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ABSTRACT

The first sections of this document include a discussion of the general characteristics and general objectives of environmental education and of criteria for choosing environmental education materials for classroom use. The final chapter is a guide to resources for environmental education at the secondary level. Annotated bibliographies of written and of audiovisual materials are provided. Curricular materials are reviewed and are classified under four headings: Semester and Full-year Courses, Modules and Mini-courses, Field Trip Guides, and Games and Simulations. Eighteen addresses for sources of games and simulations are listed. The final section discusses the use of science fiction as a classroom tool and provides an annotated list of science fiction stories with environmental themes, an annotated list of special resources, and a list of bibliographies of sources for science fiction studies.
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A SOURCEBOOK FOR SECONDARY ENVIRONMENTAL EDUCATION

by

William G. Lamb

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CHAPTER I

RESOLUTION OF THE ENVIRONMENTAL CRISIS: A CHALLENGE TO EDUCATION

Man began to apply science to technology at the beginning of the nineteenth century. White (1967) postulates that this may have been "the greatest event in human history since the invention of agriculture, and perhaps in non-human terrestrial history as well." The scientific-technological revolution has produced the highest standard of living ever recorded in human history. In the U.S.A. -- a land known for conspicuous consumption--even those officially proclaimed as in poverty live a better life with regard to material comforts and possessions than did royalty five centuries ago. We enjoy labor-saving devices that would have boggled the mind of Merlin, agricultural techniques which allow less than ten percent of the population to provide food for all, instant communication with each other even when separated by long distances, unprecedented health, wealth and ease.

But the technological developments which make the U.S.A. one of the most prosperous nations have been coupled with rising population, rampant urbanization and a culturally ingrained arrogance when dealing with non-human aspects of the environment. This has produced a problem of global magnitude--an environmental crisis which demands resolution. Failure to adequately resolve this environmental crisis will at best result in a severe diminution in the quality of life; at worst, our survival as a species is at

stake. As Stotler (1971) points out, the species most fit for survival is not necessarily the one that appears to be dominant at any point in time, but the one that is best equipped for dealing with adaptation problems as they arise.

The reaction of many people to confrontation with this environmental crisis is to totally reject technology because it seems to be the sole causative agent of pollution and to espouse a return to some romanticized pre-industrial life. Such entrancing publications as The Whole Earth Catalog and The Mother Earth News base much of their reading appeal on this type of reactionary response. Societal atavism, however, is not really a viable solution to the environmental crisis. Most of the current problems comprising the environmental crisis are solvable with current technological expertise but, as Hardin (1968) indicated in "The Tragedy of the Commons," such technological expertise is not likely to be used without a significant shift in the value structure of a majority of society's members.

The rational man finds that his share of the cost of wastes he discharges into the commons is less than the cost of purifying his wastes before releasing them. Since this is true for everyone, we are locked into a system of fouling our own nest so long as we behave only as independent rational free enterprisers. (Hardin, 1968).

The problem is not really a dearth of the scientific information or technological expertise necessary for solutions of specific environmental problems. The problem is the manner in which those individuals who comprise the society order their

priorities. Most individuals rank as highest order those priorities they perceive as being in their own or their society's best interests. Some potential actions are encouraged or curtailed by society's sanctions even when encouragement or curtailment of such an action has no base in the individual actor's ethic. For example, some persons do not publicly use certain words which are offensive to many people even though the words in question hold no horror for the user. Most people dress in a certain manner for attending job interviews, funeral services, weddings and other solemn events even though they personally do not value that style of dress. If choosing a certain action is likely to meet with peer disapproval and certain legal punishment, that action will most likely be quite low on an individual's list of priorities, especially if an antonymous action leads to peer approval instead of approbation. On the other hand, actions which an individual feels are in both his and society's best interests and which also lead to peer approval are likely to rank high on that individual's list of priorities. Until recently, actions which led to pollution, wasting of natural resources and diminution of the quality of life have not met severe social and/or legal sanction; therefore such actions were viable and often desirable alternatives for many people. On the other hand, some actions which tend to diminish pollution, conserve natural resources and lead to a general improvement in the general quality of life do not specifically

gain societal approval and reward. In fact, many such positive actions are viewed as tolerable but amusing, basically sound but not something generally done by "normal" people.

To resolve the environmental crisis will require a large scale change in the behavior of a large majority of the populace. Creating legal sanctions to discourage undesirable actions has been proposed as a way to alter behavior but legal sanctions are almost totally ineffective in the U.S.A. if those sanctions do not receive the support of a majority of the populace. The "lawlessness" of the Prohibition Era is a good example. Even in societies governed undemocratically there is little evidence to indicate that legal sanctions alone effect long-term permanent behavior changes in a majority of the members of those societies. Experimenters in behavioral science have amply demonstrated with a variety of organisms, including humans, that negative reinforcement alone is highly inefficient in effecting or maintaining behavioral changes.

If a change of behavior is to be effected, the behavior change must be a voluntary, even a desired, one. What is required is a change in the value system applied by a majority of the populace in choosing between alternative actions.

The term "value" is being used in the sense described by Raths (1966) who sees a value as chosen freely from among various alternatives and with a thoughtful consideration of the consequences of each of the alternatives. In addition, the value is

prized and leads to actions which repeatedly demonstrate the value. Rath points out that

The conditions under which behavior is guided, in which values work, typically involves conflicting demands, a weighing and a balancing, and finally an action that reflects a multitude of forces. Thus, values seldom function in a pure and abstract form. Complicated judgments are involved and what is really valued is reflected in the outcome of life as it is finally lived.

In this sense, a person's values are not only what he feels and how he believes about something but also how his actions demonstrate his feeling and beliefs; a person who never votes, for example, does not really value democratic elections no matter what he claims. A lay citizenry who possess a value system which insures the use of their knowledge and skills in the improvement of environmental quality is mandatory for resolution of the environmental crisis.

Inherent in the definition of value described above is knowledge of the various alternatives to a specific action, knowledge of the consequences of each of those alternatives, and the skills necessary to act in accordance with the value system. Therefore, a lay citizenry knowledgeable in the basic principles of ecology and economics, sociology, political science and the humanities, as well as natural science, must be developed. The majority of citizens must also be aware of environmental problems and able to use inquiry and problem solving skills in generating optimum solutions to those problems. As Kolb (1971)

has pointed out, for the environmental crisis to be resolved positively within the framework of a relatively democratic socio-political system, "major changes must be made in the citizenry with respect to knowledge, thought processes, emotions, and values." Those changes are a challenge to the educational system.

CHAPTER II
CHARACTERISTICS OF ENVIRONMENTAL EDUCATION

The need for environmental education has been recognized by the Congress which passed the Environmental Education Act (1970) "to establish education programs to encourage understanding of policies, and support of activities, designed to enhance environmental quality and maintain ecological balance." Environmental education is defined in the Environmental Education Act as

. . .the educational process dealing with man's relationship with the natural and man-made surroundings and including the relation of population, pollution, resource allocation and depletion, conservation, transportation, technology, and urban and rural planning to the total human environment (91st Congress, 1970).

The need for environmental education was also underscored by the Senate Committee on Labor and Public Welfare:

The citizens of this country, both present and future, must understand the ecosystem and the interrelation between its parts. Each phase of education from pre-school through adult and continuing education must be re-ordered to permit the introduction of ecological understanding (U.S. Senate, 1970).

The importance of environmental education has been stressed by national law and the responsibility of the educational system in helping to resolve the environmental crisis has been clearly stated by both lawmakers and lay citizenry. The problem, originally identified as the problem of changing people's value systems is thus more narrowly defined as an education problem. In what

ways can the education system organize to meet the need for changing people's values to those which will accommodate improvement of environmental quality? What form should an environmental education program take?

The U. S. Office of Education (1970) has described the basic characteristics of a good comprehensive environmental education program as follows:

1. It uses a multidisciplinary approach with an emphasis on the interrelationships of man and nature.
2. It focuses on contemporary problems relating to the urban and rural environments, both natural and man-made.
3. It incorporates non-formal as well as formal educational processes and it utilizes resources outside the classroom.
4. It develops understandings and attitudes as well as presents information.
5. It involves all age groups.
6. It is learner-centered, with the learner choosing his own priorities for learning.
7. It is activity oriented.

Stapp (1970) has reviewed the education research literature and listed twelve general principles which should be considered in the formulation of any primary or secondary education programs.

1. Behaviors which are reinforced are most likely to recur. . . .

2. The most effective effort is put forth by youth when they try tasks which fall into the 'range of challenge'--not too easy and not too hard--where success seems likely but not certain.
3. Youth are most likely to throw themselves wholeheartedly into any project if they themselves have a meaningful role in the selection and planning of the enterprise.
4. Reaction to excessive direction from the teacher is likely to be: apathetic conformity; defiance; escape from the whole affair.
5. What is learned is most likely to be available for use if it is learned in a situation much like that in which it is to be used and immediately preceding the time when it is needed. Learning in youth, then forgetting, then re-learning, is not an efficient procedure.
6. The learning processes in schools ought to involve dynamic methods of inquiry.
7. Research shows little correlation between cognitive achievement and concern and values. Able students who achieve well in traditional content-centered courses do not necessarily demonstrate commitment to positive social goals.
8. Learning takes place through the active behavior of the student. It is what he does that he learns, not what the teacher does. The essential means of an education are the experiences provided.
9. One of the keys to motivation is a sense of excitement about discovering for one's self rather than having a generalization presented by a teacher and requiring the student to prove it.
10. Attitudes may not be formed through a rational process by which facts are gathered and a reasonable conclusion drawn, but rather through repeated exposure to ideas (In fact, Kolb, 1970, indicates that much attitude formation is completed long before children reach the intellectual level which enables them to perform extended reasoning operations).

11. Helping citizens to acquire technical knowledge alone regarding an environmental problem may not increase their concern for the problem.

12. Citizens are more likely to become involved in environmental issues if they are aware how they can have some affect on decision-making.

In addition to those principles listed by Stapp, the rate, scope and sequence of instruction should be permitted to vary with the individual student's background, interests, and abilities.

With these points in mind, a discussion of the broad objectives of environmental education--a citizenry that is aware of environmental interrelationships and processes, understands how to solve environmental problems that arise, and is motivated to work toward their solution--is in order.

CHAPTER III

GENERAL OBJECTIVES OF ENVIRONMENTAL EDUCATION

The general objectives of environmental education can be classified under three separate categories: content knowledge, process skills, and values. The first two categories are supported by all educators concerned with environmental education. Some controversy concerning the teaching of value systems exists. Each category of objectives is discussed below.

Content Objectives

Many of the alphabet curriculum projects of the sixties listed their content objectives in the form of broad unifying concepts or themes around which the content could be organized and which were elaborated and repeated throughout the course of study. Environmental education can be treated in a similar manner with the added assumption that the basic themes should be elaborated and repeated through the K-12 program. One particularly complete outline of broad unifying concepts with accompanying content objectives has been published by the Broward County, Florida, School Board (1972). The outline of major concepts listed below from their publication is supported by other educators who have also published lists or outlines of general concepts which should serve as the basis of an environmental education program (White, 1970; Roberts and Dyrli, 1971):

I. All living things are interdependent and are affected by the same biological processes. The interdependence should be examined in terms of:

- A. varieties and similarities
- B. patterns
- C. continuity and change
- D. evolution

II. All organisms are related through matter and energy in the following ways:

- A. food relationships
- B. Earth's energy is supplied by the sun
- C. All organisms require matter which must be recycled since there is no continuous input.
- D. All organisms are interrelated with the non-living or physical part of the environment.

III. The causes and effects of change must be considered.

IV. Population size is regulated in nature.

V. The world is a finite system with limited resources.

The list cited above and lists of concepts cited in most publications discussing environmental education tend to over-emphasize the scientific and especially the biologic aspects of environmental education. Environmental education is often defined in terms of natural history and of the concepts derived from the biologic sub-discipline of ecology. But both the Congress (1970) and the USOE (1970) specifically mention both man-made and urban systems which are usually either underemphasized or ignored. If in fact we are interested in the environment as it relates to humans, Underwood (1971) states that we should realize:

man has a relationship to societies and cultures that should interact with our environment and become part of it. Large modifications of our surroundings is the result of corporate decisions of our social institutions

rather than the relatively insignificant acts and decisions of individuals."

The inclusion of an urban bias into much of environmental education is especially important for two good reasons. First, the real power of ecologic decision making in our democratic society rests in the hands of a currently poorly informed urban population and the major environmental decisions of the future will be made "in the city, about the city, by those who dwell in cities" (Underwood, 1971). Second, effective education demands that examples and problems relevant to the learner be studied; quite simply, examples and problems which will be relevant to urban students must be drawn largely from the urban environment.

A careful search of the literature revealed no list of economic, sociologic, political or aesthetic concepts around which environmental education should be structured, but these aspects of human existence should certainly have a major role in any good environmental education program. There is almost universal consensus among educators publishing in this field that environmental education should not be bound up in the narrow structures of biology or science, whether they call such a program inter-, multi-, pan-, a-, pluri-, cross-, or trans-disciplinary, (USOE, 1970; Naylor, 1970; Roberts and Dyrli, 1971; Underwood, 1971; Kormondy, 1971; Arnsdorf, 1972; Lucas, 1972; Hegelson, et al., 1972).

Process Skill Objectives

The process skills as applied to environmental education will develop a lay citizenry aware of inquiry and problem solving techniques and able to use these techniques in generating optimum solutions to environmental problems. While environmental education should not be confined to science, much of the information and many of the theories and hypotheses applicable to discussion and resolution of environmental problems are generated by scientific inquiry. Therefore, a thorough foundation in the process skills of inquiry and critical thinking must be a primary objective of any environmental education program. Realization of these objectives will enable each student not only to recognize and generate information for application to a specific problem but also to evaluate existing information with respect to the methodology with which that information was generated (Naylor, 1970; Lucas, 1972). Optimization techniques and human interaction skills and tactics should also be developed as social and political skills necessary for dealing with environmental problems.

