ABSTRACT

ENERGY, LEARNING, AND RURAL LIFE DEVELOPMENT: IMPLICATIONS OF AN ECOLOGY OF EDUCATION AND APPLICATION IN RURAL THAILAND

By

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This is an exploration of the limitations and potential use of energy constructs to analyze learning for rural life development. Rural poor people in non-industrial societies need more consequential and efficient learning systems in order to survive and prosper in the face of environmental degradation, control and maldistribution of resources by commercial and urban elites, underemployment, crime, and political instability. It is hypothesized that organization and direction of learning may be made more efficient and consequential if the potential energy inputs for learning can be identified and analyzed.

Chapter One includes the rationale, objectives, definition of terms, and theoretical basis of the study. In Chapter Two an attempt is made to formulate an ecology of education, with description of energy forms, flow, conversion and controls, all related to learning processes. Means to analyze energy-learning constructs are suggested. Their use in rural life development and by rural educators is discussed. Chapter Three has descriptions of Thai culture, rural people and educators. The ideas and methods raised in Chapter Two are applied to Thai society.

Chapter Four contains a review of the findings, discussion about attaining the objectives, and a set of hypotheses as recommendations for further study and action.

By reviewing data from many scientific disciplines and education, it is concluded that, with present technology, an energy-based ecology of education can not be made holistic. Too little is known about genetic information to describe it in energy terms. In perceptual information the amount of energy itself is not significant. However, energy analyses of other elements in the proposed ecology of education are useful.

"Communication-and-care," the human effort in subsidizing others with information, services, goods, expressions of love and indicators of status, significantly affects learning. Furthermore, energy amounts in forms of communication-and-care are important and can be measured. Similarly, amounts of energy in food consumed, beginning before birth and continuing throughout life, have consequences for learning and can be calculated. Where the kind of food has importance for learning ability, the energy in obtaining, processing, distributing and consuming specific foods can be analyzed. Energy analysis is easiest to apply in comparing technologies of fuels, tools and organization involved in education.

Rural Thai people, and probably the rural poor world-wide, would benefit from energy analyses of their learning systems. Farmers would understand it, and local leaders would support it, but poor rural parents and village teachers would need outside help in experiment, evaluation, and motivation to change. It appears that only the urban professionals and academic institutions in Thailand have the resources to initiate research in energy-learning-rural life development relationships. But rural Thailand is fertile for research, and rural Thai people welcome innovations and demonstrations, if they appear advantageous to the individuals or community.

The following are examples of new hypotheses recommended for further exploration. (8) Children require more energy in communication-and-care as they grow. The attention must intensify though the time given in attention may decline. (22) For promoting rural life development, the most learning-efficient and significant questions on which to focus are "Who has access to how much and what kinds of energy?" and "To what extent are the people scientific, creative, democratic and healthy?" (36d) For learning scientific planning skills, schooling is least efficient but most consequential. (44a) Personal demonstration is the most energy-efficient system for promoting rural life development overall. (51) Village teachers do not control enough energy resources to orient formal learning systems toward promotion of rural life development.

With energy-oriented investigations, rural learning ecologies become better understood, and rural life will improve.

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CHAPTER ONE

PROBLEMS OF ENHANCING RURAL LIFE IN POOR NATIONS

This investigation unites several dimensions of experiment. First, it is an inquiry into the nature of learning, to seek energy constructs for a possible and holistic "ecology" of education. It is hypothesized that all the energy sources and energy conversion and control mechanisms related to processes of learning can be described. It is hypothesized that these relationships can be expressed and evaluated with common and equivalent energy measures. And it is hypothesized that the energy constructs and relationships provide a basis for analysis of achieving learning outcomes.

Secondly, the investigation is an experiment to consider the concepts and analyses derived for use in a particular culture. The case chosen is rural Thailand. It is hypothesized that energy analysis benefits rural Thai people and that rural Thai people can employ energy analysis of learning to promote rural life development.

Finally, this study is an experiment in collecting, collating and synthesizing data from diverse sciences, physical and social. It is hypothesized that recent research and discoveries in the environmental sciences can be related usefully to the applied social sciences, specifically, education. And it is hypothesized that the applications can be directed toward some of the highest values or universal ideals formulated by humanitarians, including comprehensive good health, cultural creativity, scientific planning, and democratic relations.

In the present chapter, the rationale for the study is explained, terms are defined, goals are refined or expanded further, other objectives are raised at several points, theoretical foundations are discussed, methodology is proposed, and the plan for the study is outlined. All these tasks are considered as problems in any organized attempt to help rural poor people improve their lives. As the following section titles may suggest, planners, leaders or educators, all must understand the reasons why rural people might need attention, in order to contribute to rural life development. But to understand, potential helpers must have a common language and a theoretical foundation from which to analyze problems and alternative solutions. Furthermore, just to establish a conceptual foundation requires some method and planning.

The Problems of Change for Rural People

During the past several decades, political concern for the survival of human civilization, as expressed in the formation of the United Nations and its associated agencies, has led to scientific understanding as to how modern people can survive the potential for disaster they have created. Philosophers and social scientists, as well as the physical scientists, have contributed to generating and disseminating knowledge about ecological relationships, balances in movement and exchange of energies and materials which enable the human population, national economies, communities, families and individuals to prosper and improve in circumstances. As the global community has discovered, war is only one threat to disruption of the balance and often just a consequence of the disruption. Pollution, depletion and maldistribution of resources, and alienation from humanness, one's fellows and livelihood, constitute more fundamental and potentially greater threats than war to subsequent progress in improving and spreading whatever well-being people now enjoy.

In a similar manner, humanitarian concern for the progress of people in "poor" nations, who seem particularly vulnerable or defenseless against these threats, has begun to result in scientific understanding of the causes of social poverty and alternative approaches to remedying the vulnerability of poor people. The overwhelming proportion of highly-educated and scientific talent has been devoted to improving the health and comforts and enhancing the pleasures of the "rich" people of the world. The rich may be defined as people who live in resource-endowed, industrial countries, and the wealthy elites of resource-deficit, non-industrial nations. But gradually during the past thirty years or so, more of the talent-blessed and scientifically educated in all countries have become involved in investigation into causes of poverty. They have studied and disseminated information about conditions. Many programs have been designed to overcome barriers in improving the lives of millions of people who daily experience material, social, cultural and spiritual deprivation.

In the process, an enormous amount of information has accumulated from the experiences of countless investigators and program participants, much of it printed in a variety of research periodicals and publications for popular consumption. It is likely that enough information is available for concentration, derivation and application of unifying or comprehensive concepts by which to analyze efficiently and clearly the problems of global poverty and to reach proposals for solutions based on the realities of the particular situations, human tendencies and social trends.

<u>Energy a key variable</u>. In reviewing the literature of global and particular problems, a common phenomena was discovered which appeared to relate to every situation: the over-application or shortage or wasteful conversion of various kinds of energy. If for most people "energy" means only the calorie values in food and fuels, "depletion" of resources occurs in the rapid extraction and exhaustion of fossil and atomic fuel reserves and, because of mismanagement, in the exhaustion of fertile soil. Soil is the energy conversion and nutrient cycling medium upon which most life depends. "Pollution" results from over-conversion or too rapid or concentrated an application of one kind of energy-containing resource, which unbalances or overloads environmental processes in recycling the resources. "Maldistribution" refers to the fact that some people have immediate and extensive access to a variety of energy-conversion mechanisms and/or forms of energy such as food and fuel, while other people have very limited access to energy/energy conversion resources. And "alienation" is often a consequence of incompatible relationships and lack of information. Both information and empathy also are forms of energy and means to control or direct energy, as it is explained in subsequent discussion.

In industrialized countries, the so-called "energy crisis" began in 1973 when a number of petroleum-exporting nations quadrupled prices for their crude oil exports. The change was a consequence of a number of motivations, but it reflected a more realistic appraisal of the rate of depletion of the easily-extractable stocks. People in industrialized countries which depend on oil imports to maintain levels of comfort and luxury have become highly aware of the need to conserve fuel while searching for new fuel sources and new mechanisms for converting energy, as in nuclear fusion.[1] But now, it is uncertain whether people in rich nations such as the United States will succeed in conserving enough energy resources and developing new ones with which to maintain levels of health, comfort and luxury, or whether the technological effort will fall short, requiring extensive personal adjustments and re-organization of the economy. Opinion ranges on all sides of the question, but more informed and scientific authorities appear very pessimistic, including those who had been investigating fuel resources and technological potential for

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[1] Allen L. Hammond, in "Individual Self-Sufficiency in Energy," <u>Science</u> 184 (April 19, 1974), discussed current alternatives for individuals in fuel conservation. A. B. Makhijani and A. J. Lichtenberg, in "Energy and Well-Being," <u>Environment</u> 14 (June 1972), with less urgency at the time (prior to the fuel price increases), wrote in more abstract terms.

many years before the public became aware of the problem.[2]

The industrial energy crisis has several implications for the rural poor as well. Government plans to industrialize agricultural production in resource-scarce nations can not be implemented because of the high cost for fuels. Industrial countries no longer have as much surplus energy with which to aid poorer nations in economic planning and change. On the other hand, if and when a fusion power system becomes efficient and safe, it could provide a substantial source of energy for resource-scarce nations as well as for the rich.

Food energy. For the poor of the world, however, the real "energy crisis" began decades, even generations, ago, when an application of energy in the form of modern medical technology lowered rates of mortality, and rapid population growth put pressure on food production and distribution systems. In many countries increases in agricultural output have not kept pace with increases in numbers of inhabitants. Countries which had been able to feed themselves have become dependent on

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[2] A. Parker, "Man's Use of Solar Energy," Advancement of Science 7 (1950-1951); Howard T. Odum, Environment, Power, and Society (New York: Wiley-Interscience, 1971), pp. 124-125; Kenneth E. Boulding, "The Social System and the Energy Crisis," Science 184 (April 19, 1974); Nathan Keyfitz, "World Resources and the World Middle Class," Scientific American 235 (July 1976); and Philip H. Abelson, "Oil and the World's Future," Science 194 (Nov. 12, 1976).

grain imports from resource-rich countries such as the United States. Furthermore, industrial countries such as Japan, the U. S. S. R. and other nations in Europe, and oil-exporting countries, dominate purchases of grain, leaving numerous poorer nations to rely on international charity, the poor not being able to produce enough goods of such value to pay for all their needs in food.

The food energy crisis began so long ago that massive efforts have been made for decades to alleviate the problem, as Western industrial governments and philanthropic foundations have helped poorer non-industrial countries establish agricultural research institutes in an effort to promote productivity. In the late 1960's and early 1970's, experimental efforts bore fruit and the "Green Revolution" occurred, as hybrid varieties of grain were developed which produced higher yields than native varieties under conditions of good water control and pest control and large quantities of petroleum-derived fertilizer. At first, the new technology spread rapidly and some of the poor countries reported self-sufficiency in food. Then, according to Jean Mayer,[3]

> the increase in oil prices effectively put the green revolution out of reach of such countries as India, Pakistan and Bangladesh, which are poor in petroleum and other resources, and have gone about as far as they can in increasing yields with traditional methods of farming.

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[3] "The Dimensions of Human Hunger," Scientific American 235 (Sept. 1976).

> The increase in oil prices also dislocated the economies of the wealthy nations, reducing their contributions to international aid.

Rates of increase in population are declining. But affluent people of the world continue to consume larger quantities of food and other resources. And the numbers of high-consuming, affluent people are increasing.[4]

Agricultural productivity is expected to grow as fast as population, globally, for the next five to ten years, as fallow and marginal areas are brought into production, intensive methods of cultivation are adopted by those who have not done so already, and the latest technology is tried where possible. Over the longer run, however, authorities expect food supplies to improve only if "...radically new public policies both in rich nations and in poor..." are implemented to rapidly reduce population growth rates and meat consumption among the affluent, and/or a new and unexpected scientific breakthrough occurs with respect to plant growth.[5]

Modern civilization. John Dewey placed the blame for current global difficulties squarely on the

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[4] Ibid.; Keyfitz; and Constance Holden, "World Population Trends," *Science* 194 (Nov. 12, 1976).

[5] Sterling Wortman, "Food and Agriculture," *Scientific American* 235 (Sept. 1976); and R. W. F. Hardy and U. D. Havelka, "Nitrogen Fixation Research: A Key to World Food?" *Science* 188 (May 9, 1975).

central institution of modern civilization:[6]

> The upsets which taken together, constitute the crisis in which man is now involved all over the world, in all aspects of his life, are due to the entrance into the conduct of everyday affairs of life of processes, materials and interests whose origin lies in the work done by physical inquiries in the relatively aloof and remote technical workshops known as laboratories.

Beyond Dewey's specific criticism, Gregory Bateson characterized Western Civilization since the Industrial Revolution as an expression of several ultimately self-destructive values: the individual, the community and the nation are in competition with and must have unilateral control over the environment and other people; and, humanity lives in an infinitely expanding "frontier" which technology always can exploit and make comfortable for people.[7]

Modern science and technology laid the foundation for the industrial civilization which pollutes and depletes resources at an alarming rate, the curative and preventive medicine which allows population to increase so rapidly, and the electronic urban lifestyle, in which human relationships, vocations and recreations are mediated by complex technology seldom understood and often not controlled by those affected. On the other hand, modern

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[6] John Dewey, Reconstruction in Philosophy (enlarged ed.; Boston: Beacon Press, 1948), p. xxi.

[7] Gregory Bateson, Steps to an Ecology of Mind (New York: Ballantine, 1972), p. 497.

science and technology has brought great comfort and luxury to hundreds of millions of people, relief from pain and debilitating helplessness to billions, and new awareness of ideas and events to most of the global population. Furthermore, science and technology provide the only means through which the present four billion and the expected six to eight billion people, many of them rural dwellers and poor in resources, can survive together in this "Spaceship Earth" ecosystem.

