How Much Geology is Relevant to an Eighteen Year Old Voter?*

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A New Political Reality

The Constitution of the United States has been amended for the twenty-sixth time. This time it was a simple procedural modification providing that the minimum voting age in federal elections shall be 18 years of age instead of 21. On August 26, 1920, a similar procedural Amendment, the Nineteenth, gave women the right to vote. We have lived with women's suffrage for more than fifty years but now our political system faces a new challenge — the young voter. Scarcely having completed high school, or even a high school dropout, the young voter has been given what may become a decisive role in our political process. What manner of being are these new political persons?

Young voters who have never faced the gnawing hunger that requires children to do the work of adults in order to survive.

Young voters who do not remember what working conditions were like before the mighty collective bargaining efforts of Organized Labor met success during the Thirties.

Young voters who do not remember a time without social welfare legislation, aid to dependent children, old age assistance, home relief and emergency relief, workmen's compensation insurance benefits for those injured or killed on the job; or disability benefits for total disability not related to the job; or unemployment insurance compensation for those without jobs; or social security for widows, orphans, the aged, and the handicapped.

Young voters who do not regularly read scholarly journals, literary magazines, or even the in-depth reports in major newspapers. In some cases, young voters who do not read anything at all other than road signs, record album covers, and the occasional titles flashing across the motion picture and TV screen.

Young voters who are held in the school system until at least their sixteenth birthday, and young voters who have generally spent more time in the classroom than many of the older voters of today; yet young voters who are the product of an educational system in which many of the teachers, particularly in the elementary and secondary schools, are ill-prepared to cope with the modern science and mathematics on which major political, social and economic decisions must be based if this country is to survive.

Or we may meet young voters who are capable of leading this generation into a new era in which the many recent advances in basic science will be made relevant to social problems. Young voters who will insist that this nation tap the enormous but tragically underutilized reserve of scientific, engineering, business and industrial talent long buried in the pigeon holes of government bureaucracy or lost in some corporate organization maze, to meet the very real environmental crisis facing most of the world's metropolitan communities.

Young voters who will assume responsibilities that are now, unfortunately, scattered among federal and state agencies, universities, business corporations and industrial associations — a diffusion of leadership and dilution of initiative which cannot possibly meet the timetable imposed upon mankind by the reality of our environmental, energy, and social crises.

Young voters who can bring together the human and technological resources of these disparate communities and mount a concerted effort to restore and maintain our beneficent environment.

How Much is Enough?

These young voters will be asked to cast an informed ballot on many issues involving the Earth upon which we live, the seas from which we all may have come, the air we all must breathe and the fresh water we need to drink. While we all know that an informed ballot can only be cast by an informed voter, we have yet to face the real issue: How much Earth Science must an 18 year old voter know in order to cast an informed ballot on such issues as offshore oil and gas exploration, underground nuclear testing, nuclear or fossil fuel electric power generation, mining methods, weather modification, land use planning, water resource management, mineral exploitation, and the countless other politically sensitive, emotionally charged issues of any election year?

Just how much of the vast reservoir of information encompassed within the general intellectual discipline

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question of why they are important enough to be included. Loosely connected and poorly organized subject matter becomes glaringly apparent before the student ever comes in contact with it. The instructor not only writes the initial program, but he also must check it for mistakes and programming errors after it has been put in the computer. Some instructors advocate asking students to perform this step — debugging. For beginning students with no background in geology, this practice may prove to be frustrating and not at all wise.

The author of CAI finds himself forced into the student's position because he must anticipate possible student answers to questions he designs. He must try to analyze how the student is likely to think and how the student will assemble information he has been given previously in the program. Of course, this exercise in empathy is not always successful, but the very act of trying to think like the student impresses on the instructor the need for a new effort for clarity of presentation and quizzing. The exercise is likely to move the author-instructor to more knowledge of and concern for the student's problems in learning. These concerns overlap from CAI into the organization of his entire course.

Note: The authors would like to correspond with other people developing CAI materials in geology. If we can be of any help in your efforts to begin a program of CAI, please write to us at: Department of Geological Sciences, The University of Texas at Austin, Austin, Texas 78712.

SOUTHWESTERN SECTION

The annual meeting of the Southwestern Section was held at Flagstaff, Arizona, May 6, 1974, in conjunction with the regional meeting of the Geological Society of America. Presiding was Richard C. Peterson, President.

