material production, we in the developed countries must learn to live with less, and more efficiently. Population increases in the underdeveloped world inhibit these countries from achieving U.S., Canadian, and Western European living standards, a goal obviously unattainable for the entire world with the present technology.

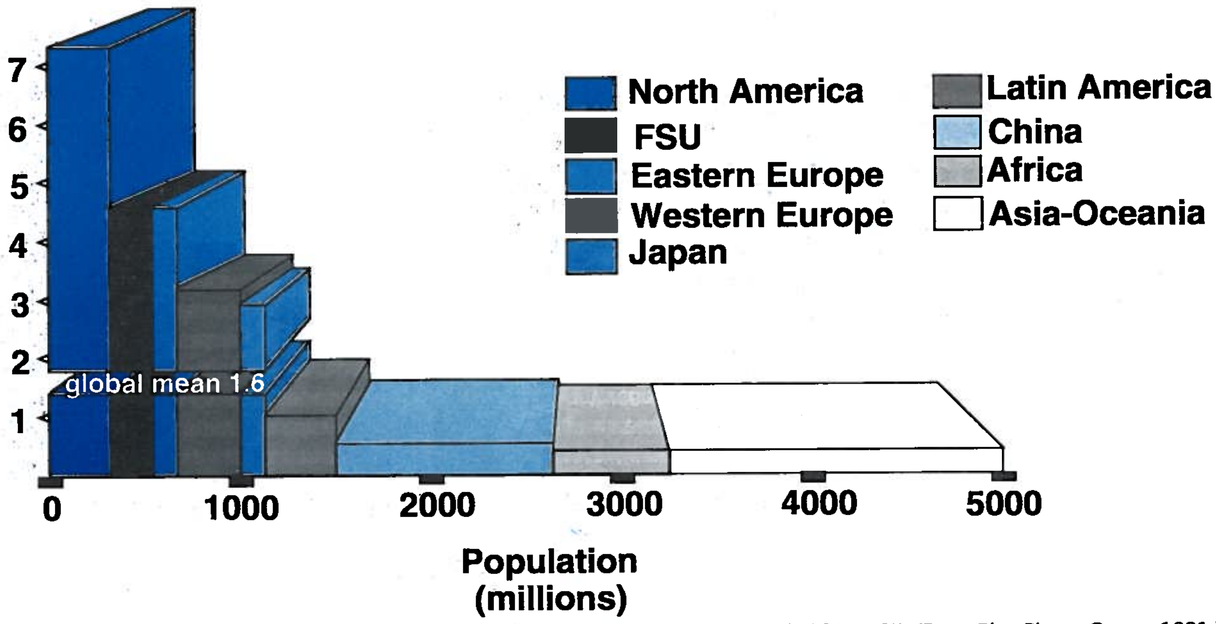
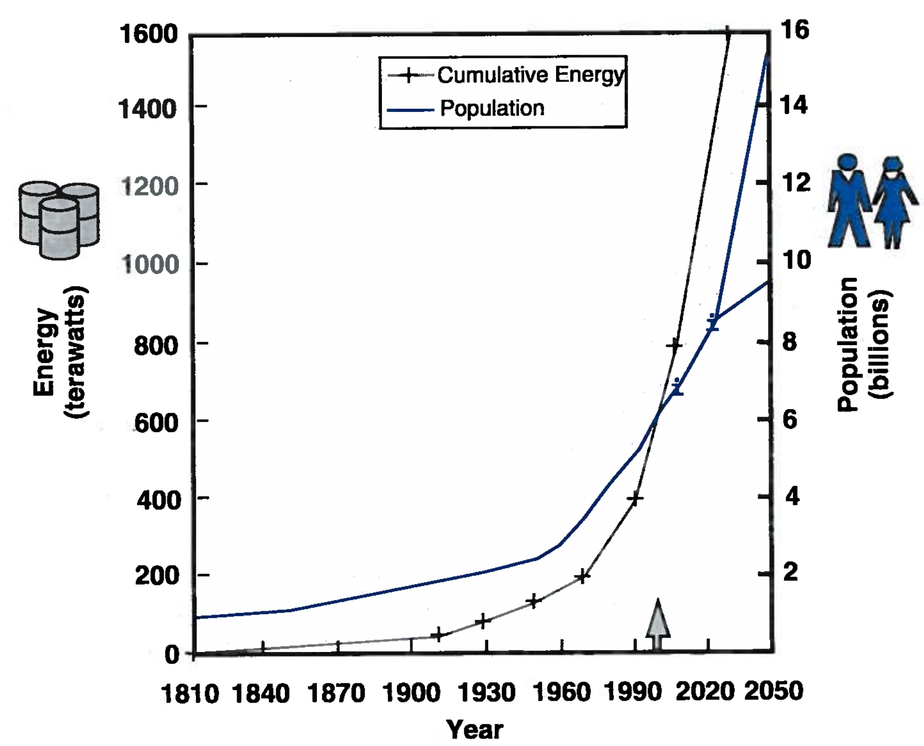