Value Objectives

A third major category of the basic objectives of environmental education is a citizenry whose value system will assure their behaving in a manner consistent with improving environmental quality. A quite common attitude of many environmental educators is exhibited by Roberts and Dyrli (1971) who would "increase the environmental literacy of all students resulting, hopefully, in

positive changes in behavior." Reviews of research in education, however, do not support the optimistic assumption that information and skills acquisition will lead to positive changes in social behavior (Stapp, 1970; Hegelson, et al, 1972). The typical environmental education programs which "consist of little more than telling students about the wasteful use of our natural resources, taking them on nature study trips and admonishing them to fight pollution" (Underwood, 1971) are no guarantee that any positive change will occur in the condition of the environment (Lucas, 1972) and can possibly be counterproductive (Naylor, 1970).

There are dangers inherent in specifically teaching for the acquisition of values. Many educators feel that specific manipulation of values in the classroom is not a legitimate role for public education in a free society and that the aim of education should be to produce informed, intellectually capable, socially concerned individuals capable of making rational, objective judgments for themselves in each case, now and in the future (Lucas, 1972, and references cited therein). These educators apparently ignore that production of such individuals indicates certain values.

As Kormondy (1971) has pointed out, the educational system has explicitly and implicitly taught values and continues to do so. In fact, teaching without applying some sort of value judg-

ment is impossible. Teachers need to examine the values implicit in curriculum materials and need to be alert to the ethical positions they assume during their environmental education activities. Most educators writing in the field of environmental education recognize the necessity of teaching what is commonly referred to as an environmental ethic (Hardin, 1968; Kolb, 1971; Stotler, 1971; White, 1970; Labinowich, 1970; Roberts and Dyrli, 1971; Underwood, 1971; Kormondy, 1971; Gastonquay, 1971).

Despite the almost universal agreement on the necessity of teaching some sort of environmental ethic to effect a positive use of knowledge and skills for resolution of environmental problems, a word of caution is in order. There is a difference between developing values which would lead to a general behavior aimed at attaining the general goal of improved environmental quality and developing specific sets of behavior as solutions to specific problems. If consideration of the environmental crisis has demonstrated anything at all, it is that nothing is as simple as it seems. Teachers who intend to develop specific behaviors as solutions to specific problems had better be certain that those behaviors are optimum solutions to the problems under consideration (Lucas, 1972).

This point is stressed because many of the publications discussing various aspects of the environmental crisis are ardent propoundings of solutions accompanied by little or no

analysis of the problem or consideration of either the alternatives to or the ultimate consequences of the proposed solution. According to Raths' definitions, the proposed actions could not be indicative of true values since all the alternatives and their consequences have not been considered. The authors of many environment oriented publications, including many in the field of education, exhibit an environmental ethic characterized by a sense of being right, an impatience with alternative ideals, and a zealotry to search out environmental wrongs as defined by their environmental ethic. Such attitudes ignore the tentative nature of scientific knowledge and are hardly based on the values which underlie science.¹ Materials exhibiting this type of environmental ethic are almost impossible to escape and can be quite useful in the classroom. Their uncritical use and acceptance by the classroom teacher may inadvertently result in development of similar ideals and attitudes in students, perhaps resulting in behavior that is actually counterproductive with regards to developing optimum solutions to environmental problems and effecting implementation of those solutions.

¹A good discussion of these values can be found in the third chapter of Education and the Spirit of Science, Educational Policy Commission, National Education Association, Washington, D.C. (1966)

CHAPTER IV

CRITERIA FOR CHOOSING ENVIRONMENTAL EDUCATION CURRICULAR MATERIALS FOR CLASSROOM USE

So far, this discussion has been generalized in discussing the need for and the characteristics of a fully developed comprehensive environmental education program. The model program was seen to have the following characteristics:

1. It should include all levels of schooling, i.e., Kindergarten through 12th grade.
2. It should be multi- and inter-disciplinary.
3. It should be concerned with affective as well as cognitive and process skill objectives.
4. It should be oriented toward studying and seeking resolutions of current real problems.
5. It should be founded on sound general principles of learning.
6. It should be organized around basic concepts such as that of the earth as a finite system with limited resources of which man is an integral part and on which man depends for survival.
7. It should be activity based and inquiry-oriented.
8. It should be student rather than teacher centered with students helping to generate at least some of the problems to be studied.

9. It should be organized so that the rate, scope, and sequence of instruction can vary to accommodate individual student differences in background, interests and abilities.

In the real world, few teachers have an opportunity to participate in an ideal environmental education program and many work in schools which have no environmental education program at all. As recently as four or five years ago, administrators and teachers alike deferred developing environmental education because suitable curricular material had either not been developed or was hard to obtain. This deferral has continued in large part because the evangelic environmental fervor of the late sixties and early seventies has diminished greatly and public pressure for schools to institute environmental education has concomitantly diminished.¹

The dearth of suitable curricular materials can no longer be cited as a sufficient reason to defer instituting environmental education. The eco-evangelism of the late sixties and early seventies impelled the federal government to finance the development of environmentally oriented curricular materials. New alphabet curriculum projects centering around environmental studies sprang full-grown, nourished by spates of federal money. Many

¹As Gastonquay (1971) pointed out, "causes fade away at a rate inversely proportional to their monetary gain or their excitability."

local school systems, receiving a smaller slice of the federal pie, began developing their own curricular materials geared to local need. Not to be outdone, the companies that exist in symbiosis with the educational enterprise--such as publishing houses and laboratory material suppliers--have begun to produce large quantities of materials geared to environmental education.¹

Whether educators wish to develop a complete environmental education program, to create a specific environmental studies course at any level, to include some units or modules in an existing course or to merely supplement an existing course with some incidental materials, a plethora of written, audio-visual, game/simulation, and laboratory materials are available. The problem besetting the harried educator is to select appropriate materials from the large array that is available.

Because much of the available material has been developed by local school systems with widely varying conditions, educators attempting to select materials for environmental education should consider several other criteria in addition to how well the materials complement the general characteristics of an ideal program. These criteria should include:

1. Are the required materials for implementation readily

¹Someone once postulated that the production of such a large mass of literature concerning pollution and the related topics of ecology and environmental quality has actually caused a measurable depletion of some natural resources.

available?

2. Is the cost of the materials appropriate to the adopted objectives?
3. How easy will it be for the teacher(s) to incorporate the materials into the program and to maintain them?
4. Are the materials suitable to the cognitive, reading, and mathematic skill levels of the students for whom they are intended?
5. Do the materials fit the particular teaching-learning situation (A set of materials designed for team-teaching in an open classroom situation would be quite inappropriate in most high schools, for example)?
6. Does the proper use of the materials require additional pre-service, in-service, or summer training for the teachers who are to use the materials, and, if so, will this training be available?
7. Can most of the materials be related to the environment which is normally available to the students?

Fortunately for educators, much of the bibliographic work has been completed so that finding appropriate materials is much easier now than it was even a year or two ago. The final chapter of this paper is bibliographic in nature and is designed to aid the interested educator in finding materials appropriate to whatever level of environmental education is being considered.

The first section of this final chapter is a secondary reference source: a bibliography of bibliographies divided into sources that list and/or review mostly written materials and sources that list and/or review mostly audio-visual materials. Significant overlap of these two categories will be noted where appropriate.

The second section is a primary material source and includes materials designed for classroom use that are not included in the bibliographies and source lists cited in the first section. This section is divided into four categories: full term curricula, modules and mini-courses, field trip guides, and games and simulations. There is often significant overlap of function, especially among the first three categories, and assignment of materials to one or the other of these categories is sometimes quite arbitrary.

The third section is a miscellaneous listing of materials that are difficult to classify such as some teacher's guides, resource guides and so forth.

The final section is a discussion of the use of science fiction as it applies to environmental education, especially education for values, in the middle and secondary schools. Included is a short list of science fiction short stories and novellas with environmental themes, a case study, and listings of secondary references and special resources.

A section on suppliers of laboratory materials for environmental education has not been included for two reasons: (1) most major suppliers of laboratory materials include quite

complete supplies for environmental studies; and (2) the commercially available environmental education laboratory supplies are, in general, very expensive. Most essential equipment can, and probably should, be assembled by teachers and students from cheap, readily available materials.

CHAPTER V.

GUIDE TO RESOURCES FOR ENVIRONMENTAL EDUCATION

Bibliographies

In this section, sources containing bibliographic listings of written and audio-visual materials are described. Type(s) of materials, indexing system, other pertinent comments, and a short evaluation are included for each citation.

A. Written Materials

(1) "Where have all the Flowers Gone? A Reference Guide and Sourcebook to Ecological Literature," Arrow Company, 3385 South Raunock, Englewood, Colorado, 80110 (1970).

This guide includes adult and children's books, periodical articles and some films. A one paragraph annotation is provided for books and films and all items including periodical articles are cross-indexed within twenty-four categories: agriculture, air pollution, animals and man, conservation, ecology and natural history, economics of ecology, food supply, forecasting and predicting change, general environment, man and environment, noise, oceans, pesticides, politics and ecology, population, recreation, resources, technical and industrial aspects, trees and forests, thermal pollution, urban environment, waste control, water pollution, and wilderness and wildlife. Most of the material included in this reference is not specifically designed for classroom use. It would be

useful for creating a list of supplementary reading materials to be available for student use in the library.

(2) Cunningham, M.C. and C. B. Cunningham, "A Selected Bibliography on the Relevance of Environmental Education to Secondary School Curricula," Virginia Polytechnic Institute and State University, Blacksburg, Virginia (1971). ERIC ED 056 911.

This bibliography provides resources for secondary school teachers in two major areas: (1) information about the environment and (2) means and methods of communicating that information in the classroom. It is divided into six sections. Part I, Bibliographies, includes collections and listings in specific areas such as films, conservation, and science. Part II, Agencies and Organizations, lists the names and addresses of groups providing extensive materials about the environment and environmental education. Part III, Journals, lists publications which emphasize the environment. Part IV, Environment, lists specific references which are informational in nature. These are classified in four categories: general, urban environment, population, and environmental resources. The latter classification is further subdivided into food and pesticides, air, water, noise, and energy. Part V, Environmental Education, separates general, environmental

quality and aesthetics, perception, curricula and programs, and techniques. Part VI, Materials, contains entries aimed toward secondary school students and includes literature, films and filmstrips, games and posters. This bibliography concentrates primarily on the man-made environment rather than on the traditional conservation of environmental resources. It is an excellent resource, usable for a number of different areas.

(3) "Environment Information ACCESS," Environment Information Center, Inc., 124 East 39th Street, New York, N.Y., 10016.

ACCESS is an indexing, abstracting and information retrieval service that covers both published and unpublished information on environmental pollution, conservation, and related fields. It provides an overview of the environmental reporting of over a thousand scholarly, scientific, industrial, technical, and general periodicals and major newspapers. It includes abstracts of important environmental radio and television programming, films, filmstrips, books, corporate publications and major conference publications. The introductory pages of each issue explain the ACCESS system, the Ecology Forum, the Microfiche retrieval system, and significant information appearing in each issue. The main entry section contains document abstracts. Other sections deal

with reviews of recent books in environmental subject areas; information on current conferences; and subject, industry, and author indexes. Much of the information in the ACCESS system is quite technical in nature and would not normally be suited to secondary school use, but careful use of subject descriptors can yield references to useful material. The ACCESS system would be especially useful if an individual student or a group of students wished to study some area in depth. The author has not personally used ACCESS and cannot comment on the extent of the ACCESS data base.

(4) "Outdoor Education, A Selected Bibliography (with ERIC Abstracts). ERIC/CRESS Supplement No. 2," ERIC/CRESS, New Mexico State University, University Park, New Mexico (1973). ERIC ED 073 903.

One hundred and eleven documents and eighty journal articles published during the period from 1965 to 1972 which deal with the subject areas of outdoor education, conservation education, recreation, ecology, and natural resources are listed. Types of material include research reports, program descriptions, instructional materials and teacher's guides. An index of subject terms is provided and ordering information for ERIC materials is included.

(5) "Environmental Education: A Selected Bibliography,"

Glassboro State College, New Jersey (1972). ERIC ED 068 363.

This is a selected bibliography cataloging texts, courses of study, research units, teaching devices, and general reference books related to environmental education. The materials noted are those available from the Curriculum Laboratory, Savitz Learning Resource Center, Glassboro State College, New Jersey, and are useful for both elementary and secondary grade levels. The fifty items cited are classified under the following headings: conservation, ecology, environmental education, outdoor education, pollution, science, or social studies. The materials described in this bibliography appear to be useful, especially for short-range programs or activities.

(6) Henderson, M. T., "Environmental Education: Social Studies Sources and Approaches," (1970). ERIC ED 042 062.

This is a guide to the use of available materials in social studies related to the following categories: (1) programs which allow individual inquiry and allow the child to explore and question; (2) programs which deal with the interaction between man and his environment and with the cultural patterns controlling man's perception of his environment; (3) programs which use the local environment or community as an integral part of the study program, offering the direct

involvement needed for learning through the environment;

(4) programs dealing with man in society--a study of values and the related political, social, economic, legal and ethical ideas. There seems to be quite a bit of overlap in the category descriptions and much of the material listed was probably assigned arbitrarily to one niche or another. This source would be useful in establishing and teaching a man/science/technology or a future studies type of interdisciplinary course.

(7) "Environment and the Community: An Annotated Bibliography," Department of Housing and Urban Development, Available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. (1971). ERIC ED 065 438.

This document lists 309 citations of books, reports, and periodicals published between 1965 and 1971. The citations are classified according to the following broad categories: general background, architecture and urban design, community facilities, ecology, environmental quality, environmental planning, housing, land use, mental and physical health, noise pollution, population pressures, recreation, technology: present and future, transportation and highways, and working conditions. A bibliography of bibliographies related to each classification is included at the end of the pertinent section. Selected films, periodicals, and organizations are included as

supplementary sources and an author index is included. Obviously this listing has an urban bias. It would be quite useful for establishing man/science/technology, future studies, and urban studies courses, but it also includes materials which would be useful for traditional science courses.

