some training in physics could not be sacrificed in preference to additional in-depth training in biochemistry. Predictably, this suggestion, in these days of competition for more students to teach to justify bigger instructional budgets, does not receive a very hearty welcome in departments of physics! Incidentally, most of the physics necessary for a reasonable understanding of say, physical chemistry or physiology, can be and frequently is taught in these subjects themselves, in the introductory parts of the course.

For the second group of students, who will return to "production agriculture" in all its diverse forms, there is room for *much more* debate and disagreement! But my personal philosophy is that to train the leaders for an ever-more scientific agriculture we should be advising students into a fairly strong program in the basic disciplines. This is easier to say than to accomplish however! No doubt you have all had the same experience as I in trying to advise a student to take an extra course in math or chemistry! And you have no doubt heard students in their final quarters, or even years after their graduation, express regret that they had not signed up for more math or more chemistry (a few rare ones have even regretted not taking more English!) But as freshmen or sophomores, they will never listen to such advice.

There are two possible solutions; the first is to teach the introductory course in the student's field in such a dynamic and revealing way that he will see clearly the necessity for solid training in mathematics and chemistry if he is truly to understand agricultural science. The second is for us to teach much more of the basic disciplines in our own courses in say, nutrition, soils, crops, genetics – for instance to interweave chemistry through the student's entire academic career; in this way, too, chemistry can very well be made much more "relevant" to the student, since he sees the immediate application of the discipline to his field of immediate interest. I have many times had this reaction from students when I introduce Statistics in the course I teach in Animal Breeding: the correlation between the weaning weight of a calf and its subsequent gain in the feedlot is much more meaningful to a student than the raw correlation between two variables X and Y!

But how much is required for this group of students? No great depth in mathematics, in my opinion – a good solid course in algebra to give a thorough appreciation of the subject; no physics needed here, beyond the high school appreciation gleaned in their science course; but the more chemistry they can digest the better – more and more of practical agriculture involves chemistry, from soil fertility to hormone implants, and the agricultural producer is beset with claims in advertising and promotion that demand a familiarity with the principles of chemistry. An introduction, at least, to biochemistry is highly desirable.

These practically oriented students could well profit from an exposure to geology, especially those returning to farming, to give them a deeper sense of appreciation of the origin of their soils. The same group would derive some benefit from atmospheric science, to aid in the understanding of weather patterns.

The last group of students, destined to enter "agribusiness" will be steeped in the theory of economics and the principles of business but will need also a fair familiarity with mathematics and chemistry. Training in statistics is preferable to deep mathematics, since the business world deals heavily in statistics and statistical problems. Again, since these students, too, will deal with businesses and products that are rooted in chemistry, they should have a good introduction to the field, preferably as far as organic chemistry.

In conclusion, there is little question that all students in agriculture should take enough physical science to give him a thorough grounding. The exact depth is difficult to specify precisely, but should be determined by the career objectives of the student.

Western Style Barbecue

CHARTER MEMBERS PRESENT AT 1971 CONFERENCE: Left to right – T. R. Buie, Southwest Texas State University; Carl Schowengerdt, Southeast Missouri State College; Clyde Hyder, Tennessee Tech University; Ralph Benton, Southern Illinois University; Conrad White, William Penn College, Oskaloosa, Iowa.

Technology and the Bioenvironment – A College Course

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*Formerly, Head, Agricultural Engineering Department, Louisiana Tech University.

Introduction: The actions of organisms affect their environment. The actions of the organism man are such that they have tremendous environmental effects, both quantitatively and qualitatively. In the short run, man seems to be affecting the terrestrial environment more than any creature in history. Perhaps, the activities of man in the United States represent the extreme case.

Recently, the news media have directed public interest toward the quality of the environment. Television has been particularly effective in this. It is interesting to speculate on why this emphasis has occurred at this particular time in history. Perhaps the news media had exhausted all other crusade possibilities or perhaps public figures saw a promising bandwagon that would further political careers. Regardless of what the purposes were, I feel that the interest is a healthy omen in our society and should

be encouraged. The course described in this paper certainly could not have been taught a few years ago.

We in the Department of Agricultural Engineering at Louisiana Tech University did some research on the use of municipal sewage effluent for irrigation of agricultural crop lands. This project was completed in 1968, after which we held a symposium that attracted professionals from 18 states and two foreign countries. We prepared a news release and submitted it to the college news bureau. The news release came back with the comment that this news items was not in good taste and should not be published. Needless to say, the news bureau would not take the same action today.