Best Earth Science Teacher Awards were announced for Arizona (Elden Walters, Phoenix), Colorado (Alan B. Swanson, Littleton), New Mexico (Bonnie Briscoe, Roswell), Utah (R. Allan Davis, Orem). Elden Walters was the Sectional winner.

Emphasis was placed on strengthening and revitalizing the Section. The ideas discussed included subsectioning the organization to obtain more local participation, an especial problem in so large a territory. Revising the Bylaws was also considered. These and other suggestions are to be investigated in conjunction with developments under way on the national level.

New officers as follows were elected, the new terms of all officers to become effective November 1, 1974: President, J. Dale Nations, Flagstaff; First vice-president, Wolfgang E. Elston, Albuquerque; Second vice-president, L. Cameron Mosher, Tucson.

Frank O. Bowman
Secretary

we now call Geology or Earth Science is really relevant to the 18 year old voter next November?

If you, the geologists, don't know now, you had better find out. Quickly!

You can no longer say, "Wait until the 18 year old goes to college". Too much time has already been spent designing one year survey courses in Geology or Earth Science for bored liberal arts students who need a year of science to graduate and can't stand the sight of blood, the smells of chemistry, or who can't add, subtract, multiply, divide, integrate or differentiate well enough to take any of the other science courses offered. It is time to determine just what information about Geology or Earth Science is needed by the 18 year old voter and then develop a program to teach *that* information during the first eight years of school, during which time there is some hope of making a meaningful educational impact. College survey courses are too little and too late.

Among other information, the 18 year old voter needs a clear understanding of the natural processes that affect the area in which he lives. The 18 year old voter needs a way to determine the impact of *any proposed development* upon the *regional ecological system* of which it will become an element, together with his family and friends and the entire human community. The 18 year old voter needs a sound basic understanding of the planning process in a systems sense in order to evaluate the conflicting demands upon particular elements of the regional ecological system of which that individual is an element.

Politics, Pollution and Education

This is a difficult task. I know that and certainly all of you who are reading this know that. Problems arise when politics enters the academic world, as it has, and when politics dictates the course of technological development, as it has, and when the people are excluded from these specialized political processes, as they have been.

Remember DDT? Think about the biopolitics of DDT for a moment. For years, agricultural chemical manufacturers financed the field research of the Agricultural Departments at Land Grant Colleges, and the United States Department of Agriculture unquestioningly accepted the results of this Agribusiness-supported research, distributing it in the form of mandates or suggestions to the working farmer. In the case of DDT, the united front presented by all of the elements of this closed system first successfully ignored, then ruthlessly suppressed, suggestions for reasonably limiting the use of broad-spectrum, persistent pesticides, and requests for rigorous investigation of the long term, environmental effects of such toxic substances on non-target organisms.

Until 1966, when a concerned woman in New York mounted the first legal attack on the widespread use of DDT for mosquito control in estuarine areas, bringing her action in the name of all the people, not only of this generation, but of those generations yet unborn, the public had never been permitted to participate in any of the decision-making processes which had resulted in the widespread contamination of the biosphere with DDE, the principal environmental metabolite of DDT.[1]

The Energy "crisis" found many sincere and well-meaning public officials unable to evaluate the conflicting claims of special interest groups each ably represented by "experts".[2]

Land, Natural Resources and Popular Sovereignty

Land and the natural resources it contains represent the fundamental capital assets of civilization.

In the United States, all the powers with respect to land and natural resources once held by the Kings of England, France or Spain are now held by the sovereign People of the United States, collectively, and exercised, by permission of the People, by the Executive, Legislative and Judicial branches of the federal government and the governments of the several states. In the United States, government acts as the agent or trustee of the power of the People, for the benefit of all the People.

> "The enumeration in Constitution, of certain rights, shall not be construed to deny or disparage others retained by the people." *United States Constitution, Ninth Amendment.*
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> "The powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved to the States respectively, or to the people." *United States Constitution, Tenth Amendment.*

Under the Constitution, the rights of individual property owners were strengthened, but at no time did the sovereign People of the United States relinquish their collective right to determine the highest and best use of land and natural resources. Neither did the people of the individual states relinquish their collective right to provide for the common good within each state and insist, on behalf of all the people, not only of this generation, but of those generations yet unborn, that land be used according to its intrinsic suitability as an element of the regional ecological system within which it forms the substrate for development.