(8) Jackson, W.B. and J. C. DuShane, "A Collection of Resources for the Environmentally Concerned Educator," Environmental Studies Center, Bowling Green State University, Bowling Green, Ohio (1971). ERIC ED 075 190.

This is a mimeographed listing of information and resources available in environmental education. The foreword contains a rationale for environmental education, some basic characteristics of good environmental education, and objectives, curriculum components and philosophy for environmental education. The first major section deals with available information and is divided into three areas: Environmental Education, Environmental Overview, and Special Areas of Environmental Concern. Each of these areas is subdivided into five categories: background (history and philosophy); curriculum and instructional materials; general references; periodicals and publications; and information in specific areas such as air, economics, ethics, government, values, and so forth. The second section deals with primary resources and is divided into six areas: groups, agencies,

and organizations; audio-visuals and media; compiled resource lists such as bibliographies and film lists; games; sample activities; and a glossary. This source is a treasure trove of information and references.

(9) "Environmental Education Curricular Material," Minnesota State Department of Education, St. Paul, Minnesota, (1972).
ERIC ED 066 336.

This is an alphabetical listing of sources of various classroom aids according to grades K-3 and grades 4-6+ with the following subject headings: games, posters, maps and charts; multimedia kits; films and filmstrips; teacher's guides; resource materials, pamphlets and booklets; and individual curriculum units. A list of sources and publishers is included. This resource would be especially helpful in constructing a program for environmental education in middle schools.

(10) "Selected Bibliography and Audio-visual Materials for Environmental Education," Minnesota State Department of Education, Division of Instruction, St. Paul, Minnesota (1971).
ERIC ED 051 069.

The first section is an annotated bibliography of ninety-nine books and six periodicals. Some free and inexpensive material such as pamphlets, government documents, and other

bibliographies are also listed in the first section. The second section lists available audio-visual materials, dividing the films by grade level. Films appropriate for high school use are further classified under: man and natural resources, population explosion, problems of the cities, pollution, and the relationship of man to communities. This section also includes a list of audio-visual rental sources and the addresses of some companies which produce environmentally related films. The film listing is concerned with films available from the Minnesota Department of Education; its value for educators in other states is in informing them of the existence of certain films.

(11) Pepe, T. F., "Environmental Education: A Bibliography Pertaining to the Environment, Environmental Education, and Environmental Education Programs and Materials," Project R.I.S.E., 117 West Ridge Pike, Conshohocken, Pennsylvania (1971). ERIC ED 153 988.

This document lists citations according to a scheme which separates material by grade level and the material's emphasis of either ecology, pollution, or environmental education. The material is further categorized as sub-areas (curriculum, curriculum units and experiments); evaluative instruments; books and other published materials about the environment

including films, filmstrips, transparencies, kits and charts; programs and projects involved in environmental education; and environmentally oriented agencies and organizations. A bibliography of the sources used to assemble the document is also included. The classification system is somewhat confusing but any teacher willing to scan this ninety-page document will discover a wealth of available materials at all levels. The document includes only material published during the period from January of 1967 to March of 1971.

(12) "Environmental Education Resource Catalog," Phoenix Union High School System, Phoenix, Arizona (1971). ERIC ED 061 030.

This listing provides information about materials which are especially appropriate for classroom presentations in environmental curriculum development. The materials are classified as: conservation of natural resources; ecology and ecosystems; environmental action and survival; environmental laboratories; mapping; outdoor education; pollution; the urban environment; and wildlife environments. The items are indexed, annotated, and coded according to the types of material using the following categories: curriculum guides; pamphlets; charts and posters; films; filmstrips; games; reference books; periodicals; geographical survey maps,

picture stories, records, tapes and slides. This document is not as exhaustive as some others cited herein but the organization schema assures that it will be quite useful for working teachers, especially teachers who already have some idea as to the type of material they need. Overall it is perhaps the most useful of the bibliographies.

(13) Qutub, M. Y., "Environmental Science Bibliography," Mid-Continent Scientific, 5616 North St. Louis, Chicago, Illinois 60659 (1971).

This document contains a listing of environmental science information resources. Books, journal articles, pamphlets, research and technical reports, films and organizations are classified in alphabetical order according to the following topic schema: astronomy, conservation, earth science, environmental education, geology, meteorology, oceanography, pesticides, pollution (air, noise, nuclear, oil and water), population, waste, and wildlife. A listing of Environmental Protection Agency subdivision addresses, national ecology centers and other selected organizations with environmental concerns is included. The material cited in this document is not generally suited to the instruction of the average high school student. Much of it is not suited for the instruction of non-technical college courses. Nevertheless, it is to be recommended if a teacher needs to find material to: (a)

challenge superior students, (b) develop a technical or scientific subject in depth or (c) personally review specific technical or scientific areas in depth.

(13) Schwertzer, J. P., "A Bibliography of Popular Books on the Marine Environment and Wetlands Ecology," Maine Environment Curriculum Study, Delaware University, Newark, Maine (1971). Available on loan from ERIC/SMEAC, 400 Lincoln Tower, Columbus, Ohio, 43210. ED 067 230.

This document contains a list of books judged by a professional panel (one biologist, one science education professor, and fifteen working teachers) to contain teacher and background material useful in K-12 marine studies and wetlands programs. The annotated bibliography includes publisher's price (now outdated) and grade level. A directory of publishers is appended. This document is quite specific for aquatic ecology. It was included because this writer's own personal teaching experience indicates that pond, lake, creek, river or beach field studies are consistently profitable and fun--literally the highlight of the semester or school year for the students who participate. The documents listed can aid a teacher in planning appropriate aquatic ecology studies.

(15) Stegner, R. W., et al, "A Sourcebook for Population-Environment Studies: Experimental Edition," Population

Curriculum Study, 205 Willard Hall, University of Delaware, Newark, Delaware, 19711 (1972). ERIC ED 065 432.

This document was developed by teachers participating in a Population Curriculum Study Workshop. Three sections-- books, periodicals, and films--are each classified by subject according to the following descriptors: demography; ecology; genetics; medical science; natural resources; pollution; population control; regional planning and land use; social, political, and economic factors; and futurism. The books, including several curriculum guides and laboratory manuals, are coded by grade level. A topical cross-index and a list of film distributors are also included.

(16) Swann, S.C., "Environmental Awareness Bibliography," Friends Council on Education, Philadelphia, Pennsylvania (1971). ERIC ED 063 145.

This document is concerned with both secondary and college education. The first section is a selected bibliography of printed material on the environmental crisis and on action which individuals, groups, and the academic community can take to deal with this crisis. Much of the material listed in this section seems to be eco-evangelic in nature and teachers should examine any materials listed in this section before ordering large quantities. The second section lists programs, courses of study, and lesson plans in four categories: outdoor

education, conservation education, nature education, and environmental education. There is, of course, a great deal of overlap in these four categories and some materials have been arbitrarily assigned. The final section is an annotated bibliography of outdoor recreation and back-to-nature type of literature.

(17) Watkins, J. C., "Ecology and Environmental Quality: A Selected and Annotated Bibliography for Biologists and Earth Scientists," Syracuse University Library, 308 Carnegie Library, Syracuse, New York, 13210 (1971).

This document is designed for those seeking information concerning the biologic aspects of land, air, and water pollution and information concerning geographic and geological facets of the biosphere. Books, periodicals, symposia and conference proceedings, maps and pamphlets published during the approximate period from 1950 to 1970 are listed. A special listing of relevant paperbacks and their sources is included along with a typical listing of appropriate organizations and film distributors.

(18) Watt, L. B. and M. H. Thomas, " Environmental-Ecological Education: A Bibliography of Fiction, Non-Fiction and Textbooks for Elementary and Secondary School," ERIC Clearinghouse for Social Studies/Social Science Education, Boulder, Colorado

(1971). ERIC ED 055 937.

The books were selected on a basis of three criteria: publication during the period from January 1, 1969, to May 25, 1971; critical reception or favorable review by at least two professional journals; and ecological content. Non-fiction juvenile titles in the first two sections are classified according to three themes: (a) problem--endangered species, over-population, hunger and pollution; (b) available natural resources and their utilization as the basis for the solution of problems; (c) surveys of what has been done in recent years to "repair the damage." Biographies, animal stories and ecology picture books are included in the second section. The third section lists fifteen juvenile fiction books "about encounters between animals and people, imagined or fictional, but relevant to everyday happenings; some are fantastic in nature." A better description for some of these stories would be infantile and irrelevant, but they may have a place in lower middle schools if carefully used. The juvenile fiction stories are conservation-oriented nature stories with little or no emphasis on man except as a disturbing element, as an interloper out of tune with the natural order of things. The complexity that is inherent in ecology is not demonstrated at all by those stories that this author could obtain for review. The fourth section lists science and social science texts. Teacher's resources are listed in the fifth section.

Appendices include review sources, and author and title indexes. This document contains useful material but it also contains material which could be counterproductive if used improperly. The fiction listed indicates that the compilers and/or their sources are familiar with neither the use of fiction for value clarification in the classroom nor the science fiction sub-genre specifically concerned with environmental and ecological matters.

(19) Grimes, M. H., "Environmental Organizations," Congressional Research Service, Library of Congress. Available from the Superintendent of Document, U. S. Government Printing Office, Washington, D. C. (1972). ERIC ED 068 331.

This is a quite extensive list of environment-oriented groups included government agencies, national organizations, regional and State councils and various smaller groups which are listed by State. Most of them distribute environmental or conservation information and many publish newsletters or magazines, informative pamphlets, and action guidebooks. Also included are a few groups which are not primarily environmental in nature but which pursue strong and continuing environmental programs. Each of these entries includes the official name and address of the listed group. This document enables teachers to easily contact appropriate groups in their own area.

B. Audio-visual Materials.

(1) Adams, J. L. and H. H. Michand, "A Selected List of Filmstrips on the Conservation of Natural Resources," Interstate Printers and Publishers, Inc., 19-27 North Jackson Street, Danville, Illinois, 61832 (1968). ERIC ED 047 938.

One hundred fifteen conservation filmstrips are described regarding content, sources, grade levels, curriculum areas and notes of interest to the user. Content descriptors include: general conservation; ecology and resource interrelationships; forest trees and other plants; forest conservation; minerals; soil and land; soil and water conservation; water; and water conservation. A list of film-strip producers is appended.

(2) "Combined Film Catalog, 1972; United States Atomic Energy Commission," Atomic Energy Commission, Washington, D.C. (1972).

This document describes films in two major collections. The first is of interest to educators and describes 134 films. Grade level is indicated and subject matter descriptors include: biology and agriculture; environment and ecology; industrial application; medicine; peaceful uses; power reactors; and research. One of the films was borrowed and reviewed; production, cinematography, and so forth were excellent but the film, which discussed power reactors, was

definitely biased. AEC films are excellent sources, but, like the eco-evangelic literature, should be recognized as propaganda and used accordingly.

(3) Bueth, C., et al, "School Learning Materials on Water Problems of New Mexico and the Southwest," National Technical Information Service, Springfield, Virginia, 22151 (1972).

This "document" is a set of audio-visual mediated learning packages based on water problems of the arid southwest U.S.A. The packages are designed for three levels--grades 3-6, grades 7-12, and adult. Each package consists of a set of color slides and accompanying tape recordings, a copy of the tape script, and suggestions for educational use. Use of the materials has been field tested and research shows that groups of learners using the packages at all three levels showed a more accurate reflection of valid water problems than did learners who used available library materials or no special learning materials. The instrument used to measure accurate reflection of valid water problems was constructed by the package designers. These packages would be quite useful for constructing audio-visual tutorial packages.

(4) "Water Films," Canadian National Committee, Ottawa, Ontario, (1970). ERIC ED 067 224.

This document is an annotated listing of 455 films on

hydrology and allied fields. The films are listed alphabetically according to title in the following subject classifications: hydrology, meteorology, ground water, snow and ice, glacierology, geomorphology, hydraulics, water quality, conservation, oceanography, and hydro-electric projects. An index of film titles and a source listing the names and addresses of organizations from which films may be obtained are appended.

(5) Cuzon du Rest, R.P., "Films on Oceanography," Naval Oceanographic Office. Available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. (GPO-O-338- 156).

Films are listed under six categories: general oceanography, biology, chemistry, engineering, and physics. Each film is described with regards to content, run time, physical description, audience or grade level, and sources and procedures for procurement.

(6) "The Environmental Film Review. A Critical Guide to Ecology Films," Environment Information Center, Film Reference Department, 124 East 39th Street, New York, New York (1972).

This document lists critical reviews of over 600 films. The first section lists film reviews of the films classified according to the ACCESS system descriptors (see reference A-3 above). The second section is an index section which allows

films to be located by subject, industry, sponsor and title. Each review gives the title, the film's physical characteristics, the producer and/or distributor, the audience or grade level, cross-referencing numbers and rating following by a synopsis of content, treatment, and ecological objectivity. None of these films were reviewed by this writer but comments included in the introduction to the document indicate that the author's approach is accusatory and that they furnish emotional commentary, i.e., they are classic eco-evalgelists. A perusal of film titles and the descriptions of film content seem to indicate that many of the films also are accusatory and/or hand-wringing in nature and that few explore alternative solutions to pollution problems. Teachers should exercise care in selecting titles from this listing.

(7) "Audiovisual Materials for Environmental Education," Minnesota State Department of Education, Division of Instruction, St. Paul, Minnesota (1972). ERIC ED 066 327.

The films are listed according to three instructional levels: primary, intermediate and junior-senior high school. The latter section is subdivided according to the following subject matter descriptors: man and natural resources, population explosion, problems of the cities, pollution, and relationship of man to community. A description of each film includes the producer, rental price and order number, physical

characteristics, and a summary of contents. A list of audio-visual rental sources and company addresses is included.

(8) Moorachian, R., ed., "What is a City? A Multimedia Guide on Urban Living," Boston Public Library, P. O. Box 286, Boston, Massachusetts, 02117 (1972).

This document is a catalog of books, pamphlets, periodicals, films, filmstrips, loops, recordings and miscellaneous sources. All items were evaluated for usefulness as an interpretation of any aspect of city living with the basic criterion being how well a facet of city life is explained or illuminated. Each entry gives bibliographic data, physical characteristics, appropriate grade level and a one-paragraph review. A list of addresses of publishers and distributors is appended.