Course Developed at Louisiana Tech University: Based on the author's interest in and study of environmental pollution and its control, a course was organized at Louisiana Tech University and taught for the first time in the fall of 1970.

Purposes of the Course: The purposes of the course were defined as follows: (1) to convey to the student basic information about the environment and (2) to show man's interaction with the environment, to include basic items such as the water cycle, nitrogen cycle and the energy cycle, as well as specific information on various aspects of water pollution, air pollution, and other environmental problems, the student being encouraged to consider all aspects of environmental problems – social, economic, and physical, and to begin a habit of looking at published information with a critical attitude. (A more detailed statement of objectives can be found in Appendix I).

Procedure for Teaching the Course: The course was set up for three semester hours credit with three lecture periods per week. During the initial offering of the course the students were given reading assignments for each period on the first day of class. At the beginning of each class period thereafter, a short test was given. The purpose of this test was to encourage the students to read the assigned material before coming to class. Students were also asked to prepare one multiple choice test question for each reading assignment. (An assignment sheet for the course is given in Appendix III).

During the fall quarter, eight guest lecturers were invited to address the class. These came from Louisiana Department of Health, Louisiana Stream Control Commission, Ruston city government, the insecticide industry, the nuclear center at Louisiana Tech, and the Tech Department of Botany-Microbiology. (A list of these lecturers is given in Appendix II).

At least once per week the class was divided into small groups of 3 to 5 persons each to discuss some aspect of the environment that might be controversial, such as population control, the banning of DDT, etc. Each group was asked to arrive at some agreements or disagreements and report back to the whole class. The time allowed for these discussions was about thirty minutes of the seventy-five minute period.

Three major tests were given during the quarter. The students were asked to prepare a term paper and give an oral report on it. One of the reasons for requiring a paper was to encourage the students to learn how to locate environmental information. In presenting the papers to the class, students tended to read the material, and in general, gave something less than an inspired performance. In the student evaluation of the course, one of the criticisms was that the student reports were boring. The requirement for an oral report was dropped for the winter quarter. Students were allowed to prepare a report or read a book and prepare a very short one page summary of the material. If they desired, they gave a 5 to 10 minute report to the class. Most of the students did not choose to present a report to the class.

Student Evaluation of the Course: The students taking the course evaluated it during the last 15 minutes of the next to the last class period. The instructor furnished the evaluation forms to a retired engineer who was enrolled in the course. He distributed the forms and collected them from the class. He returned the forms to the instructor after grades were reported. The evaluation consisted of a scale for evaluating the teacher and a survey form that encouraged comments for evaluating the course. The overall rating of the instructor given by the students was 90 on the basis of 100 being perfect. The students generally indicated that they thought the course was very worthwhile. Most of them gave useful suggestions for improving the course. (The detailed evaluation is given in Appendix IV).

Needs: There is a need for a textbook covering the basic environment and the effects of man's technology on the environment. This book should be written in a dispassionate manner, covering information that is available, and pointing out areas where information is needed but not available. It should be documented more than a textbook usually is because of the tendency of writers in this area to take a position on a particular question and defend this position even though it may not be supported by research results.

There is need for a convenient list of visual aids that are suitable for college level courses on the environment. Compilation of an annotated list of visual aids is a project that could be carried out by members of an organization such as the Louisiana College Conference. Campus wide faculty and administrative support for environmental education is needed. It appears to this writer that environmental actions will affect the physical health, emotional state and economic well being of every person in the United States for the foreseeable future. We need an educated citizenry on environmental matters. In my opinion this educational need is more urgent than that in many general education areas that consume a great deal of student time at present.

Administrative procedures are needed to prevent the environmental education effort from being splintered in an uncoordinated manner on a given college campus and on campuses throughout the country.

Qualifications of the Instructors: It appears to me that persons in applied sciences are particularly qualified to teach a course on the environment in that most of them have a background of knowledge in both physical and life sciences and in the pure and applied aspects of these sciences.

The title of the course at Louisiana Tech is **Technology and the Bioenvironment**. It is the technology of man that is having the greatest effect on environment. Those who are originating this technology are more likely to know what can or cannot be done to change the effects of this technology on the environment; they therefore should be made aware of their responsibilities in this area. Because of this need, students in the technology area should take courses such as **Technology and the Bioenvironment**, as well as those dealing with this subject from other areas of study.