If we are to live in harmony with that which has been left for us by preceding generations to use wisely, we must make certain assumptions with respect to all land and consumable natural resources:

> . . . Development of land and consumption of natural resources to some extent is inevitable.
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> . . . We must accommodate land use and natural resource consumption to the extent necessary to advance those aspects of civilization that nurture the development and evolution of those uniquely human characteristics which transcend the mere biological heritage of mankind.
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> . . . Land use and resource consumption must be limited by the natural constraints imposed by natural processes.
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> . . . Planned growth toward the highest and best use of land and natural resources is more profitable to the human community in any regional ecological system than unplanned growth.
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> . . . The *police power of the state,* the ultimate *sovereignty of the people* and traditional *private property rights* are

compatible concepts which can mutually provide for the beneficial development of land and the wise use of natural resources.

The key to successful land use legislation is determination of the highest and best use of land and natural resources in terms of intrinsic suitability and natural constraints. At the same time procedural due process must be assured by legislatively establishing administrative criteria to evaluate *use* in terms of objective data. The *Information Matrix for Environmental Impact Assessment* developed by Luna B. Leopold, Frank E. Clarke, Bruce B. Hanshaw, and James R. Balsley of the United States Geological Survey[3] is a fine example of such criteria.

Today, determination of the highest and best use of particular elements of a regional ecological system must be done by teams of individuals trained in the various disciplines necessary to define the elements of, and processes operating throughout, such a System. The human community itself, particularly its people, constitutes an element of any regional ecological system just as surely as does the land and landscape.

Scholars, People and Communication

The adequate determination of the highest and best use of the land and natural resources in a regional ecological system mandates a systems approach supported by modern computer science. It also requires sophisticated communication among scholars from diverse disciplines and the people. The public rejection of the much touted *"Brandywine Plan"* in Pennsylvania is a classic example of communications failure setting the stage for potential regional catastrophe and community disaster.

> "The message that the Brandywine experiment should hold for all is that, (while) . . . We have managed to learn a great deal about the physical planning process we often do not know as much about the human needs of the people for whom we are planning. Much has been written about sociology, social psychology, communications, public relations, psychology, anthropology, soul and sympatico — yet planners and environmental scientists have not linked arms with gifted observers of other backgrounds."[4]

Geoscience Education

Representative government in this country was founded on the principle that the people, if properly informed, can determine a wise course of action for their time through their elected representatives. This principle is based on the fundamental belief that the human intellect can discern truth, in a relative or pragmatic sense, on a case by case, situation by situation, basis in real time provided that there is sufficient information available, and provided, of course, that enough people are sufficiently interested to consider the matter at all.

Unfortunately, where Geology or Earth Science is concerned, there is little information or interest. What information is available is not in a form readily comprehensible to elected officials, much less to young voters. And what is even more disturbing is that there is little interest in matters relating to the Earth Sciences in general, and geology in particular, among elected officials, 18 year old voters, or citizens of any other age group.

Of course we can not ignore the current interest in energy and minerals mined from the earth but we should be concerned with the apparently inexorable evolution of citizen attitude that ignores scientific data and scientific methods because of the failure of scientists to make such matters seem relevant.

In order to consider relevance, we must look at the concerns of today's 18 year old voter.

The future of any 18 year old man contains limited choices. He can finish High School or drop out. In either case the next choice is among employment, military service or further schooling.

The future of any 18 year old woman is equally limited. She can finish High School or drop out. In either case the next choice is among employment, military service, marriage (as a state of dependency) or further schooling.

There is, however, a substantial probability that these 18 year olds will be concerned with their home community. Whether that community is a suburb or an urban neighborhood, generally the 18 year old's only direct exposure to the political process will have been local elections. And it is at just this level of local government that environment and the political process most often meet. Land use decisions are constantly forced upon ill-prepared local legislatures, while ill-informed citizens, fast-buck developers, and misguided purveyors of progress destroy natural resources as if there will be no tomorrow. Estuaries are dredged, marshes are filled, cesspools are drained into public water supplies, the topsoil of prime agricultural land is stripped away for sale as suburban lawns, and houses are planted on fertile Class I and Class II soils. Occasionally citizens rise up and say No! Following the age old practice of those frustrated by lack of knowledge and lack of power:

When in trouble or in doubt, run in circles, scream and shout!

A Unique College Experience

In the fall of 1970, a unique College opened in New England and an exciting experiment in higher education began. Absent were the many traditional departments of the liberal arts college. Replacing them were three schools: Natural Science, Social Science, Humanities and The Arts. Other established colleges and universities in the vicinity provided additional academic support. The new College was located in a lovely River Valley — a River of History and the setting for some of the most significant environmental controversies of this decade. Plans called for many dams, nuclear and fossil-fueled electric power generating facilities and much industrial development, as well as the constant extension of suburban sprawl. In one proposal, the River Valley was to provide the needed sanitary landfill sites for the garbage of a major city more than 100 miles away.