Figure 1. Per capita energy consumption (in kilowatt years) vs. population, compiled for 1987. (From Blue Planet Group, 1991.)

Realities

Easily identified problems exist that, if they are permitted to continue unsolved, will produce untold damage to the life-support system on Earth, if they have not already. The developed countries, particularly the U.S. and western Europe, are responsible for consumption of most of the energy and raw materials produced in the world today (Fig. 1). Underdeveloped countries that produce most of the raw materials we consume are commonly identified with unchecked population growth. We need to recognize that unchecked consumption of energy and raw materials is at least as detrimental to the environment as unchecked population growth. A useful exercise to demonstrate this would be to consider consequences and impact on energy and other resources of providing a uniform high living standard, like that enjoyed at present in Sweden, for the 2 billion population of China! Carrying the analogy another step forward, if we now have problems with 5.4 billion people on Earth, this planet cannot support 10 or 20 billion, as projected for the first half of the 21st century. The analogy is also easily applied to the consequences of continued sustainable development in the developed countries in the context of resource availability, utilization, and consumption (Paty, 1993). Possible consequences, both short- and long-term, include markedly decreased quality of life for all inhabitants of the developed countries and few improvements for inhabitants of underdeveloped countries. Both geoscience professionals and the public must recognize that man is a geologic agent capable, through our activities, of permanently altering the life-support system of the Earth and that we have been in the process of doing so for some time. An outstanding example of this lies in the pressure for real-estate development along the U.S. eastern seaboard that has resulted in attempts to influence the natural dynamic system by engineering that does not recognize the variables in the entire system. Unfortunately, increased demands by an expanding population, coupled with unchecked resource consumption, and unwise development (real estate, energy, mining) that envisions only short-term gain without consideration of long-term environmental damage will ultimately prove disastrous for a much larger area than that originally affected by the development.

Figure 2. Population increase and energy consumption vs. time. (From Blue Planet Group, 1991.)



Obvious solutions include decreased consumption of goods and energy, decreased economic growth to a steady state in the developed countries, and better means of checking population growth in all countries (Fig. 2). New nonpolluting energy sources would help, but it may take another half century for sources like fusion energy to be in widespread use. Geoscientists have an opportunity—really an obligation—to play a greater role in the solution of these problems. We have already become important participants in solving water resources, waste remediation and disposal, natural hazards, and other environmental problems, in addition to our traditional applied roles in mineral and energy resources, but we can and should do more.

Recall the systems analysis approach by a group called the Club of Rome to the world problems of population growth, environmental degradation (pollution), food supply, resource depletion, industrial output, and life expectancy portrayed in the curves that resulted in the 1972 book, *Limits to Growth* (Meadows et al., 1972). These curves (Fig. 3), plotted without bias by a computer, mostly portrayed a world that offered little hope for survival of life as we know it today in the developed countries, but they also assumed in one model that by the 1990s we would have already depleted many of our metallic resources (Cu, Au, Ag, Sn, and Zn), along with hydrocarbons. More recent scenarios summarized by Hayes (1993) employ essentially the same approach, change the variables slightly to reflect less drastic rates of change, and take into account more positive indications that resources may last somewhat longer, that the effects of pollution on agricultural yields worldwide may not be as severe initially, and other variables that reflect industrial productivity (e.g., goods and services, availability of labor, multiple new technologies). Even so, the newer models are not much changed from the originals (Fig. 4), because they still require that consumption of energy and other resources and population growth must still be sharply curtailed for survival of the life-support system on Earth. If similar models were computed employing the same variables, but computed separately for the dominantly consuming developed countries and the dominantly producing underdeveloped countries, and then compared with the world models, we would perhaps be better prepared to make recommendations for the survival of future generations.