(9) "Index to Ecology (Multimedia)," National Information Center for Educational Media, University of Southern California, University Park, Los Angeles, California, 90007 (1971).

The listing is quite extensive. Over 7,000 films, videotapes, transparencies, recordings and other audiovisual and multimedia presentations on ecology and the environment are listed alphabetically according to title, with a summary of the content and other pertinent information such as physical description of media involved, running time, grade level and

name of producer and/or distributor. Titles are cross-indexed according to subject and producer/distributor.

(10) Pratt, J., et al, "Environmental Education," American Institute of Architects, Washington, D. C. (1970). ERIC ED 042 676.

Much of this document is an essay advising professionals in all fields to cooperate with educators in promoting environmental education. It does, however, contain a guide to projects, kits, resource books, periodicals, and films and film strips. A section describing some instructional materials according to concept and emphasis, materials used, and source of origin is also included. Indexes to projects and materials are appended.

(11) Trohanis, P. L., "How to Present Audible Multi-Imagery in Environmental Ecological Education," National Science Teachers Association, 1201 16th Street, N.W., Washington, D.C., 20036 (1971). ERIC ED 053 979.

This document is not a bibliography but an instructional booklet detailing the creation of a multi-media show or, more specifically, an environmental three-screen slide and film presentation. The integral development and display of two or more simultaneously projected visual images by way of slides, motion pictures, and/or overhead transparencies

coupled with audio track is discussed in detail.

Curricular Materials for Environmental Education

A. Semester and Full Year Programs¹

(1) Exploring the World: An Environmental Handbook for Students, Billings Public Schools, Billings, Montana (1972).

ERIC ED 059 082.

This course is designed for self-paced instruction in middle schools and all investigations, experiments, and field studies are written so that students may perform them on their own. The broad objective of the course is defined as environmental literacy. Units include measurement, plant ecology, aquatic ecology, plot studies, environmental degradation, and geography. Each exercise outlines some general background information, the objective of the activity, and procedures for conducting the activity. Data sheets for recording observations are included with each activity.

(2) Me and My Environment Series, BSCS, Boulder, Colorado (1972). ERIC ED 071 264 through ED 071 267.

This course is designed specifically for thirteen-fifteen year old educable mentally retarded children, but many of

¹The nationally famous curriculum projects such as ESCP, ISCS, etc., are not included in this resource guide. The writer is assuming that classroom teachers are either already familiar with these or can easily obtain materials describing them. The implication that they are somehow less useful than the materials listed in this guide is not intended.

the activities can be adapted for use with normal students. The four major units are: I - Exploring My Environment; II - Me as a Habitat; III - Energy Relationships in My Environment; IV - Transfer and Cycling of Materials in My Environment. Ecological themes, inquiry/problem solving skills, environmental elements, and pertinent behaviors and attitudes are stressed throughout the program. The ecological themes stressed are: interrelationships of environmental components, diversity and pattern, complementarity of organism and environment, and the cyclic nature of processes. Descriptions of activities and the teacher's guides are divided into materials, strategies, and anticipated student behaviors.

(3) Buchanan, J., et al, A Teacher's Guide for the Course: Toward the Year 2000 (A Multi-disciplinary Approach), Cherry Creek High School, Anglewood, Colorado, (1970). ERIC ED 055 940.

The guide describes methods, materials, and procedures for inter-disciplinary teaching of this course. Major disciplines included are social studies, mathematics, English and science. The overall objectives are listed as: (1) teaching the elements and processes of decision making; (2) improving processes of communication; (3) developing an awareness of the interaction of society and technology; and (4) developing an awareness of present levels of technology and the future direction technology may take. Student-centered problem solving groups

deal with relevant, real-life situations. Small, medium and large groups are randomly selected and flexibly scheduled. Unit titles are: Elements of Decision Making; Communication; Nation Building; International Simulation (this can include computer instruction); The Environmental Crisis; Labor versus Management; and Major Urban Problems. Most teachers would probably not adopt this course as is because of scheduling difficulties, possible team-teaching problems, and so forth. Many of the activities and suggestions could be adapted to a variety of classroom situation, however.

(4) All Around You: Environmental Study Guide, Bureau of Land Management, Department of Interior, Washington, D.C. (1971). Available from Superintendent of Documents, U. S. Government Printing Office, Washington, D.C., 20402 (Stock No. 2411-0035). ERIC ED 064 131.

The objectives for this middle school course include: understanding basic environmental relationships; developing investigative and problem solving skills; and individual motivation to help solve environmental problems. The three major units are Awareness, The Urban Ecosystem, and Nature's Ecosystem. Teacher's pages are included in each section which give a perspective on the content. This is an activity-based course and it can be individualized although it was not designed for individualized instruction. The activities begin in the classroom and then move to the field. They

require finding the answers to questions by field investigation and by laboratory experiments, by library research and by talking with knowledgeable persons. The approach is an inquiry approach in the broadest sense and it resembles true research much more than the artificial inquiry methods of most science courses. Appendices include a glossary of environmental vocabulary terms, two bibliographies--one for beginners and one for advanced--of supplementary readings, and a list of environmentally concerned organizations.

(5) Catlin, R., et al, Every Man's Problem, An Instructional Unit for Senior High School Science, Student Manual and Teacher's Manual, Board of Education of Baltimore County, Towson, Maryland, 21204 (1970). ERIC ED 059 40.

This course is an in-depth study of a community--how it was established and how it developed. The emphasis is on the environmental changes which have occurred through the use and management, or lack thereof, of natural resources. A series of investigations into the causes of change is described. Each investigation includes a list of necessary materials, the procedure, and questions to help interpret results. The teacher's manual includes suggestions regarding preparation for the investigations, the expected results, responses to the interpretation questions, assessment tasks and acceptable responses to the assessment tasks. A list of

behavioral objectives is included for evaluation of the degree of understanding reached by students. The course was designed for Baltimore but it can readily be adapted to most cities and larger towns. Some of the investigations might produce results other than those listed in the teacher's manual, some of the responses listed as satisfactory answers for interpretation questions are limited in scope and direction and some of the acceptable responses listed for the assessment tasks are also limited in scope and direction. Behavioral objectives are unimaginative. A teacher aware of these shortcomings could use the course to excellent effect.

(6) Dasman, R. S., Environmental Conservation, John Wiley and Sons, 605 Third Avenue, New York, New York, 10016 (1971).

This is a traditional textbook-lecture course written for beginning college students and applicable to college-bound high school seniors. The emphasis is on American problems with some global implications. Chapter topics are varied and include: Urban Blight, Chemical Pollutants, Dwindling Fuel and Mineral Resources, Vanishing Wildlife, and Rampant Technology. A bibliography of suggested additional reading is included with each chapter.

(7) Fagerstrom, R. A. and B. Borad, Environmental Issues Conflict Unit: Teacher's Guide and Student Book, Diablo

Valley Education Project, Orinda, California (1972). ERIC ED 073 032.

This is a secondary environmental issues course specific to California. Parts of it can be adapted to other areas. The course consists of four major units, the first dealing with basic ecology. The second unit stresses man's ethics with regard to the use of the environment. The use of wilderness areas and of non-living ocean resources serves as focus problems for this unit. The third unit requires students to examine the right of Walt Disney Productions to develop the Mineral King area of the Sequoia National Forest in California into a resort. The final unit deals with ocean resources; issues discussed range from oil spills and fishing rights to the division of wealth in the ocean. The authors claim that the course uses inductive methods to "encourage students to discover controversy through various suggested activities." Actually, the controversies are fairly explicitly stated and the authors' views of right and wrong are often implied, sometimes quite strongly. The writer of this paper agrees with Fagerstrom and Borad on most of the issues presented; that, however, does not alter the fact that students not only do not discover the issues themselves, but often are not allowed to develop their own value judgments. The teacher's guide includes lesson plans with a rationale for each lesson, objectives, student assignments and procedures for conducting

each investigation and/or discussion.

(8) Harrington, R. F. and R. C. Passmore, Learning About Environment (Student's Text and Teacher's Manual), Canadian Wildlife Federation, 1419 Carling Avenue, Ottawa, Ontario K.I.V 727 (1972).

This is the first of a series of planned ecology units for middle schools. The principal aim of each unit is to offer a teachable block of material which will provide students with an understanding of the environment and their role in it. The text was designed for a lecture-discussion-homework type of course and it would be hard to individualize or to use for self-paced work. Topics discussed include man's place in nature, the complexity of interactions within natural systems, the vulnerability of individual strands of delicate ecological webs, the limits of the earth as an ecosystem, and resource conservation. The student text is well illustrated with both photographs and pen and ink drawings. It includes descriptive subject information and vocabulary words and there are thought and discussion questions at the end of each of the ten chapters. The teacher's manual contains additional background information and examples, suggestions for teaching, and references to supplementary reading arranged in a chapter by chapter sequence.

(9) Humphrey, E. C. and R. G. Evins, What's Ecology?, Hubbard Press, 2855 Sherman Road, Northbrook, Illinois 60062 (1971).

This text is designed for a high school reading-lecture-discussion type course and adapting it to another format except as supplementary reading would be difficult. The text and illustrations attempt to develop an overview of Planet Earth as an interactive unit to establish a basis for understanding and applying fundamental scientific principles to ecological problems. A cultural perspective to Earth's eco-dilemma is presented along with the science content. Major concerns are cultural implications of ecology and the development of a system of human behavior that will assure survival. If one wishes to teach the type of course indicated above and if the prospective students have few reading difficulties, this would be an excellent text.

(10) Kefford, C. W., Nuffield Foundation - Resource for Learning Project: A Multi-Media Programmed Approach to Environmental Studies, Nuffield Foundation, Leeds, England (1968). ED 049 986.

This document is a description of units on environment at the middle school level. The focus of the program is the coordination of several media--films, tapes, books, etc.--into a self-paced individualized course of study. Students perform a combination of classroom activities, field studies,

and simulations. Units developed to date include: traffic, highway codes, railways, farming, roads and houses. Although this is a definitely British curriculum, much of it can be adapted for American environmental education.

(11) Levy, A. G., A Man-Made Environment, Group for Environmental Education, 1214 Arch Street, Philadelphia, Pennsylvania, 19107 (1969). ERIC ED 045 026.

This is advertized as a junior high curriculum, but it seems a little below most 9th graders' level. A more accurate descriptor would probably be middle school or intermediate. It is in workbook form and is organized around three basic question: (1) what is the man-made environment? (2) why is it? (3) and how can we change it? A series of related problems and discussions, experiments and activities are suggested. Building materials and architectural plans are often used as aids in helping students understand the man-made environment. The workbook contains many pictures, cut-outs, and so forth.

(12) Alternatives for Man and Environment: Revised Curriculum Miami-Dade Junior College, Miami, Florida (1972). ERIC ED 071 856.

This document describes a one-year, interdisciplinary, individualized, modular, general education, junior college course. This course is only one example of many of the

environmentally related curricula developed at Miami-Dade Junior College. It, and the others, can be adapted for use in a high school curriculum. Modules have been designed for each of the twenty topical areas: ecological imperatives; value systems - ecological priorities; belief systems; the myth of technology; Earth as an energy system; conservation of vital resources; population dynamics; urbanization: the living community; water - supply, demand and pollution; wildlife and man; soil and man; intergroup tensions; impact of political systems; impact of economic systems; and media and the environment. Each module offers from one to five alternative routes of study and a section outlining an overview of the module. Concepts to be developed, learning activities and student objectives, and necessary resource materials are described for each module. Where appropriate, a chart is constructed indicating each concept objective, strategy for developing it and suitable evaluation procedures to determine its attainment. A bibliography is included for each module.

(13) Education for Survival: Ecology in Science and Social Studies. Curriculum Guide for Grade V, North Jersey Conservation Foundation, 300 Medham Road, Morristown, New Jersey, 07960 (1972).

This interdisciplinary course is suitable for higher

middle school levels as well as the fifth grade. It is basically a reading-discussion course which requires students to compare and evaluate their attitudes, values and concepts regarding the interrelatedness of man and his social, cultural and biophysical environments. The curriculum is presented in outline form, listing major concepts and learning activities, vocabulary aids, experiments, discussion questions and suggested reading for each of the seven units listed below. The first half of the course is scientific in nature and consists of three units: Water, Oceanography, and Plants. The second half of the course approaches social studies from an historical perspective, including units on colonization, westward expansion, landscape architecture and the American Indian. Throughout the course students are asked to examine decisions, plans, and actions which affect or affected environmental quality. Two rather simple dramas concerning environmental issues are also included.

(14) Pfeiffer, C. H., The Interaction of Man and His Environment, Monona Grove High School, Monona Grove, Wisconsin, (1968). Available from Wisconsin State Department of Education, Madison, Wisconsin (1968). ERIC ED 053 945.

This is the course outlined for the third year of a four year unified high school science program. This course

is the less technical of the two third year options. It is a traditional lecture-homework-deductive laboratory type course, but it can be adapted to a more inductive approach. The three major units are: Structure and Dynamics of the Biosphere; Population Structure and Dynamics; and Science and the Evolving Society. Each major unit is further subdivided and the text materials for each unit subdivision include: required and suggested reading; introductory questions; and a brief background reading; lecture outlines; laboratory activities and investigations; assignments which include written reports on laboratory activities, discussion questions, fill-in-the-blank questions, and problems; summary statements; and review questions. Although it is described as a unified science course, it is largely biologic in nature.

(15) Mice and Men/Environmental Balance, Parts Three and Four of an Integrated Science Sequence, Student Guide, Portland Project Committee, Portland, Oregon (1970). Available on loan from ERIC/SMEAC, Ohio State University, 400 Lincoln Tower, Columbus, Ohio, 43210. ERIC ED 076 328.