For the better part of a day in 1970, the students considered the problems of the valley and the entire

planning process in general, preparing to assert, in Court if necessary, that the people of the River Valley, not only of this generation, but of those generations yet unborn, had an absolute right to demand that development of the valley proceed in accordance with a comprehensive regional plan. This plan should embody modern concepts of environmental systems science and the people had the absolute right to insist upon determination of the highest and best use of the available natural resources, the land and landscape as elements of the regional ecological system.

The Syllabus and the Renaissance Man

Out of this discussion came the outline for a course in planning, actually a course in the planning process, suitable for high school or the introductory college level and including the minimum essential information necessary for an individual to intelligently evaluate any development proposal involving the land, landscape and natural resources of a region [5].

1. Resources—Natural, Human
   What constitutes a resource? How are resources measured? To whom do resources belong, if anyone? Preserve resources? Protect resources? Consume resources? Utilize resources?
2. General Systems Concepts—The elements of General Systems Science.
3. Models and Modeling—Conceptual Models and Predictive Models.
4. The Lithosphere—Environmental Geology.
5. The Hydrosphere—Water and nature; water and man.
6. The Atmosphere
7. The Biosphere
8. The Psychosphere—The interaction between man and nature which results from the acts of man as a rational animal.
9. Contamination—Pollution—Enrichment.
   One man's waste is another man's fertilizer . . . raw materials . . . job . . . How much is too much?
10. The Regional Ecological System as a set of regional ecological systems.
11. The methods and mathematics of General Systems Science.
12. Energy
13. Perturbations in environmental systems.
14. Environment and the Law—Environmental Legislation.
15. Environment and the Law—Equity Litigation
16. Environment and the Law—Adminstrative Proceedings
17. Land: The fundamental capital asset of civilization.
18. Planning: A communications Process
19. Regional Planning
20. Home Rule or Home Ruin?

While I cannot tell you how much of such a course would be considered within the traditional academic areas of geology, or biology, or chemistry, or sociology, or mathematics, or physics, or political science, or any other discipline, I can tell you that it will be necessary to teach such a course in some multidisciplinary fashion, so that the student emerges with a synthesis of the specialized knowledge of the teachers and never again is bothered by the traditional limitations of departmentalized academic inquiry. The time has come to revive the Renaissance Man, that noble intellect who believed that all knowledge can be learned. The time has come to instill in our young people the desire to seek the unifying principles of science, and reverse that trend in modern higher education which encourages the learning of more and more about less and less. Specialized knowledge is certainly valuable, but it must be related to the general concerns of man and his world and should be acquired as experience. This coming generation of voters must be generalists drawing together the specialized knowledge accumulated during the last fifty years of scientific inquiry and establishing a new Humanism. In any challenge to land use or resource exploitation today in the courts, you must demonstrate that in some respect the proposed action will cause serious, permanent and irreparable damage to the land, landscape or natural resources involved as elements of the regional ecological system. This means, in practice, that you must present the substance of this proposed two semester course in a matter of hours to a concerned but uninformed judge, just as was done in the *Project Rulison* litigation in 1969 [6], or more recently in the federal court challenge to all the zoning laws of Suffolk County, New York on the grounds that they are ecologically unsophisticated, environmentally irresponsible, socially irrelevant, politically naive, and incidentally do not reflect modern concepts in environmental systems science.

Restructuring Curriculum

Again considering environmental education from the pragmatic position of trying to maintain a representative system of government, it should be obvious that what has been outlined is the core curriculum in Natural Science and Social Science that must be mastered by every young man and woman before they enter the voting booth at 18 years of age. Because of the structure of this core curriculum and its ready application to matters of local concern anywhere in the country, it can be presented generally in conceptual form during the primary grades, with the emphasis on observation, classification and description of resources and environmental processes.

In the middle elementary grades the emphasis can begin to shift from general description and qualitative observation to quantification. Mathematical concepts should be introduced at this early age so that general habits of mathematical thought and the presentation of information based on observation in a mathematical form becomes a natural part of the educational process.

In the Intermediate School or the Junior High School, the student can be introduced to the general academic disciplines involved in the planning process: Earth Sciences, Life Sciences, Social Sciences and

Physical Sciences together with their common language, mathematics. There should be some specific involvement in matters of local concern in support of the high school program.