COLLEGE AND UNIVERSITY EDUCATION OF GEOSCIENTISTS

Traditional geological education has provided a basic education in geology, with minimal training in the allied sciences, in order to meet the needs of the mining and petroleum industries, and government surveys. Present and future training of geologists and other geoscientists must continue to provide a broad base of geoscience education, along with increased skills in allied sciences, mathematics, and engineering.

Geoscientists are perhaps the best qualified of all scientists to address and solve complex multidisciplinary environmental problems because of our strong tradition of training scientists in the ability to focus on large and complex problems, and achieve viable solutions with incomplete data sets. Today's education of qualified geoscientists must, because of the nature of what we are and what we do, follow a path different from that followed by the other sciences. This is because, unlike other scientists, we must gain in-depth skills in several allied sciences and engineering. The spectrum extends from the mathematician who only needs to know mathematics to a biologist who needs to know biology, chemistry, and, more commonly today, like geologists, physics and mathematics. There also has been in the other sciences a greater tendency toward specialization (and overspecialization!) in recent years, perhaps to avoid the additional effort needed for multidisciplinary diversification; for example, in many graduate programs, a Ph.D. student in organic or inorganic chemistry can minor in physical, analytical, or another chemistry subdiscipline. Ironically, geoscientists, by virtue of the very complex and inaccessible nature of earth processes, require knowledge of the other sciences and engineering more than any other discipline. Partly because of this, many of us see both the need and the opportunity to become more broadly educated than ever before at all levels because of the greater emphasis on multidisciplinary—particularly environmental—problems and the means to solve them.

The strong suit of geoscience has traditionally been in the diversity of the education we receive and in the almost unique ability to assimilate and solve complex problems with minimal amounts of data. We have been severely chastised—more likely misunderstood—by other scientists for not addressing all of our problems quantitatively and deductively, but this element of the training of geologists and the practice of our profession may be our greatest strength and should not be abandoned. For example, with the increased emphasis on laboratory training, more and more "geologists" cannot critically evaluate geologic maps, the most quantitative basic data sets in our science, although most make use of them for sample collection and other purposes.

The following quote from the recent article in *Geotimes* by AGI President and 1992 Campbell medalist Donald C. Haney stated the problem quite well:

> Colleges and universities must critically examine their roles in educating future earth scientists.... If geology is to survive, it must become interdisciplinary, as well as provide the type of training that is sorely needed by our society. If not, geology will become a service area for other disciplines that have the vision needed for the 21st century. (Haney, 1993).