But science and technology no longer can be applied piecemeal, helter-skelter and without considering all the consequences imaginable and probable, according to the collected wisdom of investigators and spokespersons in all areas of importance: culture; traditional institutions; political relationships; and every aspect of public health as well as demography and the physical sciences. Ordinary people, along with many scientists, have begun to understand the first law of ecology: "everything is connected to everything else," and its most important corollary, "we can never do merely one thing."[8] To survive peacefully as a group of six billion or more human beings, whether or not subsequent generations voluntarily choose to reduce their numbers, requires

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[8] Barry Commoner, The Closing Circle: Nature, Man and Technology (New York: Alfred A. Knopf, 1971), pp. 33-46; and Garrett Hardin, Exploring New Ethics for Survival The Voyage of the Spaceship Beagle (New York: Viking, 1972), pp. 38-39.

ecological if not holistic thinking and planning, an application of systems science where the system includes every bit of information, material, human creativity and activity accountable. And the basis for understanding an ecosystem is investigation of the energy conversion processes by which the system operates, the forms of energy produced, and their effects on different elements in the system.

Prognosis for the rural poor. Taking an ecological-energy view, at first glance it might appear that the rural poor have ecological advantages which insure their survival. The poor do not depend on machines that use diminishing supplies of fuels and minerals, and they benefit directly from solar energy, with access to cultivable land, fodder for their animals, and wood for heat and building materials. But in the present decade, the end of access to new cultivable lands, grazing areas and productive forests has become apparent, and, as populations continue to grow, rural people must learn to subsist with less land for their numbers. Cooperative tendencies and intelligent use of resources must be enhanced, including new ways to preserve or improve healthy and creative lifestyles. The concept and the process of "rural life development" explored in this study assume both the possibility and the desirability of changing rural conditions so that more people can live better lives with the limited resources available to them.

To promote rural improvements which encompass both ecological adaptability and cultural revival, however, may require widespread popular awareness, participation by local teacher-examples and leaders, and institutional support and guidance from the highly-educated and broadly-experienced urban elites. The latter may be needed to continue or help improve urban-rural linkages in trade and information, to lead in efforts to organize opportunities for youths to settle or gain experience in different vocations and environments, and to maintain production of goods and services of value to the rural population and possible to produce in fuel-scarce economies.

For this awareness, participation, support and guidance to take place, a large amount of energy will be needed, but mostly energy as information generated by organization or motivation to understand the events, situations and people involved and affected. It is suggested that one vital factor in the success of rural life development in various countries is whether or not sufficient numbers of rural-oriented educators, including farmers, parents, teachers, leaders, and outside agents, become stimulated to promote it for each community.

<u>Summary of objectives</u>. The present study includes examination of the problems surrounding the

promotion of rural life development by potential educators, using concepts related to energy conversion and energy resources as a unifying basis for analysis of the problems and for generation of alternative approaches to the solutions. It is hoped that realistic, data-based, but evolutionary or peaceful solutions are generated, that is, approaches which reflect what is known about food and fuel resources, what is known about the dispositions to think and act by all who might contribute to improving conditions in rural life, and approaches which are workable alternatives to ecological degradation and migration to urban environments with high potential for unemployment, destitution and/or political upheaval.

As a novel attempt to combine elements and information from a broad set of disciplines, including ecology, anthropology, nutrition, agriculture, economics, and psychology, it is expected that the hypotheses generated from the synthesis will have greater importance than testing the assumption that the synthesis can be made and applied to analyze a specific situation. In other words, it is hoped that reflection from the experience of investigation results in a set of ideas, suggestions or proposals which can be adjusted, applied and tested by those currently involved or expecting to become involved in helping the rural poor improve their lives.

A Common Language for Discussion

The present study involves exploration of complex data for a complex purpose. Consistent use of clearly defined terms aids in description of the data and in relating data to the purpose. In this section, it is important to specify what is meant in reference to "ecology," "holistic," "energy," "values," and "rural life development." For the sake of brevity as well as convenience, the meanings given are assumed rather than formulated by argument or linguistic analysis or by reference to current authorities.

Ecological science in summary. An "ecology" is a description of the relationships among organisms and objects in an environment. For an ecology to be understandable, it is often necessary to describe the thermodynamic properties of all elements and relationships, the chemical properties of various objects, the biological properties of the organisms, and the climatic and geographical properties of the environment as a whole. Properties are examined at frequent intervals in order to generalize about relationships and to determine the consequences of changes in any element of the system. All the relationships, properties and changes together with the objects, organisms and geographical setting may be referred to as an "ecosystem."

In "human ecology," the ecosystems examined contain human beings. The primary concerns are the relationships among people, human relationships with the material environment and other kinds of organisms, and the consequences for people from changes to any element in the ecosystem. But, in addition to the kinds of properties mentioned above, for a human ecology to be understandable there may be study and/or description of psychological properties. Human psychological properties include attitudes, motivations, emotions, cognitive structure and mental processes. These human variables may affect an ecosystem and may be affected by other elements and relationships in the system.

Holistic analysis. The psychological element makes an ecological description holistic. A holistic description is one where the elements and relationships in a system are clear enough to provide a comprehensive understanding of the system. A "comprehensive" understanding means that a person can act in the system fully cognizant of the probable consequences of any actions. A holistic analysis, therefore, may not need to be as methodical as an ecological analysis, just as an ecological analysis may not require psychological variables.

As defined for this study, a holistic analysis is more pragmatic, or guided by human purposes and desires to act, whereas an ecological analysis is more epistemological, or guided by human curiosity and desires just to know. Active experience in an environment may allow a holistic understanding of that environment to develop, whereas ecological understanding requires more scientific knowledge. But ecological understanding, or scientific information about the relationships and elements of a system, enhances a holistic view. And a holistic understanding, from active experience in an environment, may provide a basis for ecological investigation.

With ordinary experience in learning and helping others to learn, most people develop intuitive understanding of learning processes. Mature people know to some degree how much and what learning will result from their actions. For rural people in poor countries in the process of encountering new and complex cultural and environmental changes, however, it is assumed that local experience in and intuitive understanding of learning is an inadequate basis for coping with the changes. Furthermore, it is claimed, external agents or educators, in order to help the rural poor, also need a scientific or ecological, if not holistic understanding of education, to compensate for their lack of experience in the local environment, especially with the people to be aided.

Energy basis for ecology. In the present study, a more scientific holistic understanding of human learning is sought, by adding to experience in learning an "ecology of education" to be formulated in the study. An ecology of education or learning, as with ecologies of other systems, includes a description of the relationships and elements involved in learning. Chemical, biological, climatic and geographical properties are important, and thermodynamic variables provide a fundamental reference for all the elements, relationships and properties.

But this is an assumption to be tested, for the stated objectives of the present study. Whether or not thermodynamic or energy constructs may be applied usefully in an ecological description of learning processes has not been demonstrated in the educational literature reviewed. In particular, it would seem difficult to describe psychological elements in terms of energy resources, movement and conversion mechanisms. But human psychological elements are necessary to make a human ecology holistic and therefore useful as a tool in planning for objectives dependent on learning objectives.

"Energy" has been used in the introductory section with respect to food, fuel and information. The preliminary definition of energy, then, is "a force capable of changing something from its present state." To be accurate, food, fuel and information are forms of potential energy because something else must happen to them before they can function to produce changes: food must be ingested; fuel must be ignited; and information must be received and processed. But even the seemingly-pure energy of an almost-massless photon discharged from a light source must meet with an object before the photon can begin to produce change on or to the object. Therefore, all forms of potential energy are referred to as, simply, "energy."

It may appear that all objects are forms of energy. It is true that all objects embody some energy. For example every object has mass and therefore gravitational attraction. Objects located on earth contain varying amounts of heat or thermal energy. What object can not be considered a form of energy?

This question is not allowed to confuse the subsequent discussion about energy and learning. In exploring a particular phenomenon, only a limited number of energy forms are observed to be consequential. The problem is to find out how they are consequential and how to apply whatever knowledge is obtained for the betterment of human existence. But because potential energy infuses every element and is involved in every relationship, <u>and</u> energy can be measured, energy constructs are hypothesized as the fundamental variables for an ecological understanding of learning processes and outcomes.

Two meanings for "value". Amounts of energy are measured in unvarying, precise, physical terms such as calories, joules and British Thermal Units.[9] Every object has an energy value indicating the amount of potentially useful energy contained in the object as food, fuel and/or information. Every object in a human ecology also has a human value, an indication of how the object affects a person's thoughts. It is the task of later discussion in Chapter Two to find out how to relate the thermodynamic and the psychological meanings of value.

Human values, as psychological elements, are important for the construction of a holistic understanding of education. Educators seeking to change aspects of rural life should understand the origins and aspects of their own values as well as those of the rural people for whom the educators' actions have consequence. The values of all people involved are variables with interrelationships in an ecology of education.

The value of "rural life development". The ultimate purpose in formulating a holistic ecology of education is to apply it in promoting rural life development in poor countries. The rural life development values

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[9] One foot-pound=1.356 joules; one calorie=4.184 joules; and one BTU (British Thermal Unit)=1,055 joules: Chauncey Starr, "Energy and Power," Scientific American 225 (Sept. 1971).

to be sought are good health, cultural creativity, democratic relations, and scientific planning. All these values increase well-being for individuals as well as community, establish a basis for further improvement, and are enjoyable in themselves.

One may think of other values to include as part of rural life development. One may find that the values given are important for all people, not just rural dwellers. Here it is assumed only that these are the values, both necessary and sufficient when achieved in behavior, to enable rural people to maintain their dignity and much of their control over their environment and individual and community growth, in response to modern environmental, cultural, economic and political forces and changes.

The value terms adopted are comprehensive enough to subsume objectives usually recommended for and desired by rural people, yet specific enough to direct behavior for learning and demonstration. When realized in activity and upon reflection, the values are mutually reinforcing and complementary to each other. Finally, the values as such are globally acceptable, observed to some extent in most, if not all, cultures, and expressed to some degree in most, if not all, political ideologies or constitutions.

The word "life" is included in the term "rural life development" to distinguish the latter from "rural development." Governments and other organizations have formulated policies and implemented programs designed to promote "rural development" in poor countries. But "rural development" schemes, and also "community development," "agricultural development," and "economic development" tend to focus on improvements in the material infrastructure, which, if successful, often, but not always, lead to better physical health for rural dwellers. Good physical health is an important, but only one, dimension of good health. And good health is an important, but only one, value of rural life development.

Occasionally, so-called rural development schemes aim at establishing local community organizations to promote agricultural production and social welfare. But very rarely do these programs result in widespread planning capabilities and democratic relationships among the local participants. Agents of the helping organization tend to retain leadership and informational processing skills for themselves. As a learning experience as well as an enjoyable experience, rural life development activity is conceived and planned so that local people soon become the leaders and main beneficiaries of subsequent activity.

Rural life development might have been defined as activity which promotes individual and community growth and improvement in cognitive, affective, psycho-motor and moral skills. But "scientific planning," "cultural creativity," "good health" and "democratic relations" are more specific and easier to operationalize, yet retain enough flexibility to become compatible with the norms of any social system. For example, spiritual exercises and religious rites may stimulate creative thought, motivate other-directed good behavior and/or pacify harmful emotions. So forms of worship and religious reflection may be subsumed under rural life development, and they are important behaviors to be encouraged among people who benefit from the activities.

Creativity, scientific method, health and democracy are not mutually-exclusive values. An activity may be all, any combination of two or more, or only one, to be valued as rural life development. And any one attribute aids in achieving any of the others. But if an activity promotes one value while inhibiting another, rural life development does not occur. The ideal activity is creative, scientific, healthy <u>and</u> democratic <u>and</u> promotes these kinds of skills, attitudes and relationships among rural dwellers.

<u>End values and the ecology</u>. Having a value-defined objective for producing an ecology of education may affect the elements to include in the ecology. But this could be desirable. The psychological properties considered for this ecology may be restricted to human attitudes toward, feelings about and skills in creativity, planning, democracy and healthy lifestyles. Then the investigator may ignore all human values related to

learning which do not contribute to or inhibit the values of rural life development. The questions of interest are limited to those such as "What environmental conditions encourage or inhibit learning to be scientific? How much and what forms of energy are needed to promote creativity in people? What kinds of transactions support democratic relations? and What other forms of energy besides food energy are necessary to develop and maintain good health?". But these questions are of global importance and justify limiting the formulation of an ecology of education to a more manageable and practical scope.

On the other hand, despite making the study more manageable, it is not guaranteed that questions such as the above will be answered satisfactorily. It may be possible only to learn whether or not the questions are answerable at all. In other words, the only question finally answered may be, "What data and methodology are required to produce a useful, holistic ecology of education for the rural poor in general or in a particular culture?"

In summary, a useful, holistic ecology of education for the rural poor is defined as a comprehensive description of the variables affecting the learning processes. Such a description indicates the kinds of activities and how such activities may be promoted that lead to improvements in well-being among rural dwellers in poor countries. It is hypothesized that energy constructs provide the fundamental concepts and measures for an ecology of education.

How the hypothesis is to be tested and the ecology formulated and applied is explained in the last section of the present chapter. But before discussing the method and plan of the investigation, a review of its theoretical and motivational foundations is in order.