During the first two years of high school the student should take the formal course as outlined concentrating specifically on some matter of local concern such as a river, a stream, a pond, an estuary, an industrial operation or whatever concerns the students and their community. The Junior High or Intermediate School students would be involved in gathering data and preparing resource inventories.

Conclusions

The time has come for the scientific community itself to restructure the educational curriculum in environmental science.

If it cannot be done in the public school systems — for whatever reason — it must be done in the private schools and in the parochial schools. If it cannot be done immediately at the elementary school level, it must be done as soon as possible in the High Schools. There is certainly no excuse for not doing it immediately at the freshman level in every junior college, college and university in this country. If necessary let the traditional Departments of Geology be the first to try.

Unfortunately, I am only a country lawyer. I am not a college professor, much less the head of a department. I am not a public school superintendant or even a principal. It is up to you to do the job yourselves. I wish you well.

May God bless each of you, and may God help all of us.

REFERENCES

1. The peak of public frenzy over the continued use of DDT probably occurred during the 1969 hearings before Hon. Maurice Van Susteren, Chief Hearing Examiner for the Wisconsin Department of Natural Resources. For an interesting popular account of those hearings see: Henkin, H., M.J. Merta, J. Staples, *The Environment, The Establishment and The Law* (Houghton Mifflin, Boston, 1970).

2. See: *The Energy Crisis: Danger and Opportunity,* Victor John Yannacone, jr., editor, in particular Chapter 2, M. King Hubbert, "Energy Resources," Chapter 3, "Fossil Fuels Are Not Just For Burning," Chapter 4, "How Shall We Generate Electricity? Criteria For Public Choice," Chapter 4, Victor P. Bond, "Fuels For Power: Costs, Benefits, and Risks in Perspective," Chapter 9, Roland W. Comstock, "Energy Crisis: Fact or Fiction?", and Chapter 10, Mike Morrison, "Energy Economics: Real and Unreal."

3. Leopold, L.B., F.E. Clarke, B.B. Hanshaw, J.R. Balsley. *"Information Matrix for Environmental Impact Assessment."* U.S. Geological Survey Circular 645.

4. Angelo J. Cerchione, Maj., U.S.A.F., a remarkable example of the potential for an environmental coming of age at the Pentagon, accurately delineated the defects in the *Brandywine Plan* in the paper, aptly entitled, "With Sherman on the Brandywine," (University of Pennsylvania, Department of Regional Planning) and proposed the solution in "Planning, A Communications Process," Chapter 5, in *Planning, Environmental Science & Aviation,* the first volume of the three volume Proceedings of the American Bar Association National Institute on Environmental Litigation. (American Bar Association, Chicago, 1974).

5. Such a course, euphemistically entitled "Environmental Science and the Law" was offered on an experimental basis at Southampton College, a Center of Long Island University. The course was given to a class of undergraduates of varying backgrounds and interests and included non-science majors with no mathematics beyond High School and no College level science courses, as well as advanced students in the natural sciences. The interaction among the students was responsible for a general diffusion of knowledge across a number of departments. One of the principle empirical conclusions from the experience is that it should be an 8-12 credit two semester course rather than a one semester 6 credit course.

6. A detailed discussion of the legal background of the *Project Rulison* litigation can be found in Yannacone, Victor John, jr., B.S. Cohen, S.G. Davison, 2 *Environmental Rights & Remedies* §10:11, (Lawyers Cooperative Publishing Co., Rochester, NY, 1972), and a consideration of the systems testimony presented during the trial of the case is reproduced in Yannacone, Victor John, jr., "Environmental Law/Environmental Systems Science: Integration at the Interface in Litigation and Legislation. §§8.40-8.49, Chapter 8, *Environmental Systems Science,* the second volume of the three volume Proceedings of the American Bar Association National Institute on Environmental Litigation (American Bar Association, Chicago, 1974).

Editor's Note:

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He has argued numerous cases having broad environmental bases, among them: The Florissant Fossil Beds National Monument: the Cross Florida Barge Canal; the use of enduring pesticides, and planning and zoning ordinances. As writer, he has written or co-authored many articles concerning the environment/law interface, and most recently has contributed to and edited a book entitled *The Energy Crisis: Danger and Opportunity* (which will be reviewed in this journal at a later date). As teacher, he is Adjunct Professor of Environmental Science at Southampton College of Long Island University and is also affiliated with the University of Pennsylvania Law School. His home base is in Patchogue, New York.