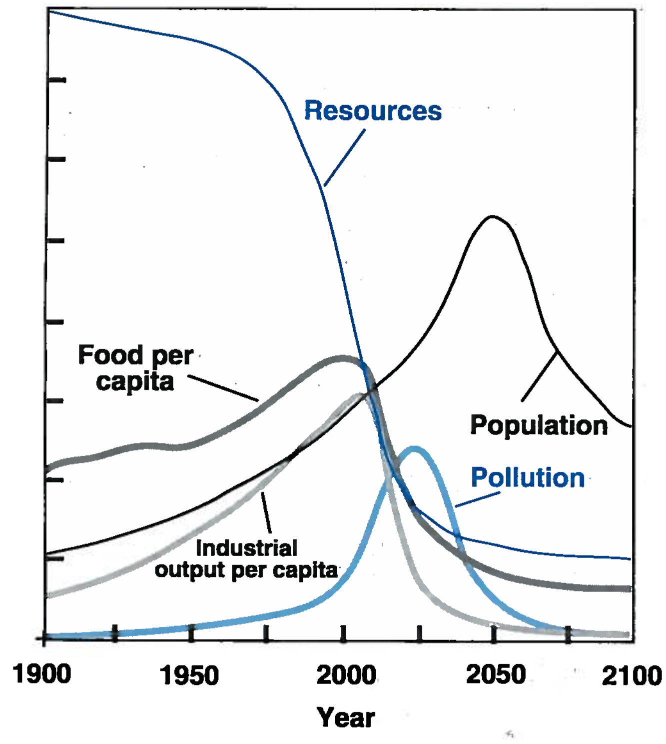


Figure 3. World standard model system. Food supplies, population, and industrial output undergo exponential growth until resources are depleted and industrial production is curtailed. Both population and pollution continue to increase for a time after resource depletion occurs, but the population decreases soon because of diminished food supply and other factors, such as decreased medical services. (From Meadows et al., 1972.)

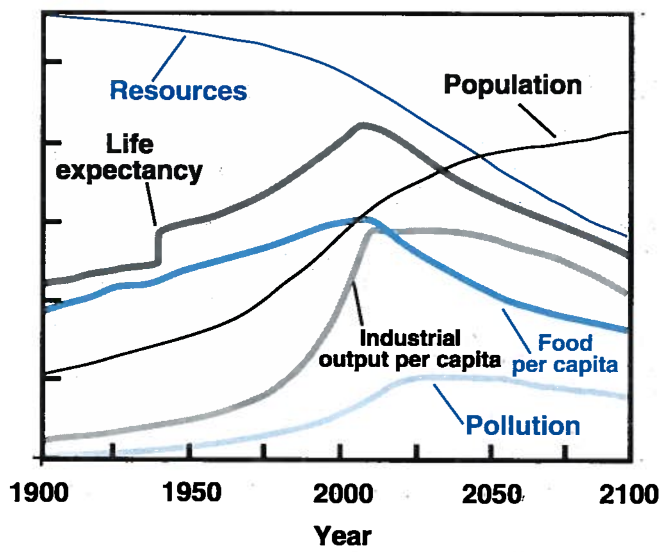


Figure 4. Model, based on increased spending, that predicts greater stability by 2100 despite steadily diminishing resources. (From Hayes [1993], and D. H. Meadows et al. [1992].)

The university in the 21st century *should not change* its primary role of producing educated people—training minds to think. Universities, colleges, and geoscience programs *should change* to reward quality teaching, revamp introductory geology courses (do students really need to memorize 30 minerals and 25 rocks?), and encourage faculty to engage in true scholarly research—not just yield to administrative pressures to generate grant money and overhead. There should be greater early involvement of undergraduate majors in research, basic and applied. Enlightened college and university administrators should respect the three essential elements of a college or university—students, faculty, and a library; lessen their dependence on grant overhead; and increase involvement of faculties in management of universities—employ less "command and control" and more "interactive" management—thereby decreasing micromanagement of faculties; this interactive management philosophy is being adopted by more and more forward-looking corporations.

Should Geological Science Programs be Accredited?

Accreditation of the professional degree in geoscience has the advantage of establishing a quality baseline for programs that will facilitate national comparisons, providing better recognition for existing high-quality programs, and gaining additional options and possible leverage for geoscience programs that are restricted administratively, and a means to upgrade others. Flexibility must be considered a cornerstone of any accreditation program, so that departments that have established excellence in geoscience education should find such an accreditation program a means of achieving additional recognition. Such an accreditation program must contain enough flexibility to permit the programs that have for decades been recognized for turning out high-quality graduates to qualify, and yet have criteria that will enable aspiring programs to be identified and modified to attain accreditation. Although some baccalaureate degree–granting geoscience programs enjoy considerable success in placing their graduates in professional careers, most geologists consider the M.S. to be the entry-level professional degree. Accreditation of professional degree programs regardless of whether they are baccalaureate or M.S. programs may be the best means to approach the problem. Focus on the professional degree in the accreditation process thus adds a dimension to the process that may be unique to the geosciences.