Foundations for Studying Change in Rural Life

Empirical data relevant to the processes of change in rural life already exist in vast quantities and more become available daily. But so many factors and kinds of processes are involved, even when considering just one small community in rural Thailand, for example, that manipulating and making understandable all the data becomes a problem in itself without some comprehensive conceptual framework or reference point. Ecological- or systems-oriented scientists have begun to provide frameworks and unifying concepts, by considering forms of energy, their sources and conversion mechanisms, and consequences for materials and social systems. Enough investigators have been using energy-related concepts in application to social research to warrant publication of a bibliography, and one has appeared.[10] Typically,

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[10] Denton S. Morrison, Energy a Bibliography of social sciences and related literature (New York: Garland Publishers, 1975).

however, social scientists only refer to the fact that energy is involved in environmental and social processes. The researchers seldom appear to consider energy processes as central or greatly significant to the issues under discussion.[11]

Energy in social science. Among those who have believed energy processes to be of greatest significance in discussion of social structure and change, several in particular provide the theoretical basis for the present study. Fred Cottrell, with Energy and Society in 1955, published the first economic history of civilization which focussed on availability of fuels and solar energy and energy conversion technology as the primary variables in social development. A second pioneering effort appeared in 1972 with Environment, Power and Society, in which Howard Odum explained in detail the energy conversion processes fundamental to all dynamic systems, including those of just chemical composition, and those with life forms, intelligence and human organization. Odum suggested methods for accounting and evaluation of energy systems, of conceptual use in the present study.[12]

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[11] For examples: Walter Firey, Man, Mind and Land A Theory of Resource Use (Glencoe, Ill.: The Free Press, 1960); Daniel Katz and Robert L. Kahn, The Social Psychology of Organizations (New York: John Wiley and Sons, 1966); and Erik Cohen, "Environmental Orientations: A Multi-Dimensional Approach to Social Ecology," Current Anthropology 17 (March 1976).

[12] Fred Cottrell, Energy and Society The Relation

Richard Adams, in Energy and Structure, synthesized energy theories from anthropologists with knowledge of historical developments and the latest in information theories, to explore policy questions about social relationships. Adams' study provided an organizational model for the present investigation, by, first, explaining the energy concepts involved, then infusing data from social science research, and finally drawing implications from the synthesis. Adams also provided some inspiration to those hesitant about exploring what appears to be an endless set of variables:[13]

> Taking the mass-energy-information complex as a whole is in no sense a sneaky way of getting the kitchen stove into the act, but rather provides a legitimate basis for relating a kitchen stove that has long been in the act, but ignored, to other events through common concepts and not analogy.

What Adams hoped to accomplish in terms of universal implications for a distributive policy based on the realities of energy relationships, the present investigator hopes to accomplish in terms of specific implications for educational policy in the rural areas of energy-resource-scarce nations. But for this purpose, a theory of learning is required which can be related to

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between Energy, Social Change, and Economic Development (Westport, Conn.: Greenwood Press, 1955); and Odum.

[13] Richard N. Adams, Energy and Structure A Theory of Social Power (Austin: University of Texas Press, 1975), p. 111.

the energy theories already acquired. Odum's description of learning as an energy system does not appear to include the structural factors involved in human learning.

Learning. The philosopher and social scientist John Dewey provided an established and relevant theory of learning, and Dewey's observations have been substantiated by anthropologists such as Margaret Mead and organic psychologists such as Jean Piaget. Furthermore, Dewey presented a holistic epistemological theory which conforms to an ecological or systems approach such as that advocated by Gregory Bateson. And Dewey promoted values shared by contemporary environmentalists and social scientists involved in the study of human resources and survival.[14] In an excellent paradign of holistic reality, sixty years ago Dewey wrote:[15]

> There is no completion in the act of thinking... Our most elaborate and rationally consistent thought has to be tried in the world and thereby tried out. And since it can never take into account all the connections, it can never cover with perfect accuracy all the consequences.

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[14] Randolph J. Haines, (abstract of) "The Value Theory of John Dewey and Ecological Values" (Yale University, 1975), in Dissertation Abstracts International, hereafter abbreviated DAI, Vol. 36, No. 1, hereafter noted 36/1, p. 2895-A.

[15] Democracy and Education An Introduction to the Philosophy of Education (New York: The Macmillan Company, 1916), pp. 176-177. Dewey summarized his theory of education in Experience and Education (New York: Collier, 1938), along with an evaluation of trends then current in school learning.

Although an individual tries to know as much as possible about everything, he can never know all and sometimes must act. Action and reflection add to his knowledge, which improves but remains imperfect. Each learning experience, however, should contribute to the ability to learn more, in Dewey's theory, in addition to being valuable or useful for present purposes and enjoyed for its own sake.

Learning itself means the acquisition of habits or dispositions to think and act in particular ways. It is a mental process, internal to the learner, which can not be observed by others as it occurs. The consequences or nature of the new habits or dispositions can be evaluated only very imperfectly by others. And as a process, learning seldom is observed even by the learner himself, although he gradually can assume control of the process.

The lack of advanced technology with which to observe the learning process means that there is no "science of education,"[16] only philosophies of education, such as Dewey's, based on the social sciences in addition to insight gained from reflection upon human experience, one's own as well as that observed and recorded in literature, religion and the arts. The contribution of the

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[16] F. Raymond McKenna, "Piaget's Complaint--And Mine: Why Is There No Science of Education?" Phi Delta Kappan 57 (Feb. 1976).

social sciences to philosophies of education has been enormous, however, and this contribution is used and assessed in the present investigation, in determining how and what data from research about education may be related to information on energy processes.

Recent studies. Much effort has been made to apply knowledge from the physical sciences to the learning process, and the most successful effort, so far, that by medical scientists concerned about the relation of nutrition to learning ability, is reviewed later in this study. A very recent trend has been attempts to use systems science and principles of ecology for analysis of the learning process, in which variables identified by all sciences are related or placed in a single conceptual scheme.[17] This holistic approach to the problems and processes of learning provides the first objective of the present research, gathering evidence from all the sciences of relevance to learning in order to synthesize a systematic conceptual framework that indicates the the mobilizing factors for learning, so that if learning

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[17] Sara T. Morgan, (abstract of) "Towards Self-Balancing in the Education of Children: Ecological Perspectives"(Columbia University, 1972), in DAI 33/5, p. 2241-A; Eleanore L. Vaines, "An Ecological Systems Framework for Home Economics/Human Ecology: The Linkage of Environment, Energy and Organism as Family," unpublished Ph. D. dissertation (Michigan State University, 1974); and Klaus Schleicher, "The Necessity of an Anthropo-Ecological Dimension in Education. Possibilities for Its Realisation," International Review of Education 21 (1975).

is perceived to have failed in its processes, clear causes may be attributed and improvements suggested.

In searching for precedents, a similar attempt was encountered in the writings of Gregory Bateson, a psychologist who has had extensive experience in anthropological investigation, psychiatric research and study of animal psychology. His experiences have been summarized in Steps to an Ecology of Mind,[18] a collection of Bateson's papers published in response to his concern about environmental issues and the inability of industrial civilization to organize solutions because of fragmentation in the sciences and humanities.

Bateson's understanding of information theory, psychology and the analytic philosophy of Bertrand Russell led Bateson to formulate a hierarchy of learning typology. His understanding of biology, anthropology and industrial civilization resulted in a theory that the evolutionary survival unit consists not of organism alone, but "a flexible organism-in-its-environment," and survival requires learning. The type of learning required for survival depends on surrounding environmental conditions, including the biological and social nature of the organism.[19]

For man, the most socially complex organism and whose habitat extends over all the world and a variety of

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[18] (New York: Ballantine, 1972).

[19] Ibid., pp. xx, 448, 451, 460-464, 482-483, 494, 497.

conditions, Bateson described a five-level hierarchy of learning: "Zero Learning...the simple receipt of information from an external event, in such a way that a similar event at a later (and appropriate) time will convey the same information;" "Learning I" or changes to Zero Learning, observable where a response to a stimuli at a later time is different from the earlier response, a process of differentiation or extinction; "Learning II," or "learning to learn," where understanding and control of Learning I develops and its rate is increased or changed in other ways; "Learning III," hypothesized as any profound re-organization of character or deliberate changes in the processes of Learning II, such as apparently achieved in religious conversion or in Eastern mental exercises; and "Learning IV," which Bateson only suggests may be possible, but if it exists, has not been described, a logical extension of the typology, that one can learn to control changes in Learning III.[20]

Bateson's typology of learning and ecological ethic have been used in at least one attempt to formulate a social learning system which would promote global peace and environmental balance.[21] Bateson's ethic also inspires the present study, but neither Bateson nor his student

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[20] _Ibid._, pp. 284-305.

[21] Lewis J. Perelman, "Elements of an Ecological Theory of Education," unpublished Ph. D. dissertation (Harvard University, 1974).

appear to have considered the energy resources required to promote either the ethic or the learning system, although they both demonstrated extensive knowledge of energy conversion requirements, fuel depletion and information theory. The present study does analyze the possible energy sources involved in learning, but in order to formulate an ecology of education rather than an ecologically-oriented system of education, and for a less ambitious purpose than world peace and harmony with nature, that of enhancing rural life in poor nations.[22]

Motivational sources. Inspiration and theoretical support for the latter purpose comes from several sources, in addition to the investigator's own interest in and experiences and involvement with rural people in Laos and Thailand. Gunnar Myrdal, in his lengthy Asian Drama and in subsequent works,[23] demonstrated both the

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[22] Leland Gilsen, in (abstract of) "A Systems Model of Social Structure, Function and Change" (The University of Arizona, 1976), in DAI 37/3, p. 1656-A, claimed to have applied models based on general systems theory and thermodynamic law to analyze patrilineage, population adaptation and man-land relationships in a shifting agricultural community in Nigeria. If the complete work had been available, Gilsen's effort might have provided theoretical support to the present investigation, that an energy-systems framework improves analysis of social processes. The present study includes several energy variables not considered in Gilsen's investigation, however, and for different purposes.

[23] Asian Drama An Inquiry into the Poverty of Nations (New York: Twentieth Century Fund, 1968); The Challenge of World Poverty A World Anti-Poverty Program in Outline (New York: Pantheon, 1970); and Against the Stream Critical Essays on Economics (New York: Pantheon, 1972, 1973).

possibility and the necessity of institutional change throughout a society in order to bring about fundamental reforms and improve the quality of life for agrarian people dominated for generations by urban interests and rural elites.

The potential for peaceful rural revivals is explored in this study with respect to the institutions which can and must change. After Myrdal, other social scientists have continued to improve the concept and aims of rural development in poor nations, stressing the qualitative aspects of life that can be and should be enhanced, rather than just quantitative approaches, which stress agricultural productivity and extent of literacy. To paraphrase Nicholas Georgescu-Roegen, the output of an economy and other processes of life is not the material flow of waste but the immaterial flux of the enjoyment of life.[24] The concept of "rural life development" includes elements perceived by this researcher as most vital to the enjoyment of life: good health, cultural creativity, democratic relations and scientific planning.

Energy variables. Perhaps the most extensive investigation of the process of change among the rural

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24 Nicholas Georgescu-Roegen, "Energy and Economic Myths," Southern Economic Journal 41 (Jan. 1975). Also, see Bernard M. Bass and Ruth Bass, "Concern for the Environment: Implications for Industrial and Organizational Psychology," American Psychologist 31 (Feb. 1976); and Elihu M. Gerson, "On 'Quality of Life'," American Sociological Review 41 (Oct. 1976).

poor has been organized by Everett Rogers. Study of his published findings[25] provided the key element in the process, i.e., empathy. Obtaining information from others respected, trusted or loved by the learner, is revealed in Rogers' works as having great influence in the process of learning and adopting innovations. Because respect, trust and love must be earned and maintained by those who have information to offer, it may be considered an activity in itself, requiring motivating energy in nutrition and information on its own. But for the ultimate beneficiary of information given by one who is respected, trusted, or loved, the effort represents a service offered in the recipient's behalf. This service effort amounts to a subsidy in energy which is called in this study, "communication-and-care," because the information comes from an empathetic individual. The information assumes importance for the recipient especially because of a significant relationship with the source. Learning from a source of communication-and-care begins in infancy (and has indispensable importance for infants) and may continue as long as one maintains or has the

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[25] Everett M. Rogers, Diffusion of Innovation (New York: The Free Press of Glencoe, 1962); Rogers with Lynne Svenning, Modernization among Peasants The Impact of Communication (New York: Holt, Rinehart and Winston, 1969); and Rogers with F. Floyd Shoemaker, Communication of Innovations A Cross-Cultural Approach (2nd ed.; New York: The Free Press, 1971).

fortune to enjoy status, trust and love relationships.[26]

The second pillar of the energy-for-learning theory formulated in this study may subsume communication-and-care, in that "environmental information," as it is called, consists of all the perceptions absorbed and affecting a person. As explained in more detail in Chapter Two, solar energy radiation, a consequence of gravitational collapse, maintains and stimulates the global environment so that knowledge of events can reach a person through the sense organs. But communication-and-care is distinguished from other environmental information because of the former's importance in the process of social change, its dependence on the activities of others than the learner who obtains many kinds of environmental information without intercession by other people.

Another main element in energy for learning is characterized simply by the word "food," because bodily nutrition energizes the growth process which fulfills the potential established by one's genetic endowment, especially, as discussed in Chapter Two, one's capacity for cognitive growth, a process of becoming or unfolding necessary for learning at every level of abstraction.