The Portland Project has developed a three year integrated high school science curriculum of which the above titles are Parts Three and Four of the first year. Emphasis is primarily biologic. The guide to Mice and Men discusses: the cell,

reproduction, embryology, genetics and genetic diseases, genetics and change, populations, density effects on populations, ecosystems, and community. The guide to Environmental Balance includes related topics with an ecological twist. After discussing ecosystems in general terms, the harmful effects of human activity in upsetting the balance of ecosystems is studied. Topics include: water pollution, air quality, and the effects of air pollution. A separate chapter "Where do We Go From Here?" ends the sequence. Laboratory exercises are suggested with space in the student guide provided for notes. A list of supplementary materials--films, periodicals, reference materials and laboratory manuals--is provided.

(16) Fargo, H. J., An Environmental Approach to Eighth Grade Science, Huxley College of Environmental Studies, Western Washington State College, Bellingham, Washington (1971).
ERIC ED 059 950.

This course is designed for the purpose of inclusion in a standard general science curriculum and the above document is a teacher's guide. The orientation is toward developing inquiry and problem solving skills within a local community setting. The teaching strategy is as follows. Each class is divided into three or four heterogenous groups simulating a community situation. Students in each group choose from a list of environmental topics and are given a "group plan"

comprised of a list of general questions unique to their chosen subject area to guide their research. The instructor's role is that of a facilitator, not a leader. Students are encouraged to expand their learning sources and to gain actual environmental experience within the community through letters to organizations. Block scheduling is suggested. Provided in the curriculum materials are: reading, information, and suggested community sources. More than half the book consists of appendices including: Student Correspondence; Student-Oriented Information for Distribution; Resource Bibliographical Information; Student Papers on Speakers, Filmstrips, and Movies; and Excerpts from Group Plan Records. The appendices are case-study in nature.

(17) Schlitt, D. M., et al, Life: A Question of Survival, Pawnee Publishing Co., Inc., Boulder, Colorado, 80302 (1972).

This is a junior high text organized around every day problems that relate to survival and science. It is activity-centered and the questions, problems and investigations are oriented towards the objective of students' developing skills in identifying and solving problems rationally and systematically. The seven major units are: Organization for Survival; Adaptation for Survival; Need for Survival; Utilizing Foods; Maintaining the Environment; Responding to the Environment; and Perpetuating the Species--Survival Through Time. Each chapter

includes a summary, a list of supplementary reading and a set of self-test questions. This is basically a life science text disguised as environmental science.

(18) Adventures in the Environment, Silver-Burdet Co., Division of General Learning Corporation, Morristown, New Jersey (1971).

Although Silver-Burdet advertises this middle school curriculum as interdisciplinary, it is primarily biologic in nature. The general objectives are described as environmental awareness and environmental ethics. The curriculum includes student manuals, outdoor books and a teacher's guide. There are twenty-one lessons built around five major themes or strands: variety and similarity; patterns; interaction and interdependence; continuity and change; and adaptation and evolution. For each of the twenty-one lessons, the teacher's guide includes advice on lesson development; incorporation of major themes into the lessons, teaching suggestions, activities for student exploration of environmental problems, and questions which may arise in solving problems or in shaping one's environmental ethic. This is a typical Silver-Burdet effort designed to fulfill a projected need. If a teacher likes other Silver-Burdet texts, the teacher will like this one too.

(19) Stoker, H. S. and S. L. Seager, Environmental Chemistry: Air and Water Pollution, Scott Foresman & Co., Glenview,

Illinois (1972).

This is a freshman/sophomore college level text but it can be adapted to a high school chemistry course. It also furnishes a wealth of information and ideas for high school chemistry teachers who wish to develop an environmental unit or module. The section on air pollution deals with typical air pollutants such as carbon monoxide, oxides of nitrogen, hydrocarbons and photochemical oxidants. Particulate pollution, the effects of temperature inversions and the greenhouse effect are also discussed. The albedo effect--increased reflection of solar energy due to excessive particulate loading in the upper atmosphere resulting in a theoretical decrease in global temperature--is not discussed and teachers should keep this in mind if the section on the greenhouse effect, which causes a theoretical increase in global temperature, is used. The section on water pollution discusses mercury, lead, detergent (but not fertilizer), pesticide, and oil pollution, and the chemical treatment of wastewater. The main focus of both sections is on the chemistry and chemical compounds involved although, as is almost unavoidable in environmental science, there is some overlap into other areas. Each chapter includes a list of supplementary readings related to the chapter topic.

(20) Turk, A., et al, Ecology, Pollution, Environment, W. B. Saunders Co., West Washington Square, Philadelphia, Pennsylvania, 19105 (1972).

This text is designed for use with a traditional lecture-recitation course for upper level college-bound, secondary students. It can be used to structure an introductory environmental science course and/or to supplement existing chemistry and biology courses. Two aspects of environmental education are considered--subject matter and decision-making. Relevant background information is presented under the following topics: ecology, agricultural environments, pesticides, radioactive wastes, air pollution, water pollution, solid waste, human population growth, thermal pollution, and noise. Study problems, i.e., for homework assignments, are included at the end of each chapter with numerical answers provided for those problems that require computation or mathematical reasoning. To deal with decision-making, a discussion of social problems and issues is included to demonstrate how various scientific and economic factors must be taken into account so that final judgments do not lead to unwanted results. Each chapter includes a bibliography. Appendices give information on units of measurement and chemical formulae. This text's primary use should be as a reference book for the teacher rather than as a text for students.

(21) Warpinski, R., A Supplementary Program for Environmental Education, Project I-C-E, Green Bay, Wisconsin (1971). ERIC ED 055 917 through ED 055 919.

These curricular materials consist of teacher's guides for each grade from Kindergarten to twelfth grade in three different areas: social studies, science and language arts. Each guide for each individual subject and grade contains lesson plans and ideas for integrating environmental education into an existing curriculum. Each lesson originates with a fundamental concept relating to the environment and states additionally its subject area, its discipline area, and its problem orientation. Behavioral objectives and suggested learning experiences are outlined. The behavioral objectives include objectives in the affective (that of attitudes and values) domain as well as the more common cognitive objectives. Suggested learning experiences are primarily student-centered in-class activities with a few outside resource and community activities also included.

(22) Weaver, H. C., Environmental Pollution (Experience/Experiments/Activities), Holt, Rinehart & Winston, Inc., 383 Madison Avenue, New York, New York, 10017 (1972)

This junior high level curriculum includes student books and teacher's guides. It is inquiry and activity centered and the experiments are designed to acquaint students with relatively simple community environmental problems. The activities emphasize some of the materials involved in pollution problems and acquaint the student with methods of detection and removal of unwanted materials from both air and water.

The activities are designed to be as open-ended as the teacher desires. Each activity is followed by elementary and advanced pollution quizzes. The teacher's guide includes background information, procedures for performing the experiments, equipment needed, possible solutions to problems, and additional approaches for conducting activities. Modification to meet local community conditions are encouraged and suggestions to aid in effecting this goal are included.

B. Modules and Mini-Courses

(1) "Unit: Life in Fresh Water. Inspection Set, National Trials," Australian Science Education Project, Toorak, Victoria, Australia (1972). Available on loan from ERIC/SMEAC, 400 Lincoln Tower, Columbus, Ohio, 43210. ERIC ED 061 106.

These activities are designed for individualizing science instruction in grades 7-10. The first student book includes six basic activities designed to effect understanding of aquatic habitats with readings on energy exchange, exchange of gases, and the structure of aquatic food webs. The second student book includes nine optional activities involving study of: fresh water quality, variations in habitat within a river, fish actions, and sewage treatment. Most of the optional activities involve student experimentation and/or information retrieval. A test booklet contains twenty-eight multiple choice questions with references to appropriate sections of

material if remedial work is needed. The teacher's guide provides an overview of the unit, suggestions for organizing the study, lists of apparatus, and suggested sources of reference material.

(2) "Environmental Education the Organic Way," (1972). Available on loan from ERIC/SMEAC, 400 Lincoln Tower, Columbus, Ohio, 43210, ERIC ED 068 361.

This is a package of assorted environmental education materials for all levels. Items include: (1) teaching aids for science, health and nature study entitled (a) "Insects - Here to Help You in the Environment," a color filmstrip, cassette recording and teacher's guide for grades 7-12; (b) "Color Me Healthy," a coloring book designed to introduce primary students to nutrition; (c) "Guide to Composting," a teacher's guide and large poster for use with grades 5-8; (2) "Teaching Science with Garbage," a single-concept unit designed for science, mathematics, and social studies courses at the intermediate/middle school level; (3) organic classroom materials including "Basic Organic Gardening Course," a teacher's guide for all levels and its companion text, "The Basic Book of Organic Gardening"; and (4) a series of reprints on various subjects from the periodical Organic Gardening and Farming.

(3) "Environment Teacher's Manual," Environment Education Project, Grafton, Illinois (1972). ERIC ED 067 241 through ED 067 246 and ED 070 680 through ED 070 681.

These documents are a series of manuals for four levels: primary, intermediate, junior high and high school; and three basic themes: water, air and land. The author's intention is for the teacher and student to cooperatively plan the approach and content to be used during the student's course of study. Teacher resource information and student material are both included in each manual. Project objectives, behavioral objectives, and pre- and post-test items introduce the unit section. These are followed by ideas, actions and/or activities for developing awareness of air/water/land quality and pollution effects. Suggestions for field trips and additional resources are listed.

(4) "Science Experience Unit: Conservation," Ferguson-Florissant School District, Ferguson, Missouri (1971). ERIC ED 054 139.

This module includes twenty-four middle school level activities divided equally between laboratory studies and field studies. A specific skill or content objective is described for each activity. Detailed procedures and numerous illustrations are provided for each activity. A bibliography of books, films and charts, and illustrations for tree and insect identification are included.

(5) Hatch, R. C., "Recycling Resources," Creative Teacher, Inc., P. O. Box 5187, Grand Central Station, New York, New York, 10017 (1972).

The curriculum is best described as a three-week mini-course for junior high school science. Materials include student handbooks, sound filmstrips, a twelve inch record, a pollution simulation game, and a teacher's manual. A handbook defines the nature of pollution and encourages investigation into the sources of and planning strategies for combating local community pollution. The filmstrips and the record are concerned with the environmental consequences of pesticides and interdependence, and pollution and depletion of natural resources as a consequence of current life styles, respectively. The simulation game requires students to role play citizens of Ecopolis and to make decisions regarding the quantity of goods to be manufactured, disposal of waste products, and economic and social costs. Enough material is provided to allow four groups of five to nine students to play simultaneously. The teacher's manual furnishes lesson plans with concept and skill objectives, background information, and teaching procedures.

(6) Hershey, J. T., et al, "A Curriculum Activities Guide to Water Pollution and Environmental Studies," Tilton School, New Hampshire (1970). ERIC ED 045 380.

Each of the activities in this teacher's guide are

classified according to one of the four following descriptors: Hydrologic Cycles, Human Activities, Ecological Perspectives, and Social and Political Factors. Each activity includes seven parts: an introduction, questions, procedures, results expected, limitations and problems likely to be encountered with the activity, and an annotated bibliography of related reading. Appendices include: a discussion of water quality parameters; aids to implementation; suggestions regarding limitations and inconveniences; suggestions related to evaluation; a bibliography; a water pollution and environmental glossary; and comments regarding laboratory and field safety. This document is over 600 pages long and contains activities ranging in quality from terrible to terrific. Any teacher attempting environmental education could use it.

(7) Kaplan, B. G., "Environmental Issues: A Study Guide," Available on loan from ERIC/SMEAC, 400 Lincoln Tower, Columbus, Ohio, 43210, (1970).

This is a mini-course designed for integration into an on-going high school curriculum. Each unit includes background information, discussion topics and questions and suggested readings and references. The guidebook is written so that students can use it either alone or in conjunction with class assignments. Unit titles include: Earth Develops its Atmosphere; Energy and Materials; Fundamentals; Characteristics of Ecosystems; Production of Food; Power Production; Harmful

Chemicals in the Environment; Transportation; Environmental Management; Principles and Methods; and Some Ubiquitous Management Problems.

(8) King, P. and J. Landahl, "Population," Washington State Office of Public Instruction, Olympia, Washington, (1971). Available on loan from ERIC/SMEAC, 400 Lincoln Tower, Columbus, Ohio, 43210. ERIC ED 054 938.

This guide is designed to help teachers provide students with some basic concepts, with stress placed on elements of decision making. Section 1 develops concepts necessary for population education, such as: growth, birth and death rates; doubling time; migration; age structure; population projections; and carrying capacity and natural regulation. The second section provides a brief overview of world, North American, and State of Washington population growth; and discusses both the ramifications of population growth and ways in which growth rates can be reduced. Section 3 provides sample teaching-learning activities which illustrate the wide range of possibilities for weaving population study into the total curriculum. A tear-out section for student use requiring decision making skills and a bibliography of books, teaching materials, films, and games are included.

(9) Kroll, C. J., "An Environmental Unit for Survival Studies,"

(1972). ERIC ED 068 348.

The unit deals specifically with Illinois strip mining. The author claims that students are encouraged to use the inquiry method to discover for themselves the facts, problems, values, conflicts, and potential solutions of an environmental issue. While many of the facts, problems, etc., are presented for the student, thereby weakening the claim to total student discovery, the author's bias against strip mining appears only occasionally and in a very subtle manner, i.e., she succeeds in being relatively objective. Materials and instructional strategy necessary for classroom use are presented. Chapter One defines the purpose, importance and significance and the terms of the topic and unit. The second chapter lists behavioral objectives, instructional aids, introductory activities, activities to yield deeper knowledge and understanding, accumulative activities, and methods of student evaluation. The third chapter presents a summary and several appendices which include: a list of free materials, instructional aids, questionnaires, tests, a coal production chart, mining terms, statements by government personnel concerning the issue of surface mining, a slide presentation explanation, a bibliography of related materials, and two magazine articles. This unit may be relevant to parts of Texas in the near future if the energy crisis requires development of lower grade coal resources available in this State.

(10) Lavaroni, C. W., et al, Air Pollution: Teacher's Edition, Water Pollution: Teacher's Edition, Noise Pollution: Teacher's Edition, Available as a package from Addison-Wesley Publishing Co., Inc. (1971).