Many of us recognize that geology programs in a number of colleges and universities are restricted by internal requirements that make the baccalaureate geology degree much less rigorous than that in corresponding programs in chemistry, physics, and engineering. While most baccalaureate programs probably do a good job with the basic geology courses (mineralogy, petrology, structural geology, stratigraphy, and paleontology), broad variability exists among individual programs in the requirements for field courses, senior research, and elective courses. The same amount of variability no doubt exists among graduate departments. A major problem with baccalaureate geoscience curricula may be that undergraduates have no latitude to take more than the usual one year of calculus—few enter graduate school with any background in intermediate calculus, differential equations, or linear algebra—and gain greater depth in another of the allied sciences, engineering, a foreign language, economics, or other subjects. A few programs have solved the problem by offering both a B.A. and a B.S. degree, the latter being earmarked as a professional degree. Unfortunately, a number of colleges and universities will *not* permit geology departments to offer two baccalaureate degrees in geology, but *do* permit the chemists this opportunity because of their accreditation program through the American Chemical Society.

The American Institute of Professional Geologists (AIPG) has established an evaluation program for geology departments, but it is intended to stop short of an accreditation review. The focus of their program is on preparation of geologists for professional engineering geology and environmental geology careers, although it is easily adapted to a more general focus. The evaluation consists of a two-day site visit, for which the expenses are borne by the program being evaluated. The course standards considered in the evaluation involve those formulated by the AIPG curriculum committee (American Institute of Professional Geologists, 1991). The results of these evaluations have had a very constructive impact on all of the departments that have requested evaluations, particularly where problems have been identified that can be resolved with minor increased support from the administration. Other programs meeting all criteria have found that the evaluation becomes a "feather in the cap" of the program. Once the evaluation criteria are met, a certificate is issued to the department by AIPG. Some modification of the AIPG recommended curriculum and evaluation program could form the basis for an accreditation program in the geosciences.

RECOMMENDATIONS

Public Involvement

More and more, geoscientists, like other scientists, have been relegated the role of providers of information to the so-called "decision policy makers." This is at least partly because of the common perception that scientists are hopelessly focused on the gathering of data, laboratory experiments, and solving esoteric or narrow applied problems. It is clearly easier for most of us to function only in the realm of pure or applied research, present the results of our research at professional meetings and in journals, or solve applied problems and write reports for our employers. Health professionals have probably done the best job in educating the public and Congress of the importance of their discipline. Physicists and engineers have probably done the next best job of communicating to the public the importance of what they do. Geoscientists have probably done the worst job.

Particularly because of the strong interdisciplinary education of geoscientists, we should play a greater rather than a lesser role in decision and policy making, and we also must make a greater effort to educate the public on the everyday importance of geologic processes and materials, as well as the justification for geoscientists to function in the policy arena. We must become part of the decision-making process in the policy arena, not just providers of data. Education of the public in how Earth is put together and why we think so, and how this affects our everyday lives, is very important—in resources, environmental quality, and siting and construction of everything from houses and highways to dams and nuclear power plants—not just when a natural disaster occurs.

Responsibilities

Our responsibilities as professional geoscientists include: (1) training geoscientists who are literate both in geology and the allied sciences and who have the ability to address complex problems—we should not produce overspecialized technicians; (2) working toward achieving equality with the other sciences; (3) attaining a level of importance of geoscience with the public; and (4) greater direct involvement in the decision-making processes related to environmental issues, and resource planning and management.

Is Our Past the Key to Our Future?

We can identify the problems in light of our past and readily see that our future will not be uniformitarian; we, as geoscientists, may never have a better opportunity than from now through the next decade to make our case and become part of the solution. The opportunities are also here to gain an equal or greater footing with the other sciences and engineering in addressing environmental problems, with the public, and in the decision- and policy-making arena. I recommend the following:

1. Maintain strong university programs in basic geoscience, but broaden them to include emphasis in multidisciplinary and applied disciplines.
2. Become more involved in convincing the public of the everyday importance of our science.
3. Work to become an integral part of the policy- and decision-making process on environmental, engineering, and resources issues.

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