Course Number: The course is designed for junior and senior students. Information presented comes from many disciplines and thus the course is interdisciplinary. It was given the designation Botany 456 at Louisiana Tech University. This designation does not mean that the information is logically a part of the conventional pure science of Botany. It means that many departments and accrediting agencies require a student to take a certain number of science courses. These organizations frequently will not recognize a course if it has an applied science designation. The Botany designation was used to satisfy arbitrary requirements. In reality this course would be more logically called **Agricultural Engineering 456**.

APPENDIX I
TECHNOLOGY AND THE BIOENVIRONMENT

I. **Objectives**

1. The main objective of this course will be to help the student gain a knowledge of the effects and dimensions of technology on the environment. Every technological innovation from agriculture to petrochemical industry, or the stone ax to the hydrogen bomb has had some effect on the environment. This course will have as its main objective the setting of these effects in perspective. Technology not only affects our physical environment, but our social and economic environment as well. During this course I hope we will be able to discuss and give some thought to the effects of technology on our physical and economic environment.
2. There are definite limitations on the knowledge that is available to us about the effects of technology on the environment in all three realms, social, economic, and physical. As a second objective, I hope we will be able to find some of these limitations and what we need to do as citizens to push these limitations back.

3. The third objective of this course will be to point out some of the effects of technology and pollution on our economic and social arrangements. We will try to predict what might happen to our economy and society if certain changes are made in dealing with pollution.
4. I hope that you, the student, will get the beginnings of a skill and interest that will enable you to advocate wise action by our society. What our government does is ultimately determined by the ordinary citizens. And you are to be the ordinary citizens, or perhaps, leaders in this realm of pollution and technology and environment. You will have the kind of environment that you wish to have. Of course, you must think of all facets of this problem when you advocate action. You must think about the technological, social, and economic effects.
5. I hope that we can discover some methods for testing the validity of statements about our physical environment. There is much alarmism in the air today. I am confused on a lot of matters, and I'm sure other people who've had less experience that I, are confused.

APPENDIX II
Guest Lecturers for
Technology and the Bioenvironment

1. Mr. Howard Anderson, Southwest Regional District Manager, Union Carbide, Dallas, Texas.
2. Dr. Glen E. Clark, Louisiana Tech Nuclear Center, Louisiana Tech University, Ruston, Louisiana.
3. Mr. C. E. Gilmore, Superintendent of Health and Sanitation Department, City of Ruston, Ruston, Louisiana.
4. Mr. J. D. Givens, Biologist, Louisiana Stream Control Commission, Baton Rouge, Louisiana.
5. Dr. Harold G. Hedrick, Associate Professor of Microbiology, Department of Botany and Bacteriology, Louisiana Tech University, Ruston, Louisiana.
6. Mr. Kermit Sneed, Director, Warm Water Fish Cultural Laboratory, Bureau of Sport Fisheries and Wildlife, U.S. Department of the Interior, Stuttgart, Arkansas.
7. Dr. Merrill True, President, Bio-Oceanic Research, Inc., New Orleans, Louisiana.
8. Mr. Perry Watson, Engineer, Louisiana Department of Health, Monroe, Louisiana.