Each guide is process-oriented, designed to aid teachers involving students with observing, data gathering, analysis of data, and hypothesizing. Each guide contains information concerning air, water, and noise pollution problems along with the general scientific and/or technical information necessary for understanding those problems. Each guide contains more than twenty student investigations designed for the particular subject under consideration. Suggestions for a series of discussions, activities, and projects suited for individual, small group and large group work are included, allowing each module to be individualized.

(11) Assorted modules from Miami-Dade Junior College, Miami, Florida.

Miami-Dade Junior College has developed many modules dealing with most aspects of ecology, environment, and population. Man and Environment Study Guide, Volume 1 (ERIC ED 071 855) and Man and Environment. Revised Curriculum (ERIC ED 056 930) are examples of full-term, modular, interdisciplinary, self-paced courses dealing with environmental education. The course Alternatives for Man and Environment:

Revised Curriculum (ERIC ED 071 856 described above in the section on full-term courses) is another example. Any educator wishing to design an interdisciplinary modular course on the environment should contact Miami-Dade for example materials and advice. Educators at Miami-Dade have done a significant amount of work in this area.

(12) "Environmental Education Units," Minneapolis Independent School District 275, Minneapolis, Minnesota (1970). ERIC ED 042 634 through 042 637, ED 043 510 and ED 043 511.

These modules are described as designed for elementary and kindergarten science but most can be easily adapted for use by junior high school or high school students. Titles include: Plants in the Classroom; Habitat Studies; Transect Study; Photography for Kids; Vacant Lot Studies; Contour Mapping; Succession in a Micro-Aquarium; Minnows and Models; and Blind Shrimp. Five handbooks outline a number of teaching methods, directions for obtaining or constructing apparatus, and other useful information. These pamphlets discuss sampling and graphing of data and provide background information and suggested teaching techniques. A broad variety of topics, skills, and activities are included. This group of materials would be useful to any educator developing an environmental education program.

(13) "Environmental Education (30 Instructional Units for Grades K-6)," Minnesota Department of Education, Document Section, Room 140, Centennial Building, St. Paul, Minnesota, 55155 (1970).

These units can be adapted for middle school use. The 30 units are self-contained, attractively packaged and designed to relate to the students' environment. A teacher's guide to the set of units includes: topical information; suggested behavioral objectives; ideas for additional activities; suggestions for evaluation; transparencies; and master copies of diagrams and data sheets. Typical unit titles are: Needs and Requirements for Keeping People Alive; Other Social Requirements; and Traffic Survey.

(14) "Environmental Education Series," Montgomery County Public Schools, Rockville, Maryland (1970). ERIC ED 075 217 through ED 075 225.

This series of activity guides for grades K-12 was developed and field-tested by classroom teachers, and it is intended to furnish activities for inclusion in an established curriculum. Titles of activities for grades 5-12 include: Activities for Studying: Streams, Wildlife, Weather, Ponds, Rocks and Soil, Megalopolis; Activities for Map and Compass Studies; and Outdoor Art Activities. The outline for each activity includes instructional objectives, procedures to

follow, materials required and notes for the teacher when necessary. A student evaluation sheet concludes each booklet. A majority of the activities in this series would be most appropriate at the middle school/junior high level.

(15) "Mini-Explorations of Our Environment," Muscatine-Scott County School System, 523 South Fairmount Avenue, Davenport, Iowa, 52302 (1972). ERIC ED 065 349.

These mini-explorations are divided into six major components of the environment: air, soil, water, plants, animals, and man. The purposes, objectives, activities and pertinent resources are listed for the study of each major component. Also included in the package are: a general comprehensive overview of the six components; an appendix detailing descriptions for constructing a variety of items useful for observing plants and animals; resources and suggestions for supplemental activities; several phonograph records; a bibliography; and a set of evaluation instruments. The activities are designed primarily for elementary and middle school students.

(16) Several titles are available from: The National Audobon Society, Educational Services, 1130 Fifth Avenue, New York, New York, 10028.

Most of the material available from the Audobon Society is in the form of printed bulletins. A series of seven

study programs (ED 046 751 through ED 046 757), which include student readers, teacher's guides, and colored wall charts, have been designed for middle school use and would make excellent supplementary material for individualizing instruction. Titles in this series include: Ecology; Insects and Spiders; Ecology Study Program; Bird Study Program; and Tree Study Program; Plant Study Program; and Mammal Study Program. Another series of fourteen nature bulletins contains such titles as: Natural Resources in the City; The Groundwater Table; and How to Build a Nature Trail. Each of these bulletins provides the teacher with background reading and suggested classroom activities as well as photographs, diagrams, and a bibliography. The Audobon Society furnishes more educational materials. Interested educators should contact them for complete listings of available materials.

(17) "Man and His Environment," National Education Association, Association of Classroom Teachers, Washington, D.C. (1970).
ERIC ED 068 439.

This teacher's guide claims an interdisciplinary approach to environmental education but it is largely biologic in nature. The first section is concerned with environmental study areas and discusses definitions of the term "study area," selection of an appropriate site, program planning and preparing to use the study area. The second section contains a number

of instructional activities based upon the now-familiar themes or strands: variety and similarity, patterns, interaction and interdependence, continuity and change, and evolution and adaptation. Activities for each strand include art, communications, mathematics, science and social studies. A selected bibliography of publications and films is included.

(18) "The Rise and Fall of a Yeast Community: An Environmental Investigation into the Dynamics of Population Growth," National Wildlife Federation, 1412 Sixteenth Street, N.W., Washington, D. C., 20036 (1972).

This module involves studying the effects of various environmental factors on a yeast population and developing a population growth curve. Suggested activities include recognition of a yeast cell and determining its size, constructing instruments for measurement of volume, conducting dilution experiments, and several step-wise investigations of the growth and death of a yeast population. Some skills developed by these activities are graphing, the use of fractions, estimating numbers by sampling and drawing inferences from sampling data. Investigation cards furnished at the back of the teacher's guide outline additional investigations and activities which can be used for enrichment, in-depth study, and individualizing instruction. The teacher's guide also includes: the description of module objectives,

methods and strategies; lists of the simple materials required to conduct the investigation; and games, graphs and charts. This module is appropriate for junior and senior high school students.

(19) "Environmental Education Instruction Activities," New York State Department of Education, Albany, New York (1970). ERIC ED 045 436 and ED 045 437.

This is a teacher's guide to basic concepts, activities, and questions designed to emphasize the primary role of man as a participant in rather than as a master of his natural surroundings. Topics covered include survival, interdependence, scarcity, recycling, right vs. responsibility, planning, valuing, social forces, and optimism. For each concept several activities and probing questions are suggested. Activities are not intended to reflect a subject matter orientation. Each guide contains a list of resources. Two guides are available: one for grades K-6 and another for grades 7-12.

(20) "The Guide to Ecology," Ontario Institute for Study and Education, Toronto, Canada (1972). Available on loan from ERIC/SMEAC, 400 Lincoln Tower, Columbus, Ohio, 43210.

This guide describes the design and contents of a series of boxes of curricular materials and provides instruction for the use of these boxes. A complete box is an in-depth, self-contained, mini-course which requires about three weeks of full-time study to complete. Students are expected to master the general principles of ecology and to study one ecological idea in depth. Suggestions for the box course include: step-by-step instructions for building the ecology continuum for the first week; the development of ten basic ideas--entropy, oceans, growth, energy, dirt, rocks, forests, diversity, environment and cycles--for the second week; and construction of an ecology exhibition during the third week based on individual student investigation of the ideas. The final section of the guide describes the actual materials contained in the various boxes which include: books, magazines, records, films, posters, prints, charts, maps, tapes, games and multi-media kits. Resources for additional information and materials are also listed. The box idea is one more effective method for individualizing instruction.

(21) "Ethics and Environment: Topics for Enquiry and Discussion by Older Children," Schools Council, London (1972). Available on loan from ERIC/SMEAC, Ohio State University, 400 Lincoln Tower, Columbus, Ohio, 43210. ERIC ED 073 916.

The objective of these investigations is to begin with

the problems in defining the environmental crisis and to move from these to a better understanding of the principles which regulate life on this planet. The units are basically concerned with the ecological balance of the human environment, of man's relationship to the physical and biological environment. There are six basic descriptors of the units' content: population, food supply, land use, conservation of natural resources, pollution, and man and his environment. Materials for each topic include: a description of the importance of the topics; some valuing problems associated with the topics; an outline of the subject, its scope, and related content; investigations and learning activities; and discussions of how the problems and topics are interrelated.

(22) Segerberg, O., Jr., "Man Builds, Man Destroys," Bureau of Mass Communication, New York State Department of Education, Albany, New York (1972). ERIC ED 068 338.

The manual describes a series of activities, presentations and information to be coordinated with a television video-taped series. Thirteen units have been developed to consider environmental problems, propose solutions to these problems and evaluations of the solutions. They are designed to present the realities of actions man may take to preserve the world's limited resources. Several aspects of individual, corporate and government environmental impact are considered.

The focus is upon man as a part of the total environment with emphasis on both good and bad aspects of man's interaction with nature. Costs, benefits and trade-offs are considered. Many suggestions for individual actions are made. A source guide of relevant books, articles, films and organizations is included.

(23) "Conservation Units," Texas Education Agency, Austin, Texas (1970). ERIC ED 014 639 and ED 042 640.

The instructional units deal with the following aspects of conservation: forests, wildlife, range land, water, minerals, and soil. Guides correlate the units with the traditional subject area descriptors such as English and biology. Each unit lists general and specific objectives, suggested teaching strategies and procedures, and, where appropriate, reference to relevant books, pamphlets, charts, films and filmstrips. The examples in both the elementary and the secondary guides are specific to Texas.

C. Field Trip Guides.

(1) Bemiss, C. W., "Teacher's Curriculum Guide for Field Ecology," Brevard County School Board, Cocoa, Florida (1972). ERIC ED 067 299.

This guide is specific for the Brevard County, Florida, plant and animal community, but most of the activities can

be adapted to other geographical locations. The guide is designed as an aid for planning student centered activities which allow for an understanding and improvement of the ecosystem of which they are an integral part. The major section of the guide outlines field studies in several areas: biomes and ecosystems, population and communities, food webs, aquatic ecology, and man vs. nature. Included in the outlines for each activity are background information, the purpose of the activity, procedures to follow, a list of required materials, and pertinent diagrams and charts. The guide also contains: a section on water and sewage analysis; a list of possible case studies relevant to ecological problems in Florida; a review of procedures for selecting and developing study sites for an ecology improvement project; and an appendix of miscellaneous references and research materials.

(2) "Environmental Curriculum Materials, Level III (5,6)," Division of Elementary Education, Delaware State Department of Education, Dover, Delaware (1973). ERIC ED 073 930.

This guide contains more than 50 outdoor and 60 in-class follow-up activities for middle school environmental education. A discovery and questioning strategy is used to focus on the interdependence of life and the interrelationships of man, plants, animals and the physical environment. Major activities fall under one of six categories: seasonal acti-

vities; flora; fauna; habitat studies; weather, geology, soils, hydrography; and awareness, man and nature. Each activity lists the appropriate grade level, season and a coordinated follow-up activity, as well as objectives, procedures, and pertinent questions. Diagrams and charts supplement some materials.

(3) Floyd, S., "A Study of Patterns in Tree Succession as Environmental Education for Intermediate Grades," Huxley College of Environmental Studies, Western Washington State College, Bellingham, Washington (1971). ERIC ED 059 948.

This is a multi-disciplinary program for intermediate/middle school students encompassing activities in mathematics, social studies, art, science, music and language arts. Concepts of pattern in tree succession are taught first with pre-site, in-class activities, then with field activities performed at the observation site, and finally with post-site in-class activities stressing development of student values and an environmental ethic. This document may not be generalizable for many teachers but it is an excellent example of the pre- and post-site activities which are necessary to make a field trip truly meaningful in a broad educational sense.

(4) Henderson, A. L., "The World Around Them: Environmental Education in the Urban Environment," Conservation and

Environmental Studies Center for Southern New Jersey, Box 2230, RD 2, Browns Mill, New Jersey, 08015 (1969).

The document is a teacher's guide to urban middle school environmental studies field activities. It is divided into four sections: A City Block - Environmental Design; The Streets of the City; Noise Pollution; and Student Worksheets and Study Guides. The first three sections include objectives, generalizations, procedures for proposed activities, suggestions for discussion topics, and activities involving the investigation of environmental conditions in the vicinity of the school. The activities are designed for outdoors and deal with land use, physical change; kinds of streets; street planning; traffic; street maintenance and drainage; loudness of sound; and sound, noise and people.

(5) Knapp, C. E., "Outdoor Activities for Environmental Studies," The Instructor Publications, Inc., Dansville, New York, 14437 (1971).

This is a compilation of field-tested outdoor activities easily adaptable to most age groups. It introduces basic projects for individuals and small groups in monitoring certain aspects of the environment and would be quite useful for educators who are interested in individualizing instruction. It provides the teacher with many new ways to involve students directly in meaningful and developmental learning

and helps students to become more sensitive to and understanding of the quantitative aspects of their environment. Activities are interdisciplinary in nature and the lesson plans allow for a wide variety of student abilities and grade levels. For each project or lesson, background information, objectives, concepts, vocabulary, necessary materials, instructional procedures, and activities and ideas for further investigation are each discussed and/or outlined.

(6) MacBean, J. C., et al, "Birds: Examining Your Environment," Mine Publications, Inc., 25 Groveland Terrace, Minneapolis, Minnesota, 55403 (1971).

These activities, written for intermediate level students, are designed to improve observational skills. The four sections are: Live Birds, Birds' Eggs, Birds' Nests, and Dead Birds. Activities involving such diverse subjects as flight patterns, incubation of eggs, material used in construction of nests, and an examination of the parts of dead birds are described. Procedures, necessary materials, and probing questions related to each activity are included.

(7) Majors, J. M. and C. A. Cissell, "Environmental Education Objectives and Field Activities," Paducah Independent School District, Paducah, Kentucky (1970). ERIC ED 049 026.