Genetic information at least determines the basic

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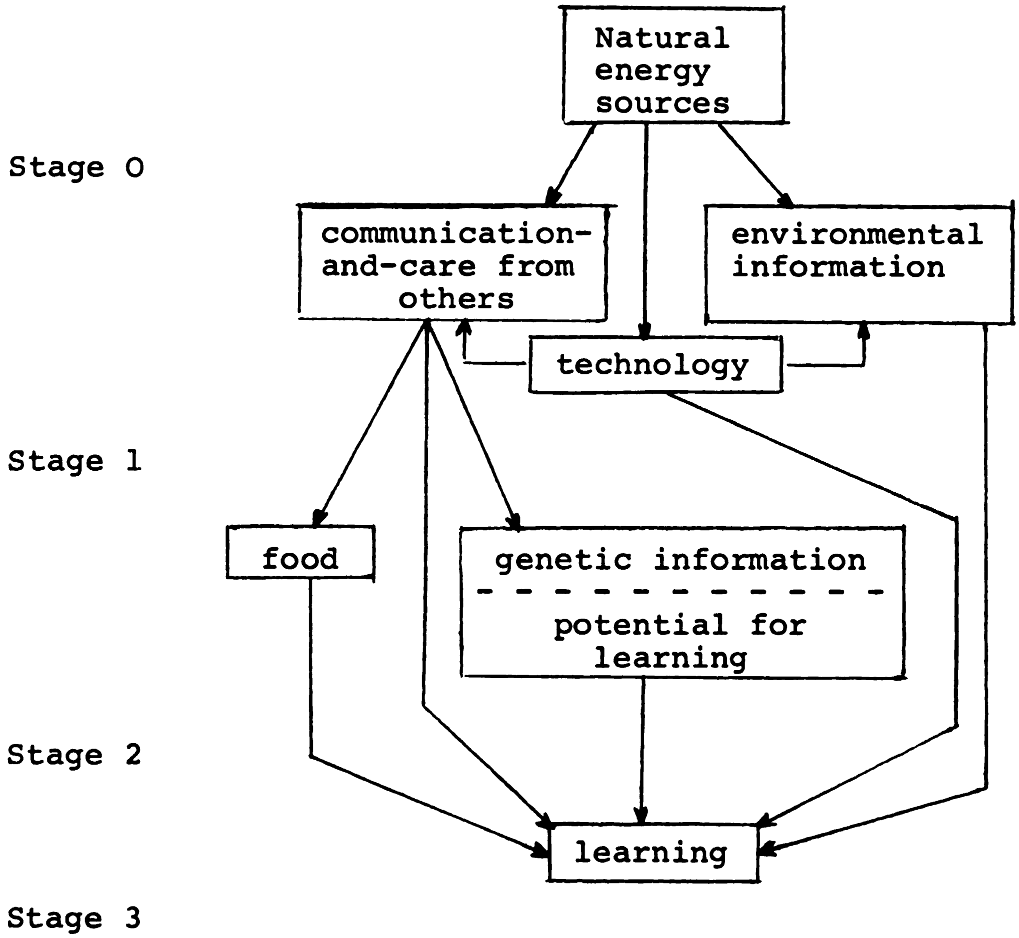
[26] Professional educators often discuss and value highly the ability to communicate empathy in organized learning activities: Robert C. Bender, "Education as a Function of Effective Communication," The High School Journal 58 (April 1975); and L. Thomas Hopkins, "The Overlooked Factor," Phi Delta Kappan 55 (June 1974).

structure of the human mind. But the mind is a complex system that in itself is far from being well understood by those who study it. It is a structure which depends on various stimuli or certain kinds of energy for it to operate, grow and develop according to whatever information is contained in a gene-and-chromosome molecular pattern apparently unique for every human being.

The technology of fuels, tools and organization is the last element considered in the ecology of education proposed. Organic fuels, constructed tools and cooperation and specialization have aided man's learning for hundreds of thousands of years, making food more digestible, environments more inhabitable, and communication more extensive. In the present age, non-organic fuels such as hydrogen and atomic fuels are becoming indispensable in sustaining modern civilization and supporting or enhancing learning activities in countless ways. A thorough understanding of this phenomenon may enable man to predict the effects fuel depletion could have on learning activities and institutions. Or realistic proposals can be made about extending communications and learning institutions in a country, with respect to the tool and fuel resources available to that society.

Figure I-1 may clarify relationships among the energy-for-learning variables mentioned. Energies from a variety of natural sources provide conditions that enable a person to be formed, to grow and to develop a

Figure I-1: Energy flow of information and other nutrients in the process of learning (arrows indicate direction of flow)



Stage 0; association of the elements needed for
Stage 1: forming a potential for human learning;
Stage 2: fulfilling the potential for learning;
Stage 3: self-directing the fulfillment of one's potential.

capacity for learning. As indicated by arrows in the diagram, communication-and-care from others depends on those people having environmental information, and frequently, technology, to extend and obtain information. A learner, especially a small child, may be exposed to environmental information as a result of caring persons.

Later, at "Stage 3," the learner controls food acquisition, and controls activities which result in information for the learner and others.

It is expected that five variables, technology, food, environmental information, communication-and-care, and genetic information, will provide a unitary framework with which to examine the problems of change and to support solutions to the problems. As will be explained in Chapter Two, the variables can be evaluated in the same units of measurement.

The hypothesized framework itself conforms to the most advanced model discussed by Marjoribanks and Walberg in their description and evaluation of twelve successive theoretical models of environment and cognitive development. In the last model, achievement of abilities at a given time two is pictured as a function of abilities at time one and all the environmental influences from time one to time two.[27]

In the energy-based framework presented here, time one is the moment of conception, and the present and potential abilities at time one are determined with the genetic information acquired by the new human being. Then environmental influences become significant, at

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[27] Herbert J. Walberg and Kevin Marjoribanks, "Family Environment and Cognitive Development: Twelve Analytical Models," Review of Educational Research 46 (Fall 1976).

first, nutrition, then, after birth, communication-and-care and other perceptual information. Technology is an indirect influence at first, as it is used only by others to support learning and growth in an infant. If time one is given as a certain age after birth, then abilities at time one may be directly observed, to the best of the observer's technical proficiency and reflection about experiences with the observed individual. The question of interest in the present study is how much energy constructs improve technical means to analyze learning processes and abilities.

Moral dimension in research. Solving social problems does not depend only on having an instrument with which to analyze the problem. According to an expert in the methodology of social science, Pertti Pelto, there must exist concern in addition to the data collected, and this concern should translate into benefits for the population studied, even if it is only knowledge about themselves.[28] Scientific objectivity must be tempered with empathy in evaluating cultures, to summarize thoughts expressed by another anthropologist.[29] And, as Dewey

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[28] Pertti J. Pelto, Anthropological Research, The Structure of Inquiry (New York: Harper & Row, 1970), pp. 325, 328.

[29] Robert H. Lowie, "Empathy, or 'Seeing from Within'," in Stanley Diamond (ed.), Culture in History Essays in Honor of Paul Radin (New York: Columbia University Press, 1960).

wrote, "The only guarantee of impartial, disinterested inquiry is the social sensitiveness of the inquirer to the needs and problems of those with whom he is associated."[30]

The case analysis in Chapter Three is an attempt to meet the requirements of empathy and personal concern so that the investigation might benefit the population studied. In addition, the case study provides for a test of relevance for the conceptual formulations, if the methodological problems can be solved, as discussed in the following section.

Plan and Methodology

Perhaps, as Kenneth Boulding said, "...planning is ninety per cent ritual,"[31] and as description of

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[30] Dewey, Reconstruction in Philosophy, pp. 147-148. Denis Goulet, in "On the Ethics of Development Planning," Studies in Comparative International Development 11 (Spring 1976), raised even higher standards: "Unless...social planners are ethically purified and achieve consistency in their ethical praxis, they cannot believe in the power of ethics to counter the power of wealth, of politics, of bureaucratic inertia, of defeatism, of social pathology," and without this individual ethical belief, which cannot be institutionalized, Goulet added, plans ultimately fail to help the poor. Goulet contributed significantly to the definition of development for poor people in The Cruel Choice A New Concept in the Theory of Development (New York: Atheneum, 1975).

[31] Reported in M. Taghi Farvar and John P. Milton (eds.), The Careless Technology Ecology and International Development (Garden City, N. Y.: The Natural History Press, 1972), p. 782.

methodology in research corresponds to a study plan, it serves as much to alleviate tension and promote the morale of colleagues in initiating an investigation as it serves for a binding statement of the procedure and the criteria to be followed in collecting and interpreting data. Accordingly, the present investigation began with a plan which provided comfort and confidence to the researcher that progress would result, but with little, if any, formulation of criteria which would indicate when or whether the objectives would be attained.

However, as Dewey stated, "The only situation in which knowing is fully stimulated is one in which the end is developed in the process of inquiry and testing... Any limitation whatever of the end means limitation in the thinking process itself." The process can begin with only a definition of a problem and a vague sense of the meaning of its difficulty, and knowledge will result from "...a certain kind of intelligently conducted doing."[32]

Some contemporary social scientists advocated even more flexible approaches: "To be genuinely scientific [only] means having a valid knowledge of a chosen domain of reality," according to R. D. Laing, who has experimented in the exploration of "inner space" as a psychiatrist. Bateson claimed that "...the advances in scientific thought came from a combination <u>of loose and strict</u>

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[32] Dewey, <u>Reconstruction in Philosophy</u>, pp. 121, 140-146.

thinking, and this combination is the most preceious tool of science.[33]

Type of approach. Dewey wrote that experimental method involves transcending past experiences to construct new and better ones in thinking, and that success occurs in any attempt at improvement that is practical, interesting, exciting or arouses attention. The present study attempts not just to "solve" problems by showing the relationship of ideas, but to solve problems "...in the concrete by supplying...hypotheses to be used and tested in projects of reform."[34] As for the hypotheses given at the beginning of the present chapter, the object is not to test their truth or falsity with data, reflection and logic, but to discover the scope and limitations of those hypotheses.[35]

The procedure to be used roughly follows Paul Reynolds' characterization of a "composite" approach to research and theory construction: an exploratory look at selected phenomena, developing ideas in the process; then description of patterns and empirical generalizations; finally an explanatory phase of theory construction,

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[33] R. D. Laing, The Politics of Experience and the Bird of Paradise (London: Penguin Books, 1967), pp. 102-103; and Bateson, p. 75.

[34] Dewey, pp. 95, 137, 192.

[35] Philip H. Phenix, Realms of Meaning A Philosophy of the Curriculum for General Education (New York: McGraw-Hill Book Co., 1964), p. 99.

testing and reformulation.[36] Chapter Two includes: looking at a selected phenomena, the relationships of energy and learning; and descriptions of patterns and empirical generalizations. Chapter Three consists of a test, to find out whether energy analysis is useful or not with respect to data on a specific culture. And the new hypotheses in Chapter Four represent a reformulation of the analytical scheme.

Beyond what Dewey and Bateson have proposed, it is expected that the material presented in this investigation meets the standards raised by Reynolds for "scientific knowledge," which is supposed to provide: an exhaustive, consistent, mutually exclusive typology; predictive and explanatory power; a sense of understanding causes; and potential for control of events.[37] A typology is formulated for energy and learning. A holistic understanding of energy-learning relationships is attempted, an understanding, it is hoped, sufficient to be predictive and explanatory and to promote potential for control.

Resolving hypotheses. To describe energy-learning constructs, to develop common measures for them, and to analyze learning processes and outcomes with the constructs, many scientific disciplines are reviewed.

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[36] Paul D. Reynolds, A Primer in Theory Construction (Indianapolis: The Bobbs-Merrill Co., Inc., 1971), p. 154.

[37] Ibid., p. 4.

Relevant and useful data are described and discussed for each construct. Then a judgment is made about the utility or predictiveness and explanatory power of the constructs. The judgment is based on feasibility in acquiring relevant information, extent of variation in the data among individual cases, and difficulty in processing and interpreting the data for policy, planning or action.

To resolve hypotheses about the benefits and use of energy analysis among rural Thai people, an extensive amount of material about rural Thailand is reviewed. Instances of forms of energy analysis are sought and considered for significance. The consequences where energy analysis is not employed also are considered. Description of rural Thai personality, values and abilities are compared to conclusions about what attitudes, values and abilities are required in order to employ energy-for-learning analysis and to promote rural life development.

Usefully relating discoveries in the environmental sciences to learning concerns many professional educators, and scientists as well. By reviewing literature about forms of energy and by considering ways to measure energy conversion processes, perhaps a useful connection can be developed between physical science and human values. A useful connection would be one in which all elements can be meaningfully quantified in equivalent terms, such as kilogram-calories. Secondly, there should be convenient means to quantify the values. And for the purposes of this study, "convenient means" are those employable by rural educators in poor countries and culturally acceptable to the rural poor.

Attitudes in approach to study. The approach used in collecting and collating data has importance for the descriptive results and reflects the philosophy which guides the inquiry. Dewey believed in the essential unity of mind and matter, subject and method, growth and participation, physical and social, ends and means, and so on, in order to "...attain as unified, consistent, and complete an outlook upon experience as is possible." Nothing, Dewey claimed, is isolated, singular, unrelated or unmeaningful.[38] This corresponds to present-day ecological or systems approaches, exemplified in Rene Dubos' statement, "...organisms cannot be understood unless they are studied in their integral responses to the environment."[39] Although Kenneth Boulding cautions the investigator, "...be careful of the man who says we have to know everything before we can do anything,"[40] it is assumed that every reasonable effort must be made to examine every source of information relevant to the study of learning for rural life development, given the time, physical

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[38] Democracy and Education, pp. 377-380.

[39] Rene Dubos, Man Adapting (New York: Yale University Press, 1965), p. 338.

[40] Boulding in Farvar and Milton (eds.), p. 147.

limitations and objectives appropriate for a doctoral dissertation.

One more consideration constrains the method of presenting ideas and proposals. Bateson quoted Margaret Mead, who was discussing the methods of social scientists with respect to democratic ideals. Mead had written that imposing defined ends amounts to manipulatory, anti-democratic behavior, therefore social scientists must work "...in terms of values which are limited to defining a direction [to make] it possible to use scientific methods in the control of the process without the negation of the moral autonomy of the human spirit."[39] In this study, the schemes outlined, the definition of rural life development, the solutions proposed, all are considered only directions for further exploration, alternatives for further testing or alternatives within which extensive and flexible modes of behavior exist to be chosen, as the hypotheses presented in Chapter Four may indicate.

Review of the plan. The design of the study and presentation of the material reflects an exploration of directional values. Chapter Two, "Energy and Learning," begins with a review of what is known about energy sources, conversion processes, and entropy. An energy system is described: the energy flow and nutrient cycling, control mechanisms and limits in conversion of energy. Next,

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[39] Bateson, p. 159.

information as a form of energy is discussed and related to learning processes, and a description of a learning system as an energy system is given, with social theory needed to explain how human interactions control the flow of information. Cultural learning systems are discussed, particularly the kinds and consequences of communication-and-care, with respect to energy conversion processes, including social motivators. A review of nutritional research follows, to describe what has been discovered about food as an energy-nutrient resource essential to human growth and learning potential. Then a method of quantifying energy in learning systems is explored, with examples presented and discussion of its potential utility, and implications for learning systems and the energy resources in social systems. The penultimate section has assessments of energy analysis with respect to each aspect of rural life development. And discussion of further implications concludes the chapter, focussing on how the energy-based ecology of education may aid and direct rural educators seeking ways to improve individual and community life.