APPENDIX III
Assignment Sheet for
Technology and the Bioenvironment

1. Name of course. Instructors name. Instructors qualifications. Objective of the course. Materials needed. Preview of the subject matter. Grading procedure. Classroom procedure. Survey of student interest. Movie on water pollution. Assign book reviews and reports.
2. Basic Earth Cycles – The Energy Cycle – The Water Cycle. Pages 54-64 and 98-110. 1970 SCIENTIFIC AMERICAN.
3. Bias and ecological information. A chapter from ENVIRONMENTAL HANDBOOK. Thermal pollution. Assignments:
   1. The Energy Cycle of the Biosphere, September 1970 SCIENTIFIC AMERICAN, Pages 64-74.
   2. "Pollution in Agriculture", handout by F. E. Beckett.
   3. A Future that makes Ecological Sense, from ENVIRONMENTAL HANDBOOK, by Garrett DeBell, Ballantine. 1970.
4. Pollution and economics. Some effects of economic activity on pollution. A historic look at the American economic ideology. A proposal for a new pattern of American ideology. Small group discussion. Report by group chairmen. Assignment:
   1. Pollution – The Mess Around Us, CONTROLLING POLLUTION – THE ECONOMICS OF A CLEANER AMERICA, by Marshall I. Goldman, pages 3-19.
   2. "Thoughts on Historic Effects of Land Ownership Patterns on American Economic Ideology", handout by F. E. Beckett.
   3. "An Outline on Universal Capitalism", by F. E. Beckett.
5. Psychology of Pollution. Why do people pollute? From an economic standpoint, what are some solutions to pollution? Assignment:
   1. The Tragedy of Commons, ENVIRONMENTAL HANDBOOK, Pages 31-49.
   2. Pollution – The Mess Around Us, CONTROLLING POLLUTION – THE ECONOMICS OF A CLEANER AMERICA by Marshall I. Goldman, pages 19-39.
6. Water Pollution. Assignments:
   1. Water Pollution and the Environment, pages 1-13, from CLEAN WATERS FOR THE 1970'S, A Status Report by the Federal Water Quality Administration.
   2. What is Pollution? from CONTROLLING POLLUTION by Goldman, pages 59-70.
   3. Thermal Pollution of Aquatic Life. SCIENTIFIC AMERICAN, page 19, March 1969.
7. Power Generation. Effect of waste heat on the environment. Probable future needs for power. Fuel sources. The effects of economic development on power use. Assignment:
   1. Human Energy Production as a Process in the Biosphere, SCIENTIFIC AMERICAN, September 1970, pages 174-190.
   2. The Calefaction of A River, SCIENTIFIC AMERICAN, May 1970, page 42, also Letters August 1970.
8. Economic effects of water pollution. Possibilities for economic improvement during the process of economic abatement. Assignment:
   1. Historical Roots of Our Ecological Crisis, THE ENVIRONMENTAL HANDBOOK, page 12.
   2. The Rhur Valley Scheme, ECONOMICS OF A CLEANER AMERICA.
9. TEST. Small group discussion on the effects of a policy of no economic growth on: (a) Capital ownership, jobs, economic, ideology, (b) pollution. Committee reports: summary of ideas and research needed.
10. The Oxygen Cycle, SCIENTIFIC AMERICAN, September 1970, pages 110-123, and The Carbon Cycle, SCIENTIFIC AMERICAN, September 1970, pages 124-132.
11. Air Pollution. Nation-wide extent. Extent in Louisiana. General contributions to air pollution. Small group discussions. Small group reports. Assignment:
   1. Air Pollution and Public Health, by Walsh McDermott, SCIENTIFIC AMERICAN, offprint No. 612, October 1961.
12. Air Pollution. The effects on agriculture. Contributions by agriculture. Particulate air pollution. Dust storms. Industrial particulates. Volcanos. Assignment:
   1. The Control of Air Pollution, SCIENTIFIC AMERICAN, Offprint No. 618, January 1964, by A. J. Haagen-Smith.
13. Carbon Dioxide and the Weather. Assignment:
   1. Carbon Dioxide and Climate, SCIENTIFIC AMERICAN, July 1959.
14. The Effects of Fertilizers on the Environment. The effects of nitrogen, phosphorous and other fertilizers on the environment. Assignment:
   1. The Nitrogen Cycle, SCIENTIFIC AMERICAN, September 1970.
   2. Mineral Cycle, SCIENTIFIC AMERICAN, September 1970, pages 148-158.
15. The effects of insecticides on the environment. The MRAK Commission Report, pages 7-17.
16. Ocean Pollution – oil. Chemicals. Sewage. Others. Assignment:
   1. The Nature of Oceanic Life, SCIENTIFIC AMERICAN, Offprint No. 884, September 1969.
17. Poverty and pollution. The effects of pollution abatement on the economic system. On labor. On ownership. Human Food Production as a Process in the Biosphere, SCIENTIFIC AMERICAN, September 1970, pages 161-170.
18. TEST. Discussion of course to date.
19. Population and pollution. The effects of population on pollution. Historical. Projections in the future. The effects in the U.S. The effects world wide. Assignment:
   1. Re-read The Tragedy of Commons.
   2. Population, SCIENTIFIC AMERICAN Offprint No. 645, September 1963.
20. Soil pollution. Magnitude of the problem. Contributors. Regulatory organizations and actions. Unanswered questions. Social goals and actions. Assignments:
   1. Soil Pollutants and Soil Animals, SCIENTIFIC AMERICAN, Offprint No. 1138, April 1969.
21. Pollutants taken voluntarily. Tobacco. Alcohol. Drugs. Effects on individuals. Effects on society. The psychology of eradication. Assignment:
   1. Smoking and Lung Cancer, Ruth and Edward Brencher, CONSUMERS REPORTS, June 1963, pages 265-280.
22. Noise. The effects of noise on people. Sources of noise. Control. Present and future prospects. Assignment:
   1. Noise, SCIENTIFIC AMERICAN Offprint No. 306, Dec. 1966.
23. Solid Waste. Magnitude of the problem. Contributors to the problem. Disposal. Reuse. Regulatory organizations and action. Social goals for use of solid waste.