This teacher's guide is divided into two parts. The

first section includes a suggested instructional approach and a philosophy of environmental education. Objectives for general education, for the school, and for specific subject areas are also listed in this section. The second section describes eighty-six activities developed for elementary students using the Youth Activity Station at Land Between the Lakes, Kentucky. A bibliography, sample program schedule, sample check list, and sections on writing behavioral objectives are also included.

(8) "Outdoor Activities," Minneapolis Independent School District 275, Minneapolis, Minnesota (1970). ERIC ED 042 643.

This guide describes twenty-four activities for elementary and middle school students. Three types of activities are included: activities designed to promote awareness; simple qualitative experimental studies such as observation of soil inhabitants or plant succession in burned off areas; and experiments which introduce the students to quantitative measurements of soil and air temperature, soil composition, fish population dynamics, and mapping. Teaching strategies are suggested for each activity.

(9) "Observing Our Environment Through Our Senses, Unit I," Muscatine-Scott County School System, 1523 South Fairmount Avenue, Davenport, Iowa, 52802 (1970). ERIC ED 046 709.

This is a guide to outdoor activities for children in grades K-6. Objectives, concepts, and activities are described for each of the five senses with an emphasis on making each student more aware of the environment.

(10) "Vacant Lot Studies: An Environmental Investigation," National Wildlife Federation, 1412 Sixteenth Street, N.W., Washington, D. C., 20036 (1971).

This is a teacher's guide to an interdisciplinary study of vacant lots. Activities deal with: litter on the lots, visitors to the lot as determined by burrows, droppings, tracks, and food; plant types; and how the vacant lot affects the community. Grid mapping is essential for completion of many activities so twenty preliminary activities concerned with grid systems, map drawing, and grid games are included. Descriptions of objectives and methods, lists of necessary materials, and sample questionnaires and data sheets are included with each activity.

D. Games and Simulations.

Games and simulations can be quite helpful in teaching about the environment, about the ecology, and about the related social parameters but they are not an easy and/or sure-fire method of producing instant experts. They are best used as supplements to rather than as substitutes for

other forms of teaching-learning and are most helpful if used in a wide context of information and discussion. Postman and Weingartner (1969) point out that most games and simulations "mirror political or economic institutions as they are now" and "they encourage quiescent and conformist attitudes" since "success in winning the game is premised on accepting the 'simulated reality' as it is rather than on examining what is wrong with it." An obvious solution to this problem not mentioned by Postman and Weingartner is to have students propose changes in the game/simulation rules which would make maintenance of high environmental quality easier, then to discuss the societal changes which would be necessary to make the revised game a realistic simulation.

1. Sources of Games and Simulations for Environmental Education.

- (a) Educational Games Company
Box 363
Peekskill, New York 10566
- (b) Jim Egbert
Pilgrim United Church of Christ
4418 Bridgetown Road
Cincinnati, Ohio 45211
- (c) Harwell Associates, Inc.
Box 95
Convent Station, New Jersey 07961
- (d) Urban Systems, Inc.
1033 Massachusetts Ave.
Cambridge, Massachusetts 02138

- (e) Western Publishing Company, Inc.
School and Library Department
850 Third Avenue
New York, New York 10022
- (f) Instructional Simulations, Inc.
2147 University Avenue
St. Paul, Minnesota 55114
- (g) Simile II
P. O. Box 1023
La Jolla, California 92037
- (h) Urbandyne
5659 S. Woodlawn Avenue
Chicago, Illinois 60637
- (i) ABT Associates, and/or Games Central
55 Wheeler St.
Cambridge, Massachusetts 02138
- (j) Environmental Design
P. O. Box 683
Chatsworth, Georgia 91311
- (k) Interact
P. O. Box 262
Lakeside, California 92040
- (l) The MacMillan Co.
School Division
Department SNY
Riverside, New Jersey 08075
- (m) Science Research Associates, Inc.
259 East Erie Street
Chicago, Illinois 60611
- (n) Milton Bradley Company
Springfield, Massachusetts
- (o) Luis H. Summers
University of Oklahoma
180 West Brooks St., Room 252
Norman, Oklahoma 73069
- (p) Olaf Helmes and/or Theodore Gordon
Institute for the Future
Middletown, Connecticut

(q) Sinauer Associates, Inc.
200 Second Street
Stanford, Connecticut 06905

(r) Environmental Simulation Laboratory
109 East Madison Street
University of Michigan
Ann Arbor, Michigan 48104

2. References which discuss game/simulations and their use.

(a) Harmon, C., "Environmental Games: An Analysis, 2nd Edition," (1971). ERIC ED 067 232.

(b) Guide to Simulation Games for Education and Training
Information Resources, Inc., P. O. Box 493, Lexington,
Massachusetts, 02173.

(c) Bibliography of Simulations: Social Systems and
Education, Western Behavioral Sciences Institute, 1150
Silverado, La Jolla, California (1969).

Miscellaneous Environmental Education Materials

(1) Bemiss, C. W., "Teacher's Environmental Resource Unit:
The Automobile," Brevard County School Board, Cocoa, Florida
(1972). ERIC ED 067 302.

This teacher's guide provides the teacher with basic information to aid a classroom review of automobile pollution problems. Topics discussed include: transportation efficiency, cost of transportation, the automobile, the automobile in the environment, air pollution, land use, water pollution, improving the internal combustion engine, alternatives to the conventional internal combustion engine, and mass transit. A bibliography is included.

(2) "Smog and your Automobile (Teacher's Manual, Filmstrip, Record)," California Air Resource Board, Sacramento, California (1971).

This short module was designed for use with a driver's education course. The teacher's manual is coordinated with a filmstrip and record and includes questions and technical background information for more comprehensive study/discussions.

(3) Figurski, A. J., "Industrial Arts and Environmental Education: A Resource Guide," State University of New York, Department of Industrial Arts and Technology, Oswego, New York (1971). ERIC ED 065 721.

This resource guide is designed for industrial art instructors who wish to incorporate environmental education into an existing program of industrial arts instruction. Major sections of the guide are: Introduction; Perspectives on Pollution; The Role of Industry; The Role of Government; Directions - Industrial Arts and Environmental Education; and Resources. Appendices include: an environmental glossary, a list of National Association of Manufacturer Environmental Quality committee members, a list of additional companies "with environmental answers," and a selected reading list.

(4) Foster, P. W., Introduction to Environmental Science

Programmed Learning Aids Series, Learning Systems Company, Richard D. Irwin, Inc., Homewood, Illinois 60430 (1972).

This is a supplementary study guide for a full-year, college-level environmental science course. It is not programmed instruction in the commonly accepted Skinnerian sense. Six sections include: Historical Perspectives; Man's Disruption of the Environment; Ecosystem Terms - Especially the Biosphere; Population Growth and Urbanization; the Various Costs of Environmental Decay; and Environmental Trade-offs in Public Policy. Each section consists of text passages of one and two pages followed by a series of related diagnostic questions. Students check answers to the diagnostic questions and are expected to review any material they do not understand before proceeding to the next passage. Three review tests with answers, a glossary of terms, and index are included.

(5) Gross, F. and D. Corso, "To Save the Earth. A Tool Kit to our Environmental Quality Index," National Wildlife Federation, Washington, D. C. (1971). ERIC ED 068 337.

This document explains how a teacher can initiate a program for learning about environmental quality and for taking action to effect improvement of environmental quality. The instructional approach is interdisciplinary in nature, stressing skills involving: questioning, gathering and

evaluating data, meeting and interviewing people, translating information into statistics, and making presentations. It attempts to lead students from research and discussion to constructive actions designed to alleviate environmental problems.

(6) Hegelson, S., et al, "A Review of Environmental Education for Elementary and Secondary School Teachers. Final Report," Research Foundation, Ohio State University, Columbus, Ohio (1971). ERIC ED 059 913 through ED 059 915.

This document consists of three separate volumes for elementary and secondary teachers, for teachers of urban/disadvantaged students, and for administrators. Following a general orientation, specific needs are identified and research related to these needs is noted if available. Current practices concerning environmental education programs and materials are summarized together with recommendations regarding program development and implementation. Brief descriptions of selected programs and materials and case studies describing program development and implementation are included. Sources of information for supplementary materials are listed and a copy of the Environmental Education Curriculum Analysis Instrument is included. A summary of learning approaches to environmental education concludes the work.

(7) Holman, A., et al, "Environmental Awareness Sampler," (1971). ERIC ED 062 121.

This document provides information for initiating and dealing with environmental studies in the classroom. Behavioral objectives are listed for social studies, science, mathematics, language arts, health, physical education, recreation, music, and geography in an attempt to demonstrate that environmental education may already comprise a portion of a given curriculum. Two sets of charts demonstrate how the behavioral objectives may be used in designing environmental education curricula. One set centers on basic concepts involved with social, cultural, technological and ecologic implications; the other emphasizes individual objectives and associated outcomes. A variety of activities and sample lessons for different disciplines in all grade levels, discussion questions and ideas, working procedures for selected activities, sample data collection charts, a glossary, and descriptions of case studies are all included in this useful general source.

(8) Horsley, K., et al, Environment and Population. A Source Book for Teachers, National Education Association, Washington, D. C. (1972). ERIC ED 075 315.

The primary objective of this source book is to relate the causes and consequences of population change to other

social and environmental issues being explored in the secondary classroom. Many sources are suggested for use as supplemental material to be integrated with existing curricula. The main sections are: Contemporary Issues, Family Life, Health, History or Social Studies, Science, and Sociology. Each chapter is divided by concepts with a supportive discussion, suggested activities, references and recommended readings, and relevant films.

(9) Kellner, R., "Environmental Concern Inventory," Project I-C-E, Green Bay, Wisconsin (1971). ERIC ED 055 921.

This is a problem-solving quiz designed to help a teacher discover types of problems or environmental concerns which are confusing students. Hypothetical problem situations are given and solutions are chosen from among several alternatives. Inventories adapted for both high school and middle school students are available.

(10) Knapp, C. E., "Teaching Environmental Education with a Focus on Values," Department of Conservation and Outdoor Recreation, Southern Illinois University, Carbondale, Illinois (1972). ERIC ED 070 614.

The technique of value clarification developed by Rath (1966) is discussed as it applies specifically to environmental education.

(11) Lines, C. J. and L. H. Bolwell, Teaching Environmental Studies in the Primary and Middle School, Ginn & Company, 18 Bedford Row, London, W.C. 1 (1971).

This document presents practical, realistic suggestions for teachers who are unfamiliar with environmental education. Section I includes discussions of the nature of environmental studies, the role of the teacher, scientific and creative aspects of the suggested approach and the contributions which children with informed opinions can make toward improving environmental quality. Section II discusses introducing environmental studies into the curriculum, assessing the value of different studies, organizing a study, evaluating student progress, and dealing with different environments. Section III contains descriptions of a number of case studies of programs carried out in schools; and Section IV describes ways in which teachers can expand and improve their own knowledge and techniques.

(12) "Learning to Live: A Manual of Environmental Education Activities," Minnesota State Department of Natural Resources, Bureau of Information and Education, St. Paul, Minnesota (1973). ERIC ED 073 913.

Several activities are listed to develop each of the

following topics: ecology and aesthetics; the decision-making process; a plea for an alternative (the impact of the snowmobile on the winter environment); studying the gray squirrel habitat; a deer browse story (plant/animal relationships); snow hydrology; the beneficial effects of logging; how to build a compost pile; environmental action activity; nature activity; and going somewhere (places to go and things to see outdoors). Appropriate charts, diagrams, and pictures are included.

(13) "Handbook of Environmental Education Strategies," New York State Department of Education, Albany, New York (1972). ERIC ED 066 298.

The handbook describes instructional strategies for integrating environmental concerns into established secondary curricula. Typical strategies are: use of concept-centered activity packages; student involvement in community projects; readings and quotations as learning activities to improve reading skills; student environment/ecology clubs; and family participation activities.

(14) "Career Education and the Environment: A Handbook," Olympus Research Corporation, Washington, D. C. (1971). Available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. ERIC ED 063 471.

This handbook is designed for use in secondary schools by administrators, curriculum planners, teachers, counselors, librarians, and students. It furnishes aid for exploring environmental problems and solutions and it provides information on existent and emerging career opportunities. The first section, "Career Education and the Environment," provides an overview and describes the extent of, reason for and proposed solutions for present environmental degradation. The second section, "Environmental Careers," is a comprehensive report categorizing available and emerging career choices as science and research, technology and education, technology implementation and equipment operation. The third section, "Two Environmental Curriculums," describes two courses of study. One is a 15 day mini-course on environmental awareness and pollution. The other is a semester course which focuses on the physical world, natural resources, and social problems with environmental overtones. An annotated 61-page bibliography is included for use as a reflected guide for all schools beginning or upgrading the environmental literature in their library.

(15) "Administrator's Environmental Education Evaluation Handbook," School of Education, South Dakota University, Vermilion, South Dakota (1971). ERIC ED 067 231.

Two sets of evaluation instruments are compiled. The

first set functions for evaluation of existing attitudes and interests concerning the environment. The second set is specifically designed as a pre- and post-test instrument for evaluation of the South Dakota Interlakes Environmental and Outdoor Education Program. This latter set can either serve as a guide for developing other instruments or can be adapted for local situations.

Science Fiction: A Unique Classroom Tool

Teaching science fiction has been gaining in popularity on both college and high school campuses. Williamson (1973) estimates that the number of science fiction courses currently being taught in the U. S. A. in college and high school is close to a thousand and his paper "Teaching Science Fiction" lists the addresses of instructors of several hundred science fiction courses. Descriptions of courses by Williamson and in such articles as "Science Fiction Courses: An Example and Some Alternatives," by Stanley A. Schmidt (1973) indicate that most such courses are English type courses. That is, they are literature surveys of one sort or another that teach about science fiction as literary art rather than use science fiction to teach something else. A few educators such as Sandery (1973) and Livingston (1974) have recognized uses for science fiction in the classroom beyond its value as a literary sub-genre but, as a general rule, science fiction as a didactic tool has been largely ignored.