Chapter Three, "Rural Life Development for Thai People," is a case study, a discussion of using energy constructs and analysis in a specific culture. First, a description of Thai culture is provided from a review of literature about Thailand and Thai people. The values of rural life development are compared to rural Thai values. Then potential rural educators or promoters of rural life development are described in successive sections, according to literature about them: farmer-parents, village teachers, local leaders, and agents from outside or urban institutions. The environment, abilities, social circumstances and specific problems of each type of educator are examined, to see whether or not and how a rural educator could employ energy constructs and analysis for learning rural life development values and behavior.

Evaluation of the study takes place in Chapter Four, the concluding chapter. First, a summary synthesis of the preceeding chapters is presented. Next, there is discussion about resolving or refining the hypotheses. Then the chapter and the investigation end with a new set of hypotheses as recommendations for further study or action.

CHAPTER TWO

TOWARD AN ECOLOGY OF EDUCATION: ENERGY AND LEARNING

In order to formulate an ecology of education, knowledge about energy function and process must be reviewed, explicated and synthesized. Then the constructs may be applied and described with respect to learning. A method of relating energy measures to human values must be found to make the ecology more holistic. All these tasks are performed in the present chapter. The last several sections of the chapter are concerned with discussing the implications of earlier discoveries.

Energy Flow

Scientists speculate about gravity, the ultimate measurable source of energy, but have no testable explanation of the mechanism for its origin. "Gravity" remains a primitive term, although everyone experiences its effects and highly sophisticated devices have been constructed to measure its effects. "Gravitrons," a name given to the hypothesized, sub-atomic element or elements which "cause" the tendency for bits of matter to approach each other, have never been detected in high-energy particle-accelerator experiments.[1]

When huge amounts of matter collect in one place, gravity forces the material closer and closer, until the normal arrangements of various atoms become disrupted, releasing heat, and sub-atomic particles press against each other, also generating heat. In the case of the collection of matter known as "the sun," the heat becomes a thermo-nuclear reactor, radically transforming the matter at a rate of four billion kilograms of mass each second. Much of the matter achieves forms which escape the sun, radiating into space, and within minutes some of it reaches the earth.[2]

To people on earth, "solar energy" seems to represent the mechanism which supports all life. But some of the heat generated by gravitational collapse in the interior of the earth reaches the surface in a useful form, as steam or heated water. Proposals exist for

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[1] Richard Adams, Energy and Structure, p. 135; and David B. Cline et al., "The Search for New Families of Elementary Particles," Scientific American 234 (Jan. 1976).

[2] G. Tyler Miller, Jr., Energy and Environment Four Energy Crises (Belmont, Calif.: Wadsworth Publishing Company, Inc., 1975), p. 16; Hans A. Bethe, "The Energy of the Stars," Technology Review 78 (June 1976); and Nicholas Georgescu-Roegen, in "Energy and Economic Myths," Southern Economic Journal, summarized the quantities of energy involved.

using advanced technology to directly tap geothermal heat and provide electricity.[3] However, the earth does not concentrate enough mass to generate a thermo-nuclear reaction. Compared to the sun, the earth is so cool that a hard crust covers the surface, although movements in the crust cause earthquakes and allow channels to form which result in volcanic eruptions.

Solar gravity and lunar gravity directly affect the surface of the earth in the form of tidal action. People take advantage of the consequent water movement to aid in navigation and fishing. Perhaps it will become feasible to construct mechanisms to convert tidal flow into electricity as well.

Photosynthesis. Compared to the energy derived through solar radiation, however, the tides and geothermal radiation represent nearly insignificant sources of energy presently utilized.[4] All life depends directly or indirectly upon the photosynthetic process in plants which occurs with the energy carried to plants by radiation from the sun, through space and through the atmosphere, and, in the case of underwater vegetation, through part of the hydrosphere. In addition, the distribution of life forms to various parts of the world depends upon

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[3] Martha W. Gilliland, "Energy Analysis and Public Policy," Science 184 (Sept. 26, 1975).

[4] Georgescu-Roegen.

climatic variations created by the action of solar radiation absorbed into the atmosphere, the lithosphere and the hydrosphere. Figure II-1 depicts the process by which solar radiation eventually is absorbed and converted by plants.

On a typical summer day in the United States, 500 calories, or ½ kcal[5] reach every square centimeter of ground surface. In a complex process involving carbon and other elements in the atmosphere and the soil, plants convert part of this heat or thermal energy to potential chemical energy in the form of biomass, usually over twenty grams of organic matter for a square meter of plants in one day.[6] In turn, part of the plant may be consumed by a person. The potential chemical energy contained in the plant becomes converted by the human organism into neuro-electrical and other forms of chemical energy which enable the person to maintain systems and contract muscles.

<u>Human energy</u>. A person's energy requirement depends on his weight and the type of activity which

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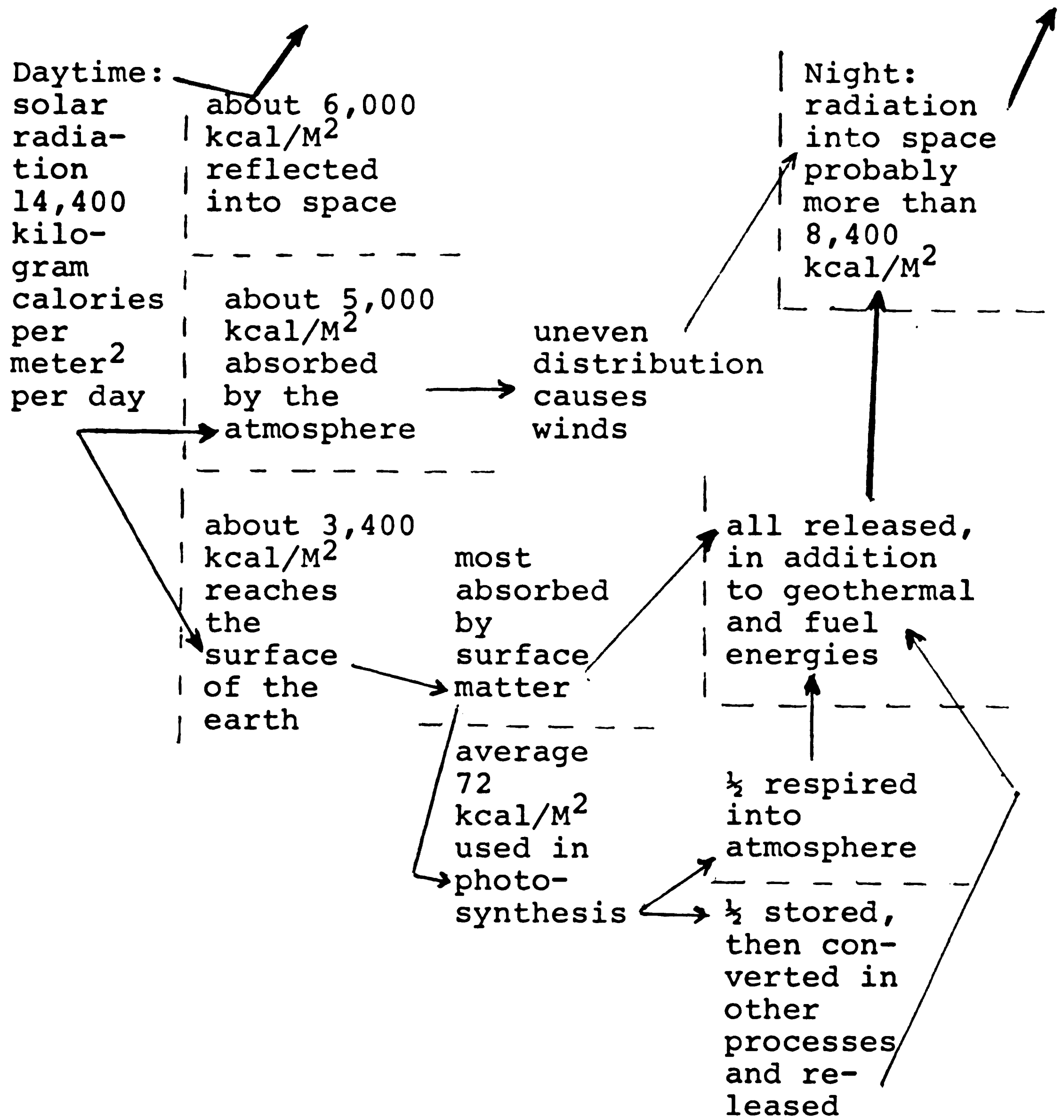
[5] One calorie or gram-calorie equals the heat energy required to raise one gram of water from 14.5^{o} to 15.5^{o} Centigrade. One kcal, or kilogram-calorie, equals 1,000 calories: G. T. Miller, p. 16.

[6] David M. Gates, "The Flow of Energy in the Biosphere," <u>Scientific American</u> 225 (Sept. 1971). Solar energy reaching the ground varies according to latitude and climate, from 70 kcal/cm^2/year in tropical rain forests, to 200-220 kcal/cm^2/year in deserts.

Figure II-1: Flow schematic of average global solar radiation received (not drawn to scale)[7]



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[7] Derived from Howard Odum, <u>Environment, Power and Society</u>, pp. 47-50; and Edmund J. Kormondy, "Natural and Human Ecosystems," in Frederick Sargent II (ed.), <u>Human Ecology</u> (New York: American Elsevier Publishing Company, Inc., 1974). In David M. Gates, <u>Energy Exchange in the Biosphere</u> (New York: Harper & Row, Publishers, 1962), Chapter One, there are more details.

takes place. But only about twenty percent of the chemical energy of the food can be converted into mechanical energy, or physical work. Eighty percent goes to maintaining the body, growth and/or reconstitution after illness, and waste heat, through the respiratory and digestive processes.[8]

Despite this limitation, a person can perform considerable work over time. With a diet of 3,000 kcal per day, normal in the United States, 600 kcal can be translated into mechanical energy, or nearly one "Horse-Power-Hour." A Horse-Power-Hour equals 641 kcal, the amount of chemical energy equivalent to 550 foot-pounds per second in mechanical energy, which means the raising of 550 pounds a distance of one foot in one second, repeated every second for an hour. Of course, few people can concentrate muscle energy so quickly, but a strong person might accomplish the task in ten hours. Because so many tasks do not involve a simple raising of a given weight, however, energy measurement of movement becomes quite complicated. Most scientists prefer to calculate the total energy converted during a task, using values

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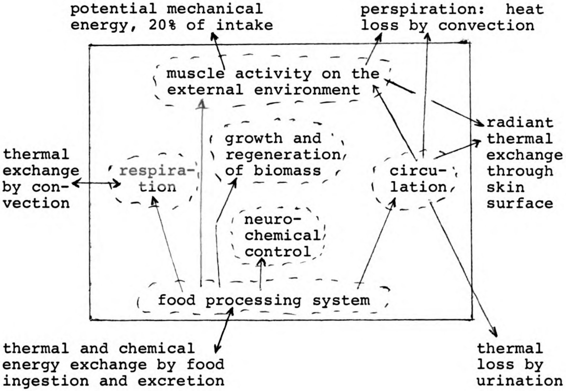
[8] R. Passmore and J. V. G. A. Durnin, "Human Energy Expenditure," <u>Physiological Reviews</u> 35 (Oct. 1955); Fred Cottrell, <u>Energy and Society</u>, pp. 17-18. Durnin and Passmore, in <u>Energy, Work and Leisure</u> (London: Heinemann Educational Books, Ltd., 1967), pp. 1, 16, described the chemical reactions of photosynthetic conversion of solar energy and the subsequent conversion of the energy in plant biomass. 1.34 grams of carbohydrate, with one litre of oxygen, convert into nearly five kcal of heat.

Figure II-2: Schematic representation of chemical and thermal energy flow through human beings and functioning sub-systems (arrows indicate direction of flows)



determined from experiments involving breath calorimetry and/or analyses of food intake and weight changes.[9] Figure II-2 summarizes the energy exchanges that take place between people and their environment. Not pictured are far more complex cellular, molecular and ionic processes involving chemical and neuro-electric energies.

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[9] Starr; Cottrell, p. 7; Odum, p. 26; Passmore and Durnin; and D. A. T. Southgate and J. V. G. A. Durnin, "Calorie conversion factors. An experimental reassessment of the factors used in the calculation of the energy value of human diets," British Journal of Nutrition 24 (1970).

The energy required to perform a given task varies directly with the square of the rate desired. Working faster requires proportionately much more energy,[10] although if easily-employed fuel sources are available such as horse fodder or gasoline, people have substitutes for their own labor. Horses and tractors convert energy so rapidly that where climate or rainfall patterns limit the time available to cultivate, such substitutes must be used for the land to support a large population. But in terms of total energy inputs to obtain a given output, such practices are exceedingly inefficient and much energy becomes "lost" because of the high conversion rate.