APPENDIX IV
Student Evaluation of the Course
Technology and the Bioenvironment

1. Evaluation of the Instructor — Percent Rating
   - I. Interest in the subject 97
   - II. Knowledge of the subject 86
   - III. Presentation of the subject 93
   - IV. Attitude toward students 83
   - V. Intellectual stimulation 93
   - VI. Fairness in grading 83
   - VII. Level at which the course is taught 93
   - Overall Average 90
2. Evaluation of the Course
   1. Do you think the subject matter covered in this course is important enough to be taught as a college course?
      14 Yes 1 No
   2. What were the most useful features of this course?
      1. Guest Lecturers
      2. Text Materials
      3. Group Discussions and Evaluations (Student Participation)

4. Term Paper (Independent Research)
5. Hand Out Material
6. Films
7. Opportunities for facts rather than second-hand or slanted opinions.

3. If you were teaching the course what changes would you make?
   1. Eliminate term papers being presented orally
   2. Make term papers count for extra credit
   3. Have more visual aids
   4. Have a guest speaker for each area covered
   5. Have more class discussions
   6. More outside reading
   7. Have longer class period to allow for class discussion
   8. More challenging exams
   9. Do away with daily tests
4. What advice will you give other students who might be thinking of scheduling this course?
   12 would advise others to take the course
   3 would give students no advice
5. Other comments and suggestions.
   1. More difficult tests
   2. Daily tests should be more thorough and graded harder
   3. Bonus points awarded for extra outside reading
   4. Do away with term papers being presented orally

*NOTE: Twenty students enrolled in the course; four dropped early; three were absent on the day of the evaluation.

Hosts and Prexies

Jack C. Everly (left) University of Illinois, recipient of E. B. Knight Journal Award for 1970; Frank Carpenter, Chairman and recipient of 1969 Award.

Relating Agricultural Instruction to Environment Improvement: The Role of Land and Soil

Wallace H. Fuller, Head
Agricultural Chemistry and Soils, University of Arizona, Tucson, Arizona

INTRODUCTION

Man's waste can serve man . . . or pollute his environment.

Technically, that's the gist of the problem. The technology and know-how needed to harness refuse in the service of man is with us here and now.

The will to act is with us, too; but, so far, it appears to be too feeble to meet the political, social, and economic challenge. We may, however, take some comfort in the fact that the will to act may be gaining strength, slowed only by dollars. Instruction in environment improvement is needed and it must begin with the young people who are forming their political, social and economic habits.

I can at least see some change in people's thinking since a decade ago when I said, in a published article, "Man cannot afford to wait any longer to solve his waste disposal problems."

I felt alone, then. Today, I hear many voices echoing the same message.

Historically, waste has been discarded carelessly at little or no cost, as a way of life. This is changing and we now must pay to maintain or better our environment. Fortunately, there are solutions. Agricultural instruction is one of these.

This discussion is drawn from four main experiences I have had over the last 25 years.

1. USDA Soil Conservation Service, one of the first pollution abators. It was commended, in a recent report to the President of the United States, as being an excellent example of man's awareness of environmental improvement (having been initiated in 1932 by an act of Congress, long before the hippie movement).

2. US Department of Health, Education, and Welfare; US Public Health Service. Also pointed to as an early and effective pollution control program, long known for keeping man's sewage and city effluent under health control and the envy of foreign countries.

3. A student-organized ENVIRONMENT AWARENESS lecture-discussion seminar, undertaken, planned, and managed by upper-classmen and graduate students with faculty adviser for bringing together the best talent on environment improvement, pollution control, solid-waste management, and planning for future environment management for the betterment of man.

4. Water Quality Control Research and recent involvement as a member of the Arizona State Water Quality Control Council.

5. Five-year membership on the study and consulting board of the HEW, US Public Health; Office of Grants, Contracts, Fellowships and Trainee-ships in Solid Waste Disposal program.

I bring these sources of pollution awareness and abatements to your attention because they have been so sadly overlooked by the din and tinkle of the new movement on pollution, that occasionally has reached hysteria proportions.

Pollution ends up either in the soil (land) or ocean, since air and streams primarily are vehicles of transport into these end-systems. Sensitivity over what enters the ocean has become so keen, only the soil is left for mass disposal. The soil is an experienced "old-timer" at effective and efficient digestion and disposal of plant and animal waste. Pollution can be *controlled through* the soil. Indeed, I will illustrate how effective the soil is in controlling biological cycles of nutrient supply and digestion of wastes, but first a few words about agriculture and the environment.