That students can learn science content material from narrative reading passages as well as, or better than, they can learn that material from expository reading passages was recently demonstrated by Kindler (1974), who concludes:

It can be stated that the use of narrative reading materials should pose no obstacle to the teaching of cognitive abilities to science students. Narrative materials are generally more interesting to read than expository materials, can be made essentially self-motivating, and can also be effective in the formation of attitudes. If they include appropriate content material, there need be no sacrifice of cognitive learnings, which are, of course, of considerable importance in teaching the natural sciences.

Dr. Gregory Benford, a science fiction author and a research scientist studying controlled thermonuclear fusion for the Atomic Energy Commission, indicated a second function for science fiction in education when he said:

Science fiction is a way to get at the ambience of science - the thrill of discoveries. The kind of feeling for the way things work in distant fields shall we say. That is: what is the balance of all the facts one learns in science? What is their impact on human beings? (Benford, 1973)

A third function of science fiction in the classroom, one which can relate directly to environmental education, is as a tool for value clarification. A major component of valuing as discussed by Raths (1966) is imagining many alternatives to specific actions, projecting the probable and possible consequences of each of these alternatives, and choosing an action from among the alternatives based on a consideration of their consequences. Science fiction study is especially applicable to the processes of imagining alternatives and projecting both the short-range and

the longer-range possible consequences of those alternatives. Writing science fiction short stories is an excellent strategy for involving students in projecting the possible consequences of certain actions. In reading science fiction, Livingston (1974) reminds educators that

. . .it is not just the more or less accurate predictions that are worth studying. (Old science fiction stories) that were off the mark bear special attention, because examination of the reasons for prediction errors in SF will reveal the same dangers in extrapolation open to non-fiction forecasting, such as overreliance on the assumption that 'all other things' will remain equal and the difficulty in adjusting for radical social change.

Therefore, analysis of older extrapolative fiction can be used as activities for examining the underlying assumptions leading to both essentially accurate and grossly inaccurate predictions.

Reading and/or writing science fiction stories will not automatically create values in the students who read or write them. Any science fiction study must be carefully and thoughtfully coordinated with other activities such as discussions which are designed to aid students in clarifying their value selection, in examining more than one alternative, and in imagining the possible consequences of their actions. The case study, listed with the other resources below, has been included as an example of how to approach coordination of science fiction study activities in the event that the reader has had no experience with using fiction in the classroom.

Included below are resources which educators can use in coordinating science fiction study with other activities in either

traditional or specifically environmental curricula. These resources include: the aforementioned case study describing a group of activities designed by this writer, their use in the classroom, and some of the results; a short list of science fiction stories; a selected bibliography of sources to which educators can refer in finding SF stories appropriate to their needs; and a list of some special resources for SF study.

A. Case Study describing the classroom use of a science fiction study module.

Ray Bradbury's "A Sound of Thunder," an excellent short story reprinted in Social Education, Playboy and other reputable journals, describes a situation in which a time traveler named Eckels changes the course of human history for the worse by stepping on a butterfly in prehistoric times. The first activity of the module required students to read the story or to listen to tape recorded transcriptions of it. They then joined small (approximately three students) discussion groups and were assigned to develop and submit a written report outlining the decision regarding Eckel's punishment at the end of the story. Each group was informed of the possibility that they might be required to defend their decision to the class as a whole.

The results of the group decisions were listed on the chalk board. The class was split just about evenly between groups who felt the shooting of Eckels was justified; groups who main-

tained that, while Eckels deserved punishment, other men should not have taken his life; and groups who proposed that shooting was too good for Eckels, that he deserved a protected and exceedingly painful death. A spokesperson for each group presented a statement justifying the group's decision and the class then voted individually by secret ballot for one of the three basic proposals. The shooting of Eckels in the manner described by Bradbury was approved by a large majority.

Following this vote, students were asked to think of things they did, actions they took every day. Each student was then required to contribute one unique action to a list which was recorded on the chalk board and also recorded by the students in their notebooks. Each individual student was then assigned some other student's action and instructed to write a short story in the style of Bradbury projecting the possible consequences of that action no less than 100 and no more than 1,000 years into the future. A number of cassette recorders were available so that students had the option of reciting their story to a tape recorded microphone.

The stories were collected and ditto stencils of all stories, including transcriptions of the tape recorded stories, were typed. Copies of these stories were run off and were collated and assembled to form copies of a science fiction anthology written by the members of the class. These anthologies were passed out to the class and assigned as reading. As students read the

generally dystopian consequences attributed to their actions by other students, arguments and discussions began. The general pandemonium, which lasted into the next class period, was ignored in the interest of peer-mediated instruction. This was probably the first time many of these students had considered the idea that their actions had consequences at all, much less long-range consequences for which they might be morally responsible. A joyous academic side-effect of the anthology was that the class clique of non-readers began reading. They read their own stories first and then read the story describing the possible consequences of their own contributed actions. Finally, they encouraged other members of the clique to read their stories and were encouraged, in turn, to read their friends' stories. Where non-academic side effects were concerned, the classroom, the halls, and the play area were kept a bit cleaner and for a week or so following the completion of the module, students could be heard exhorting each other to consider the consequences of their actions. These are small successes, but certainly they are steps in the right direction.

B. Selected Science Fiction Stories With Environmental Themes.

This list is not exhaustive. Anthony Lewis, a recognized scholar of science fiction, has estimated that approximately 30,000 English language science fiction stories have been published (Lewis, 1974). Only a small percentage of all science fiction

stories have environmental and ecologic themes, but even a small percentage of 30,000 stories is a lot of stories. There are almost certainly hundreds of stories with environmental and ecological themes not included below. The only criterion for inclusion of a story in this list is the successful use of that story in the classroom by this author.

(1) Bradbury, Ray, "A Sound of Thunder," Reprinted in SOCIAL EDUCATION, 35: 875-881 (1971).

This story is described in the case study above. A time traveler changes history by stepping on a prehistoric butterfly.

(2) Chilson, Robert, "Ecological Niche," ANALOG, 86: 8-52 (December, 1970).

Men establish huge, self-contained cities intended to be devoid of non-human life, only to find that all manner of beast manage to sneak in and establish a working ecosystem. The hero, a biologist, traces through the established food web in a thoroughly enjoyable manner. The difference between adaptation and evolution is succinctly pointed out and is a vital part of the story.

(3) Curtis, Wade, "A Matter of Sovereignty," ANALOG, 88: 8-32 (January, 1972); and, "Power to the People," ANALOG 89: 90-110 (August, 1972).

These are two stories about Nuclear General Corporation and Nuclear General's trouble shooter, Bill Adams. Nuclear General is a private industry which runs nuclear power plants and has attached to their nuclear power plants such environmental and ecological engineering projects as pumping up nutrient rich deep water to increase plankton growth which in turn is used for feeding fish. Subsidiary operations include things like retrieving icebergs, towing them to arid areas, and beaching them to furnish a fresh water supply. The trouble Bill Adams must shoot in these and other Wade Curtis stories is of the socio-economic political variety. Curtis' economic/political viewpoint seems to strongly favor laissez-faire free enterprise capitalism but it is instructive that the owner of Nuclear General Corporation is an environmentally aware and responsible captain of industry. The Curtis stories basically describe political dealing with the environmental engineering and ecology interests of Nuclear General as a crucial background.

(4) Gillette, Glen L., "Monster in the Waterhole," ANALOG, 89: 74-81 (July, 1972).

The setting of this story describes one possible technological solution to the water shortage problem. The theme deals with the Lazarus Long aphorism: "Never underestimate the

power of human stupidity."¹ This story can be used to promote a discussion on possible feasible solutions to water shortage problems. Some technical problems are inherent in the story's proposed technology which are ignored and these can be elicited in another discussion.

(5) Herbert, Frank, "Greenslaves," THRILLING SCIENCE FICTION: 4-31+ (August, 1972).

This short story serves as the basis for a novel of the same title. For classroom purposes the short story is better. Both short story and novel describe the ecological and political results of a campaign to wipe out insects in Brazil. The adaptation/evolution proposed by Herbert seems far out on first inspection, but it is only an extension of current patterns of survival tactics exhibited by some of the more exotic social insect species. This story is not the excellent writing produced by Herbert when he wrote the novel Dune but it is quite useful in the classroom.

(6) Howard, Hayden, "The Biggest Oil Disaster," ANALOG, 84: 138-160 (February, 1970).

In this era of energy crises, offshore oil installations,

¹Heinlein, Robert A., Time Enough for Love, G. P. Putnam's Sons, New York, New York (1973), p. 251.

nuclear power and oil spills, this is what is known as a relevant story. The basic themes are concerned with decision making and responsibility in times of crisis, and with making responsible decisions in the face of public opposition. The political approach of Howard is quite similar to that of Curtis, and the Curtis and Howard stories can be used together effectively for examining industry's side of the "Ecology Now" issue.

(7) Laumer, Keith, "The Plague," ANALOG, 86: 8-27 (November, 1970).

The lead description for this story says "the most dangerous type of plague is one which destroys the basic ecology of a region." The story revolves around the conflict between the hero and a group of people who want to take over his homestead. The intruders lose because the resident knows the ecology and how to manipulate it. Teachers should read this story before using it in the classroom.

(8) Powers, William T., "A Congregation of Vapors," GALAXY: 6-51 (July, 1971).

This story describes coping with a severe nation-wide air pollution and power shortage crises. It is told from the viewpoint of a group of pollution control admini-

strators trying to cope with and/or control the impending disaster and a family of ordinary people who have to live through it. The thesis presented by Hardin (1968) in "The Tragedy of the Commons" is powerfully presented in this excellent story and a number of related ethical issues are raised. This writer highly recommends the story for high school students.

(9) Roberts, Keith, "The Deeps," in ORBIT I, ed. Damon Knight, Berkeley Publishing Co., New York, N.Y., (1966). pp. 173-192.

At one level this is a very human story about a woman's psychological adjustment to living under the sea. The population explosion turns all available land masses into an urban sprawl and humans go underwater. "The pressure, the need for room, pushed them out again. The houses sank like silver bells into the blueness and quiet and at last there was room enough." Food production, carbon dioxide consumption and oxygen production by the displaced greenery, and non-renewable resource utilization are all ignored by the author in developing the initial over-population scenario which drives men to the seas. (Could this really happen is a good discussion question.) The author's apparent intent is to demonstrate how humans cope with monumental problems, but one of the final sentences--"The sea people would go on

now, pushing their domes lower and lower into the night, fighting pressure and cold until all the seas of all the world were truly full; and the future, whatever it might be, would care for itself."--is a truly chilling entry to many possible topics for discussion and other activities.

C. Bibliographies of Sources for Science Fiction Studies.

(1) Briney, R. E. and E. Wood, SF Bibliographies: An Annotated Bibliography of Bibliographical Works on Science Fiction and Fantasy Fiction, Advent Press, Chicago, Illinois, (1972).

(2) Clareson, T. B., Science Fiction Criticism: An Annotated Bibliography, Kent State University Press, Kent, Ohio, (1972).

(3) Day, D., Index to Science Fiction Magazines (1926-1950), Perri Press (1952).

(4) Hall, H. W., ed., Science Fiction Book Review Index, Hal Hall, 3608 Meadow Oaks Lane, Beyan, Texas, 77801. (Annually since 1970).

(5) Lerner, F., An Annotated Checklist of Science Fiction Bibliographical Works, Fred Lerner, 7 Amsterdam Avenue, Teaneck, New Jersey, 07660, (1969).

(6) New England Science Fiction Association, Index, Science Fiction Magazines and Original Anthologies (1966-1970), N.E. S.F.A., P. O. Box G, M.I.T. Post Office, Cambridge, Massachusetts (1971).

(7) New England Science Fiction Association, Index, Science Fiction Magazines and Original Anthologies (1971-1972), N.E. S.F.A., P. O. Box G, M.I.T. Post Office, Cambridge, Massachusetts (1973).

(8) Pfeiffer, J. R., Fantasy and Science Fiction: A Critical Guide, Filter Press, Palmer Lake, Colorado, (1971).

(9) Siemon, F., Science Fiction Story Index (1950-1968), American Library Association, Chicago, Illinois, (1971).

(10) Strauss, E. S., Index to Science Fiction Magazines: 1951-1955, N.E.S.F.A., P. O. Box G. M.I.T. Post Office, Cambridge, Massachusetts (1966).

D. Special Resources.

- (1) The M.I.T. Science Fiction Society Library
Room W20-421
Massachusetts Institute of Technology
Cambridge, Massachusetts 92139

The M.I.TSF Society Library is run by the M.I.T. SF Club and is not part of M.I.T.'s official library system. An educator wishing to obtain a specific story not available from other sources could probably obtain a copy from the M.I.T. SF Society for the cost of copying, handling and mailing.

- (2) The Science Fiction Research Association
c/o Professor Thomas D. Claeson
Box 3186, College of Wooster
Wooster, Ohio 44691

The S.F.R.A. was formed to promote teaching and research in SF and, in conjunction with the Modern Language Association, it publishes the semi-annual journal Extrapolation. The emphasis seems to be on the literary art of SF rather than on SF as a teaching tool but the S.F.R.A. and Extrapolation are excellent sources.

- (3) Teaching SF
Jack Williamson
Box 761
Portales, New Mexico 88130

In addition to tidbits of wisdom, Williamson's document includes a quite extensive, though not exhaustive, listing of persons and/or schools offering SF courses. Interested teachers can use this source to find other teachers in their geographical area who have had experience teaching SF.

- (4) Eco-Fiction
Edited by John Stadler
Washington Square Press
630 Fifth Avenue
New York, New York

Not all the stories in this collection are SF (Daphne du Maurier's "The Birds", for example), but a number of excellent SF stories including Bradbury's "A Sound of Thunder" are included. Seventeen short stories with ecological/environmental themes are reprinted and all could be used to excellent effect in the classroom.

- (5) The New England Science Fiction Association
P. O. Box G, MIT Branch
Cambridge, Massachusetts

The N.E.S.F.A. is probably the most scholarly active SF fan group in the country. Dr. Anthony Lewis of that group offered both suggestions and criticism which were very helpful in the development of the SF section of this paper.

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