Entropy. On the other hand, no matter how slow a process occurs, some energy becomes lost, meaning dispersed into the atmosphere and unrecoverable. Furthermore, as the ecologist H. T. Odum explained, no process can occur without this "heat drain." Organisms tend to operate at that efficiency which produces a maximum power output which is never more than fifty-three percent, or a minimum heat loss of 47%. Most natural processes take place far below this efficiency. As noted previously, human energy converts to work at 20% efficiency. The highest efficiency in converting plant food into animal food is about 25%, for milk and eggs. The efficiency

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[10] As expressed in the formula, energy equals mass times velocity squared: Cottrell, p. 8.

depends on the structure of the converting mechanism and the state of entropy of the fuel or feed converted.[11]

Entropy, or energy degradation, means the loss of order into disorder. Fossil organisms such as crude oil represent a state of low entropy when contained because they remain stable over a long period of time and they can be quickly converted to heat and mechanical work. Sunlight, however, represents a state of high entropy because it readily disperses into the environment and only a comparatively long period of collection and concentration of it results in conversion to heat or mechanical energy. Photosynthesis in optimum conditions such as growing sugar cane results in barely 1.8% of the sunlight energy available becoming chemical energy in biomass. The most advanced diesel engines achieve an efficiency of just 35%, not even counting the energy cost of constructing the engine, nor the energy cost in converting crude oil to diesel fuel. Some mechanical-chemical devices invented by man have very low entropy, however. A discharging electric battery wastes only 20% of its energy. Organization and technology reduce entropy and conserve energy, as in the processing of coal, where

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[11] Claude M. Summers, "The Conversion of Energy," Scientific American 225 (Sept. 1971); Odum, pp. 28-31; Howard T. Odum and Richard C. Pinkerton, "Time's Speed Regulator: The Optimum Efficiency for Maximum Power Output in Physical and Biological Systems," American Scientist 43 (April 1955); and Jean Mayer, "The Dimensions of Human Hunger." For a theoretical physicist's definition of entropy, see S. W. Hawking, "The Quantum Mechanics of Black Holes," Scientific American 236 (Jan. 1977).

a mere eight percent of the energy stored in the coal is lost.[12]

The entropy phenomenon means that materials require continual energy supplements just to prevent degradation and eventual dispersal into the environment. Living organisms have low stability and require frequent replenishments of energy for maintenance, even when at complete rest. Maintenance may include fuel processing, materials processing, synthesis of parts by combining materials, re-arrangement and connection of disarranged parts, energy storage for fuel reserves and necessary structure replacement, and removal of old worn parts.[13] A human adult, deliberately at complete rest for twenty-four hours, still requires over 1,000 kcal in food, depending on body weight, for maintenance. A body works just to stay alive and intact. And any external activity increases the energy requirement for maintenance within, in addition to the energy needed for the activity.

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[12] Georgescu-Roegen; Freeman J. Dyson, "Energy in the Universe," Scientific American 225 (Sept. 1971); Wilson Clark, Energy for Survival The Alternative to Extinction (Garden City, N. Y.: Anchor Books, 1974), p. 13; Odum, p. 83; Cottrell, p. 107; and G. T. Miller, p. 32.

[13] Odum, p. 140.

Nutrients and Energy Controls

Life requires more than just an energy supply. A variety of mineral and chemical compounds provide structure, carry the energy through an organism, and convert energy into the forms required. And before many of these functions can take place, something must initiate the event, or act as "trigger mechanisms" as one social scientist called them, or control mechanisms.[14] For example, two phosphate compounds in plant surfaces trigger the photosynthesis reaction, where carbon dioxide and water, with light energy, part of solar radiation, become carbohydrate, oxygen, half the original amount of water, and some heat energy.[15] Notice the number of materials necessary. In addition to carbon dioxide, water and phosphorus, plants need nitrogen, potassium, calcium, magnesium and sulphur in large amounts, and boron, copper, iron, manganese, zinc, molybdenum and chlorine in small amounts.[16] All these elements reach the plants through roots in the soil and/or surface exposed to air or water.

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[14] Adams, p. 117.

[15] Israel Zelitch, "Improving the Efficiency of Photosynthesis," Science 188 (May 9, 1975).

[16] Gaylord V. Skogerboe, "Agricultural Systems," in Sargent (ed.).

Nutrient cycling. Animals require all these elements and more. For man at least six other elements have been identified as essential to his general health.[17] All these elements must be obtained from the environment. The elements necessary for life are called "nutrients" and the process by which nutrients are secured from the environment, used, and returned to the environment is called the "nutrient cycle." Water, various carbon compounds and proteins have such importance to life that their respective cycles, the hydrological, the carbon, and the nitrogen cycles, become subject to study and extensive manipulation by man.

Other minerals, not essential to life, but important to human cultural patterns, such as steel, aluminum, gold, uranium, and so on, cycle to a certain extent as they are extracted from the earth, manipulated, and distributed to users. As dense compounds they remain stable over long periods of time, and instead of being returned to the natural environment, they might be re-shaped and re-distributed in human culture. When discarded they tend to take long periods to degrade and disperse in the environment. They may become obstacles to the natural cycling of nutrients, or in the case of some manufactured chemicals,

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[17] Sohan L. Manocha, Malnutrition and Retarded Human Development (Springfield, Ill.: Charles C. Thomas, 1972), pp. 37-42. And Thomas H. Maugh II, in "Trace Elements: A Growing Appreciation of Their Effects on Man," Science 181 (July 20, 1973), reported that developing dental enamel has forty-three regular components.

move along with the nutrient cycle, but undegraded, and cause damage to life when ingested. Also, heavy concentrations of nutrients may temporarily overload portions of the environment and disrupt the cycling of other nutrients, for example, when a large amount of human or animal waste pollutes a water system.[18]

Nutrients can cycle because of the energy flow. The energy moves through the environment on mineral, chemical and molecular structures. And these structures are constructed from nutrient or mineral elements, in the case of living organisms, mostly carbonates and water. Energy provides the momentum for the organisms to obtain, process, store and discard essential nutrients and more energy. Another distinction bears repetition: nutrients cycle, at varying rates but seldom becoming lost to the earth and its inhabitants, while energy degrades at each stage of any process, eventually becoming unavailable, and needs replenishment.

Controlling energy. Control mechanisms direct the rate of energy flow and nutrient cycling and the distribution of energy and nutrients within the organism. A triggering mechanism controls the initiation of a process, as the phosphate catalysts do for plants. Complex

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[18] Frances Moore Lappe, Diet for a Small Planet High Protein Meatless Cooking (rev. ed.; New York: Ballantine Books, 1975), p. 22. See Peter J. Reynolds, "Minerals," in Sargent (ed.), for a discussion of the present supply of minerals in the world.

molecules carrying genetic information, catalysts, enzymes and central nervous systems act as control mechanisms for living things. All matter is subject to molecular, chemical and physical properties which govern changes in structure and movement and the rates of various changes. Controls require energy to operate and nutrients for structure, but controls typically use only a small portion of the energy and nutrients in the processes of control and to maintain the control mechanism.

At a more complex level, man has discovered control processes with which to obtain great amounts of energy and nutrients with comparatively little expenditure on his part. For example, 3.6 kcal/square meter (M^2)/year of effort applied in tillage may secure 19.5 kcal/M^2/year in grain. An even smaller effort in herding can secure animal protein in addition to energy, from milk and meat.[19]

Agricultural discoveries, learning, and information as such, all function as control mechanisms for human beings. Knowledge directs how people's energy will be used. The energy in information may be very small compared to the energies that the information directs. But, as explained in the following section, information has attributes similar to other forms of energy.

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[19] Odum, p. 108.

Learning from the Flow of Energy

From heat sources such as the sun or burning wood, sub-atomic, nearly massless particles of energy called photons strike objects, reflect in frequencies of the visible spectrum, and carry images to the human brain through the eyes. The ears distinguish vibrations and the skin senses pressure caused by motion of materials. The skin also distinguishes radiant heat energy differences in materials. Human taste and smell organs distinguish chemical differences in substances brought into contact by movement. The sense organs, therefore, function to distinguish, measure and enable response to the movement of energy and matter in the environment. Any significant differences in quality or quantity of energy or matter is a "bit" of information. Information, in other words, is "a difference which makes a difference," or has consequences, even to the slightest degree, for some other substance.[20]

Information as energy. Information may be considered a form of energy because it shares all the properties of energy. Like energy, information can be acquired, changed in form, stored and passed on or lost. Like energy,

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[20] Gregory Bateson, Steps to an Ecology of Mind, pp. 271-273.

information requires a nutrient structure for its conveyance through and retention in the environment. Obtaining and processing energy requires energy. Uncertainty is to information as entropy is to energy and mathematical formulas exist which describe both in equivalent terms.[21]

Energy used in order to acquire information can be measured in calories. To make the smallest distinction between two alternatives, one "bit" of information, requires very little energy. As H. T. Odum explained, large amounts of energy generate such a strong signal that senses are "over-powered," distinctions can not be made among the enormous number of bits of information received. Attempting to look directly at the sun is an example. Objects in the environment absorb much of the sun's energy and reflect images of a more manageable number for human sensory equipment. Human senses can process up to 10,000 bits of information per second with effort as little as 10^{-15} kcal of energy for neuro-electric impulses in the nervous system, seemingly immeasurable.[22]

But the human nervous system constantly senses such small magnitudes of various energy forms. Consider the mechanical effort in moving the point of a pin into contact with the skin from a distance of one-thirty-second

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[21] Myron Tribus and Edward C. McIrvine, "Energy and Information," Scientific American 225 (Sept. 1971).

[22] Odum, p. 171; Tribus and McIrvine. The latter describe the energy for one "bit" of information as 10^{-23} joule per degree kelvin.

on an inch. The skin immediately senses the pressure, a form of mechanical energy. Muscular reaction to it consumes a far greater amount of energy. The form of reaction also is governed by information, in this case an automatic reaction acts as the control mechanism to direct the muscles. The directing neuro-electric impulse requires energy, a small amount, however, compared to that used in muscular movement.

Retaining information. Information retained by an organism and potentially of use in control of organic processes is called "knowledge," and the activity of acquiring and retaining information is called "learning." "Memory" is a control apparatus which selects, stores and makes available information gained by learning.

Very little of all the information sensed by a person is accessible as memory for future use. Even with concentration, perhaps only about one percent of normal sensory data at any given moment may be immediately recalled. Over time much more is lost. Of that remaining, a small proportion may be used in directing one's activities, although it appears that all conscious control of one's activities stems from knowledge derived from sensory data. Genetic information seems to control the remainder, one's automatic reflexes and internal processes, including the way in which consciousness operates and memory is controlled.[23]

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[23] G. T. Miller; Bateson, pp. 130, 414; Isaac Asimov,

Figure II-3: Flow of energy as information (unit volumes suggestive only)[24]

Information available to senses: 10^4 bits/second → sensed → 10^3 bits selected → 10^2 stored → 10 retrieved → use in control

↓ (sensed) 9,000 bits not selected for storage

↓ (selected) 900 bits stored but repressed or irretrievable

↓ (stored) 90 retrievable but ignored

Figure II-3 indicates how inefficiently most people's systems operate with respect to sense-data. This apparent inefficiency may have been a desirable genetic development, however. Humans function quite well without being able to, and perhaps because they can not, recall everything stored in the brain.

It appears, however, that the amount and kind of information retained and available for use varies widely among individuals and for each individual with respect to such factors as age, emotional state, type of activity, interval since the experience, and environmental context. Even after being subjected to most advanced and extensive testing, individuals often remain virtually unpredictable as to which and how much information they may be able to

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<u>Is Anyone There?</u> (New York: Ace Books, 1967), pp. 30-40; Frances O. Schmitt <u>et al.</u>, "Electronic Processing of Information by Brain Cells," <u>Science</u> 193 (July 9, 1976); and David E. Meyer and Roger W. Schraneveldt, "Meaning, Memory Structure, and Mental Processes," <u>Science</u> 192 (April 2, 1976).

[24] Data from George A. Miller, "The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information," <u>The Psychological Review</u> 63 (March 1956); and Asimov.

use, or may be of consequence, from a given experience. Furthermore, manifestations of genetic information presently remain very poorly understood, and difficult to predict or control. About the most that might be stated is that genetic information appears to account for as much as four percent of subsequent variance in personality differences, but in unpredictable ways.[25] Scientific understanding of perceptual and genetic information is so limited, in fact, that energy measures do not appear feasible to apply. This could restrain the scope and utility of an ecology of education. The full implications of this problem are discussed in the concluding sections of the present chapter.

At least, human beings know that they only imperfectly acquire and apply knowledge and that there are ways to increase the stability and accessibility of information systems. The information contained in a book remains available longer than genetic information imprinted in a cell, just as the energy contained in an enclosed tin of gasoline remains available longer than the chemical energy stored in a potato. Man has discovered many ways to

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[25] Loehlin and Nichols found that identical twins correlated .20 higher than fraternal twins in every personality measure. Also, they noted the unpredictability of the environmental variables that were examined. "We seem to see environmental effects operate almost randomly with respect to the sorts of variables that psychologists ...have traditionally deemed important in personality development:" John C. Loehlin and Robert C. Nichols, Heredity, Environment, and Personality (Austin: University of Texas Press, 1976), as reported by I. I. Gottesman and H. H. Goldsmith in Science 195 (March 4, 1977).

to decrease the entropy of information, including printing symbols of language on various materials, recording sounds, computer memories, photography and sculpture. All have in common the application of energy to alter materials and duplicate the knowledge in forms that last longer than molecular patterns in human memory.

Duplicating genetic information from or within a living organism also requires energy and nutrients. The most common process, cell replication, will not take place without momentum or heat energy and sufficient organic structure. The mixture of genetic information from two organisms for reproduction requires mechanical energy to bring substances bearing the information together. The parent organisms may supply the energy, or it may come from the movement of wind, water or animals in the case of many plant species.

<u>Communication and learning</u>. For the human species, however, the most important and controllable process for conveying information involves the various means of communicating. Many methods exist for each set of sense organs. The main human categories of communicating are aural, visual and tactile. Each culture may use a unique collection of sounds, displays and contact patterns which distinguish it from other cultures. But individual ability to use them begins with inherited information, one's genetic endowment. And the ability develops through acquired knowledge, in the communication

with others and from experience in the wider environment. Inherited or genetic information may control rate of development of abilities, however, so one scientist could claim, "There is no clear distinction between what is learned and what is instinctive," or inherited genetically.[26]

Again, and unfortunately for the purpose of establishing a predictive ecology of education, individual retention of and individual response to communication forms are as unpredictable and immeasurable as other sense-data. Commercial advertisers, political propagandists and other users of modern mass communication systems may estimate that certain kinds and numbers of people will change attitudes and behavior because of a number of carefully-planned messages received. But among millions of potential recipients, only a very small percentage seem to be significantly influenced by the message. Even simple awareness of an idea or the fact of a message is difficult to communicate and establish among many people.[27]

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[26] Bernard J. James, "Human Behavior," in Sargent (ed.).

[27] A brief survey of business literature yielded some evidence to substantiate these remarks: George P. Moschis, "Shopping Orientations and Consumer Uses of Information," Journal of Retailing 52 (Summer 1976). An econometric study concluded that advertising was important in generating sales but its impact was minor compared to other marketing variables such as price and product quality: J. J. Lambin, Advertising, Competition and Market Conduct in Oligopoly over Time (Amsterdam: North-Holland Publishing Company, 1976), as reviewed by Franklin S. Houston in Journal of Marketing 40 (Oct. 1976). Children may be the most susceptible to advertising claims, unfortunately, and there has been extensive debate about the effects of commercial media on children in the United States. See Harry F. Waters, "What TV Does to Kids," Newsweek 89 (Feb. 21, 1977).

Human development and learning. Development psychologists have contributed to the scientific understanding of the sorts of information to which people respond at different stages of growth. And there has been some success at classifying types of learning processes. For example, one psychologist, William Thorpe, has distinguished evolutionary stages of learning capacity similar to Bateson's typology of learning, beginning with habituation, the lowest stage, equivalent to Bateson's "Zero Learning." Associative conditioning may be a stage higher, like trial-and-error, or Learning I, where some reward follows a response to a stimulus. Instrumental conditioning, with negative reinforcement or the comparison function active, allows "learning-to-learn" or what Bateson called "Learning II." Then Thorpe's model diverges from Bateson's. The next higher stage is "latent learning," ability to associate indifferent stimuli or situations without a patent reward. Thorpe's highest stage is "insight learning," any new adaptive response from apprehension of relations. Perhaps insight learning compares to Bateson's "Learning III," but the descriptions were not clear nor complete for either paradigm.[28]

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[28] William H. Thorpe, "The Evolutionary Stages of Learning Capacity," in Nevin S. Scrimshaw and John E. Gordon (eds.), Malnutrition, Learning and Behavior (Cambridge, Mass.: The M. I. T. Press, 1968). And see W. T. Powers, "Feedback: Beyond Behaviorism," Science 179 (Jan. 26, 1973).

But human beings appear to have a broad range of already-developed learning abilities at birth. The newborn infant immediately begins building a store of differentiations from the information carried to the infant by his immediate environment, and these are differences which make a difference, or which have meaning or value to the infant. The newborn child experiences relative coolness, hunger, lack of confinement and a variety of strange noises. The first two may seem painful and the latter may seem frightening. The mother, usually, supplies warmth, food, constraint by contact, and familiar sounds, and the child learns to distinguish pleasure from pain and safety from fear. Soon the child associates mother with safety and pleasure, and with improving vision the child can distinguish the mother's face from other objects. Life becomes a series of experiences which lead to more complex and many new differentiations, including and especially the consequences of one's own motor and communicative acts and methods of controlling them.[29]

Kinds of knowledge or differentiation structures themselves have been classified into domains of human development by scholars with different interests, although

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[29] Uriel G. Foa and Edna B. Foa, Societal Structures of the Mind (Springfield, Ill.: Charles C. Thomas, Publishers, 1974), pp. 18, 32; and Adams, p. 166. John Dewey, in Reconstruction in Philosophy, p. 92, characterized the child as having not a passive mind, but one which enables the child to act to shape his environment and others' activities.

it appears that in any given activity a wide variety of learned behavior may be involved. Theoretical dimensions of development include the cognitive, the affective, the moral, the psychosocial, and the creative.[30] Such classifications and conceptual schemes may provide directions for professional teachers, change agents and instructional materials designers, but remain useless as predictive tools. Children and adults develop cognitive skills, creative interests, moral reasoning, emotional expressions and so on at different rates and differently with respect to various situations, activities and personalities. To be able to predict how much and what kinds of things a person will learn is a function of intimate knowledge about that person. Developmental psychology only may suggest to the educator why a person responds to certain kinds of information in certain ways.

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[30] Hans G. Furth, Piaget for Teachers (Englewood Cliffs, N. J.: Prentice-Hall, 1970); Benjamin S. Bloom (ed.), Taxonomy of Educational Objectives The Classification of Educational Goals Handbook I: Cognitive Domain (London: Longmans, 1956); David R. Krathwohl, Taxonomy of Educational Objectives The Classification of Educational Goals Handbook II: Affective Domain (New York: David McKay Co., 1964); Lawrence Kohlberg, "The Cognitive-Developmental Approach to Moral Education," Phi Delta Kappan 56 (June 1975); Erik H. Erikson, Identity and the Life Cycle Selected Papers (New York: International Universities Press, 1959); Abraham H. Maslow, Towards a Psychology of Being (2nd ed.; Princeton: Van Nostrand Co., 1968); Irving A. Taylor, "The Nature of the Creative Process," in D. Smith (ed.), An Examination of the Creative Process (New York: Hastings House, 1959); and Klaus F. Riegel, in "The Dialectics of Human Development," American Psychologist 31 (Oct. 1976), described a multi-dimensional developmental process.

<u>Conclusion</u>. There seems to be no useful way to quantify forms and amounts of perceptual information that people receive, select and use in control of behavior. The problem lies in the fact that information has a nutrient structure in addition to its energy characteristics, and that, for learning and behavior, the organization or structure of information has far greater significance than the amount and kind of energy in the information. Furthermore, the structural variables of most significance frequently are on the molecular level, unobservable by ordinary means and difficult to measure or describe even with sophisticated technology. Genetic information is even more difficult to quantify, control or relate to learning outcomes than perceptual information.

On the other hand, where information originates in human activity, most of the energy involved in <u>transmission</u> of the information may be calculated without difficulty in observation and measurement. And in social systems, an enormous amount and variety of information originates in human activity. Learning occurs in consequence. Therefore, an examination of information-bearing transactions in social systems is in order. If energy constructs apply to social learning, the ecology of education may be improved, despite the barriers with respect to including measured perceptual and genetic information in the scheme.

Social Learning Systems

Infants rarely survive just on the strength of their genetic inheritance, a large amount of food, and exposure of their senses to the informational energy of the environment. The kind and quality of information received has significant effect on survival. Until a child learns to protect himself, he cannot be exposed haphazardly to environmental energies. Until a child learns to select suitable foods, obtain them and feed himself, some other person must act to nurture him. Children require all sorts of care to survive and learn, including the communication of personal interest and love.

Communication-and-care. Regardless of cultural differences in language and non-verbal ways of communicating, and methods in feeding, holding and protecting a child, the time and effort devoted represents a subsidy in energy from another person, energy which results in the child's survival and, concurrently, learning for himself to survive. The child may have instinctive or inherited means to stimulate responses in others, such as the child's immature shape and his crying. A mother, particularly, may respond initially because of an inherited or genetic tendency to be caring and communicating to her child. But subsequently, extensive effort must be applied, a conscious, intelligent and improving effort on the part of the elder, because the needs of the child become more complex and unique with age. Consequently, family relationships and interchanges become more complex and unique. But the subsidy in energy for learning that the older or more experienced provide to children remains important, if not necessary, to the child's well-being and subsequent maturity and full participation in family and community life. What motivating values or control mechanisms maintain the family learning system?

Within a household or community many kinds of transactions take place in addition to the acquisition of information. U. G. Foa and E. B. Foa categorized six transferable and cross-culturally desirable elements possible in every activity involving two or more people: goods, money, services, information, the communication of care or love, and the award of status. The easy exchange of any one of the elements reinforces the tendency for people to live in proximity and form households and communities.[31] And any transaction involving the elements may be observed and the energies required may be estimated. Over time, the total subsidy in the capitalized energy of goods and money and the efforts involved in communicating with and caring for a child may be calculated. Transactions among peers similarly may be analyzed, and for any kind of situation and social system. Then correlations

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[31] Foa and Foa, pp. 26 ff.

may be made with the kinds and extent of learning, if any, that was observed, if possible, to have occurred.

Contact-promoting transactions. Goods include nutrient structures, food or otherwise, any material item of use or value to the recipient. In his discussion of "grants economics" Kenneth Boulding argued that transactions of goods outside the market have far greater import for individuals than market transactions. Within the family the distribution of goods does not depend upon an immediate reciprocal exchange of goods, as in the market. Most cultures foster serial reciprocity where adults distribute goods to children and the elderly in gratitude for what they received as children and expect to receive when elderly themselves. But distribution of goods need not depend on distant expectations or gratitude. Any act of distribution confers status on the giver,[32] a pleasureful feeling of pride, superiority or self-esteem, usually reinforced by some outward expression from the recipient. Status may be so valued in a culture that people exert great energy to achieve it. Any sign or symbol that one controls a large amount of energy, nutrients or valued information delineates status.

Of equal, if not greater, value within a family

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[32] Kenneth E. Boulding, The Economy of Love and Fear, A Preface to Grants Economics (Belmont, Calif.: Wadsworth, 1973), pp. 3, 34. Also, see John A. Price, "Sharing: The Integration of Intimate Economics," Anthropologica 17 (1975).

and among friends, love and its myriad expressions stimulate the distribution of goods. A feeling of benevolence when the recipient benefits or pleasure in proximity suffices to effect the transaction. Again, people in many cultures expend great energies to achieve these highly-desired feelings. A multitude of expressions, activities and goods indicate love feelings in a culture.

To secure goods for subsequent distribution may require expenditure of energy, distinguished as a service for the recipient on the part of the giver. Or a donor of a good may expect and obtain some service from the recipient. Services, energies which people expend for the benefit of others, and indirectly, for themselves, may constitute the largest or most common element of the "grants" economy.[33] Family members perform many services for each other, whether or not love, status and goods are included in every transaction. Labor exchange can be vital in communities which rely on labor-intensive agricultural methods.

Where a market economy exists, money often becomes an element in transactions, even within the family. Money has many forms, all of which cycle as nutrients do, requiring energy in the process and for replacement or maintenance.[34] Money functions as a symbol or substitute for the mutually-shared value of a good, service

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[33] Boulding, p. 30.

[34] Odum, pp. 174 ff.

or information. Any of the latter may be exchanged for money, and the distribution of money may secure status in some cultures, and, perhaps, love.

Information given in forms such as verbal instruction or a demonstration requires energy of the giver, like services, varying with the amount of time and physical difficulty involved. A donor of information also may expect for his effort: money, goods, services, status, love, or information for himself, or some combination of these elements. The information of highest value consists of methods of obtaining and controlling these six elements, highly desirable in nearly all cultures. Information about transactions or exchanges as such is available with each occurrence. Over time and many repetitions, a child or stranger to a culture becomes socialized, or knowledgeable and experienced in the expectations concerning transactions in that particular culture.

Energy in transactional elements. Goods may be assigned an energy value equal to the effort required to obtain them. Where conferred on another, the effort that a donor makes in the act of distribution must be added. For a child being fed, therefore, the subsidy includes the caloric value of the food, and the effort that an elder makes in securing the food and feeding the child.[35]

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[35] How to calculate this "effort" mathematically is detailed in a later section of this chapter.

Non-material elements--acts of service or communication--more easily are measured with respect to being conferred on another, because only the effort of the donor is relevant. But from the donor's effort should be subtracted any element received by the donor from the child or other person involved in the transaction, to calculate the net subsidy in energy. There is effort required for even the most momentary response directed at someone, and this act may be observed and assigned an energy value. From detailed observations of family transactions, and the accumulation of manipulable data, the theories of Foa and Foa and Boulding may be refined, and communication-and-care may become a predictive tool with respect to learning and overall human development.

There will be limitations in application, of course, reflecting the problem of describing perceptual information. For example, it may not be of much use for parents or educators to know, "On the average, every child must have a three million kcal net subsidy in communication-and-care in order to realize his or her genetic potential by age ten." More critical than total quantity is the form, structure or organization of "communication-and-care," as pediatric experts have produced hundreds of volumes to describe it. Communication-and-care would lack meaning if it were only quantified in kilocalories and spatial relationships.

But many parents and other educators think about the consequences of their actions and wish to improve their actions for the benefit of children or learners. For the educators it could be of importance to know the minimum number of times they should direct encouragement and expressions of love to children of certain ages. How frequently and extensively should elders organize the play environment for children? How often should parents participate in children's play? Supplying play materials takes effort. How much variety is optimal? Given indications of the energies consumed in various activities of communication-and-care, and statistical relationships with subsequent cognitive, emotional and psychomotor growth, useful directives or implications for planning education could be derived.

Home stimulation research. During the past decade, at least one research instrument has been perfected for use in determining the relative importance of different aspects of communication-and-care. Bettye Caldwell and her associates found that their "Home Observation for Measurement of the Environment" (HOME) technique was greatly superior to other predictors of subsequent cognitive development in children. Using HOME in an hour of observation and interview, an investigator can assess six aspects of communication-and-care from a parent to child: emotional and verbal responsivity of mother; avoidance of restriction and punishment; organization of physical and temporal environment; provision of appropriate play materials; maternal involvement with the child; and opportunities for variety in daily stimulation.

In one longitudinal analysis, HOME scores of about seventy children's environments when the children were six months old had a multiple correlation of .50 ($p < .05$) with Stanford-Binet Performance tests given to the children when they were four and a half years old. HOME scores for the same children at two years of age were even more predictive, having a multiple correlation of .63 ($p < .01$) with the age four and a half tests. The most significant of particular aspects were "provision of appropriate play materials," .56, "maternal involvement with the child," .55, and "emotional and verbal responsivity of mother," .50 (all $p < .01$). Other investigators found that HOME could be a reliable indicator of the likelihood of subsequent malnutrition in children.[36]

Results from research about children's home environments substantiate claims presented about communication-and-care as a vital element in a person's ecology of

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[36] Robert H. Bradley and Bettye M. Caldwell, "The Relation of Infants' Home Environments to Mental Test Performance at Fifty-four months: A Follow-up Study," Child Development 47 (Dec. 1976); Richard Elardo, Robert Bradley and Bettye M. Caldwell, "The Relation of Infants' Home Environments to Mental Test Performance from Six to Thirty-six Months: A Longitudinal Analysis," Child Development 46 (March 1975); and Bettye M. Caldwell, "Descriptive Evaluations of Child Development and of Developmental Settings," Pediatrics 40 (July 1967). Walberg and Marjoribanks (re "Family Environment and Cognitive Development...") would characterize the Caldwell model as relatively and perhaps overly simple, because only family environment is examined for effect on abilities.

education. Communication-and-care remains important well into childhood, and the relationships and character of communication-and-care must become more complex with age. Caldwell's methods have yielded statistical support to Jerome Kagan's observations, that infants become bored, and caretakers must invent ever-more complex "surprises" to evoke a pleasure response, that the quality of home stimulation then depends on the sustained creative effort of parents or older associates.[37]

But energy measures of communication-and-care activities have not been attempted by investigators. The data have not been collected which could demonstrate the usefulness of relating communication-and-care to energy conversion on behalf of others. For example, it may be hypothesized that there exists a maximum limit beyond which effort in communication-and-care amounts to over-indulgence. This would result in a child becoming over-dependent and unable to organize his own learning or to find stimulation for himself, with detrimental consequences for psychosocial and/or cognitive development. For a variety of social settings, statistical correlations have been derived to

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[37] Jerome Kagan, "On the Need for Relativism," in Liam Hudson (ed.), The Ecology of Human Intelligence (London: Penguin, 1970). Also, see Earl S. Schaefer, "Parents as Educators: Evidence from Cross-Sectoral, Longitudinal, and Intervention Research," in Willard W. Hartley (ed.), The Young Child: Review of Research, Volume II (Wash. D. C.: National Association for the Education of Young Children, 1972); and C. Neale Bogner and Arlene W. Brown, "Mothers Learn to Teach Their Own Children," Phi Delta Kappan 58 (Feb. 1977), for evidence and discussion about parental influence on children's cognitive development.

support this hypothesis and suggest causes for the origins of certain neuroses.[38]

Energy measures of communication-and-care. The findings lend credence to the idea of communication-and-care as a form of energy. Over-application has detrimental effects, just like over-consumption of food calories, over-exposure to solar energy, and excess conversion of fuels in a small area.[39] But, as with the home stimulation data, material on indulgence is suggestive only and provides no specific indicators for optimal applications of time and effort.

On the other hand, and again, energy measures may facilitate analysis but may be limited in application. It would mean little to a rural parent in a poor country to learn that she should devote at least 200 but no more than 500 kcal per day in responding emotionally and verbally to her child. But it might prove important for the parent to know, if it could be demonstrated, that adults should hold, play and converse with a baby at age one year at

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[38] John W. M. Whiting and Irvin L. Child, Child Training and Personality: A Cross-Cultural Study (New Haven: Yale University Press, 1953), pp. 91-97, 103, 114-116.

[39] There have been studies of the psychological consequences of excess exposure to environmental information as well, for example: Harry Heft, (abstract of) "An Examination of the Relationship Between Environmental Stimulation in the Home and Selective Attention in Young Children" (The Pennsylvania State University, 1976), in DAI 37/5, p. 3212-A; and less scientific but widely read, Alvin Toffler, Future Shock (New York: Random House, 1970).

least three hours but not more than six hours each day.

As with other forms of environmental information, from the recipient's perspective, the actual energy value of the subsidy in communication-and-care has little significance compared to its form and frequency. The net energy subsidy for communication-and-care _is_ significant for parents and educators, however. For example, farm parents with a small amount of poor land must devote most of their personal energy to securing and processing the material necessities for the survival of selves and children. Between the parents, there may not be available three hours for all of the children together. And each child, it appears, needs the individual attention of an adult. Even a small infant can sense whether or not it is the focus of attention from its mother. But giving attention requires more energy than that needed to just rest. And a person who has been laboring all day to keep material needs satisfied simply may not have the energy remaining for anything other than rest, passive reception of sense-data, or casual conversation. None of the latter require as much effort as responding to and stimulating a child.[40]

Communication-and-care among the rural poor. Data on forms and extent of communication-and-care among rural people in poor countries would not be as difficult to

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[40] This may be merely a common observation. But it could be, and perhaps already has been, substantiated by investigation or energy analysis.

obtain as follow-up developmental data. Caldwell's method of interview and observation could be adapted for any culture and language. And a more extensive procedure has been tested and used for gathering data on daily activities and personal transactions in small agricultural communities.[41] These tools and variations of them would be satisfactory for evaluating human outputs and transactions in learning. But for these data to be useful in planning education and convincing parents of its importance, tests must be perfected and given to children and learners years after their learning inputs were recorded. Caldwell and her colleagues have used an I. Q. test for deriving an indication of a fairly narrow aspect of cognitive development. Other investigators have relied on indicators such as grades and extent of academic achievement, even though academic achievement may have little or no causal relationship to subsequent economic, political or scientific achievement.[42] And there are numerous _non_-cognitive personality characteristics deemed very important by child development experts,[43] and means have been perfected to

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[41] George A. Axinn and Nancy W. Axinn, "The Indigenous Diary-Keeper: A Methodological Note," _Human Organization_ 28 (Spring 1969).

[42] William D. Altus, "Birth Order and its Sequalae," in Hudson (ed.); R. B. Zajonc, "Family Configuration and Intelligence," _Science_ 192 (April 16, 1976); Jacob W. Getzels and Philip W. Jackson, "Family Environment and Cognitive Style," in Hudson (ed.); Christopher Jencks _et al._, _Inequality_ (New York: Basic Books, 1972); and Liam Hudson, "Academic Prediction," in Hudson (ed.).

[43] Particularly, according to one survey: self-esteem, self-confidence, sensitivity to others, positive

measure and assess these characteristics.

More relevant measures of learning outcomes and behavior must be adopted. For example, Kohlberg's theory of moral development has been translated into tools for testing an individual's level of moral growth. Psychologists have perfected techniques for assessing individual degrees of psychological well-being and kinds of creativity.[44] Coupled with standard and new forms of intelligence testing, systems for evaluating overall development and its relationship to communication-and-care present no serious intellectual obstacles to researchers and educators.

A serious obstacle exists with respect to time, however. Many of these hypothetical consequences of the communication-and-care received in early childhood may not be manifested and measured until adulthood. Planners, parents and educators need data now. It may be necessary to rely on current sociological data to relate to child care practices. However, in many rural cultures the forms and extent of communication-and-care may be assumed not

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responsiveness to others, clarity of values, assumption of responsibility, autonomy, social interaction skills, sense of humor, and positive task orientation: Robert Huebner, "Noncognitive Characteristics Most Important to Children's Development," Phi Delta Kappan 58 (March 1977).

[44] Kohlberg; Norman M. Bradburn, The Structure of Psychological Well-Being (Chicago: Aldine, 1969); and Sylvia Rimm and Gary A. Davis, "GIFT An Instrument for the Identification of Creativity," The Journal of Creative Behavior 10 (3rd Quarter 1976).

to have changed significantly during the past generation.[45] Data on adult innovativeness, planning skills, participation in art and religion, extent of local crime and conflict, psychological well-being, distribution of wealth and extent of ecological deterioration may be related, among other variables such as nutrition, to aspects of communication-and-care during childhood. With enough cross-cultural, inter-group studies, macro-inferences may be drawn and locally-specific responses planned by researchers and educators.

Meanwhile, cross-cultural data already have begun to accumulate with regard to early childhood nutrition. Nutrition, as discussed in the following section, is even more amenable to energy analysis than communication-and-care.

Food for Learning

As much as one-fifth to one-third of the adult human population does not obtain an average two thousand kilocalories of food per day. What makes this an "energy crisis"? It takes energy to get energy. Undernourishment means that a person can not work very hard to secure the goods needed to maintain health and other values.

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[45] The six-culture childhood studies directed by John and Beatrice Whiting at Harvard University have been based on this assumption.

Participants in the international conference on "Nutrition, National Development, and Planning" reviewed all the ways in which general good health and the nutrients to support it correlate with economic production and sometimes with declines in population growth rates.[46] At first, improved nutrition results in declining morbidity and mortality rates and therefore population increases,[47] but some technological change adversely affects food quality, for example when cash crops replace important food crops, and intensive milling of grains removes essential nutrients from staples.[48]

Malnutrition and learning. Conference participants also described how nutrition affects growth and change in individuals, citing results of experiments on animals and social research. It has been found, for example, that protein deficiency in rats and monkeys delays mental development and enhances susceptibility to infection. Longitudinal reports indicated retardation and poor neuro-integrative response to stimuli among children exposed to severe protein-calorie malnutrition early in life,

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[46] Douglas Wilson, "The Economic Analysis of Malnutrition," in Alan Berg et al. (eds.), Nutrition, National Development, and Planning (Cambridge: MIT Press, 1973); and Carl E. Taylor, "Nutrition and Population," in Berg.

[47] R. D. Brown and J. D. Wray, "The Starving Roots of Population Growth," Natural History 83 (Jan. 1974).

[48] Michael C. Latham, "A Historical Perspective," in Berg, and "Nutrition and Infection in National Development," Science 188 (May 9, 1975).

although it appears that children may become normal in many respects with improved diets. But while they remain retarded, they lose learning time of all sorts because of being less responsive to the environment, including other people.[49]

More recent and more technical, Nutrition, Growth and Development[50] contained several reports on malnutrition and its consequences, especially the importance of nutrition for pre- and post-natal changes. For example, three stages have been identified which relate to DNA synthesis in the brain before birth. DNA, deoxyribonucleic acid, found in all cell nuclei, transmits hereditary characteristics and controls the building of proteins. In the first stage, very early in fetal life, DNA and cell numbers multiply rapidly in the brain. Then the rate of multiplication slows and cell size increases. Finally DNA synthesis and cell division stop in the brain, about one year after birth, and only cell growth occurs. Chronic malnutrition of the mother and child before stage three causes incomplete DNA synthesis and cell formation in the brain of the child, from which no

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[49] V. Ramalingaswami, "The Effect of Malnutrition on the Individual: Cellular Growth and Development," in Berg et al. (eds.); Joaquin Cravioto and Elsa R. DeLicardie, "The Effect of Malnutrition on the Individual," in Berg; and Myron Winick et al., "Malnutrition and Environmental Enrichment by Early Adoption," Science 190 (Dec. 19, 1975).

[50] Cipriano A. Canosa (ed.), Nutrition, Growth and Development (Basel: S. Karger, 1975).

recovery occurs.[51]

At birth the brain weighs only 25% of its adult weight but already 54% of the cells in the cerebrum, the "center" of thought and control of voluntary movement, should have been formed. However, during the first year of life, much still remains to be formed and several doctor-researchers have stated that the year may be sufficient to compensate for pre-natal malnutrition.[52] Another scientist wrote that cell deficits of ten to twenty percent may be no handicap anyway, that dendritic branching and synaptic connectivity has more significance for higher mental activities. "The rates of synthesis by the brain of at least three kinds of neuro-transmitters are affected by diet." Success in these developments provides pathways and "storage facilities" in the brain and depends on neuronal multiplication, which begins in the sixth or seventh month of fetal life but continues through the second year after birth. There is more time to correct deficiencies if malnutrition occurs in late pregnancy of the mother or early infancy.[53]

Several doctor-scientists have published extensive

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[51] Myron Winick, "Maternal Nutrition and Intrauterine Growth Failure," in Canosa (ed.).

[52] Peter H. Chase *et al.*, "Nutrition and Biochemical Maturation of the Brain," in Canosa (ed.).

[53] John Dobbing, "Maternal Nutrition and Neurological Development," in Canosa; and Gina Bari Kolata, "Brain Biochemistry: Effects of Diet," *Science* 192 (April 2, 1976).

reviews on early malnutrition and subsequent failure to grow and develop fully.[54] Shneour noted the correlations between small birth size and subsequent retardation, low intelligence scores and poor physical growth, all associated with chronic malnutrition of the mother. Furthermore, poor growth persists over generations in laboratory animals and probably humans. Chronically malnourished offspring never reach full physical size. For females, such retardation results in relatively small placental growth when pregnant. Smaller-than-average babies are born who grow into smaller-than-average adults. Good nourishment must continue through several generations before sizes become normal again.[55]

Shneour compared present scientific knowledge of the nutritional-mental retardation relationship with early nineteenth century knowledge of antiseptic practices and health. Causal mechanisms have not been explained but the association clearly exists. Educators and social leaders have enough information to act just as doctors used to act even though the latter did not understand how uncleanliness caused disease. Educators must encourage improvement of social environments as well as nutritional environments, however, because explicit evidence exists

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[54] Roger Lewin, in "Starved Brains," Psychology Today 9 (Sept. 1975), wrote a brief, tertiary, but less accurate account.

[55] Elie A. Shneour, The Malnourished Mind (Garden City, N. Y.: Anchor Press/Doubleday, 1974), pp. 43-53.

regarding the quality of home life and subsequent development.[56]

Retardation and diet. Manocha published a more comprehensive and detailed review than Shneour's, but reinforced all the latter's findings with additional data and explanations. Manocha seemed just as confident that chronic malnutrition early in life causes retardation of mental and physical development, and that the effects persist over several generation. Brain cell deficits reaching fifteen to twenty percent may occur in both pre-natal and post-natal growth, totalling 40% in the worst cases of chronic malnutrition of both mother and child. According to Manocha, "There is clear evidence that the malnourished children may never catch up with the other children in intelligence." In addition, researchers have found high correlations between malnutrition and susceptibility to infections. Even after recovery from malnutrition, retardation is likely, especially during ages three to six with regard to motor skills and language learning.[57]

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[56] Ibid., pp. 144, 185; and Joaquin Cravioto and Elsa R. DeLicardie, "Microenvironmental Factors in Severe Protein-Calorie Malnutrition," in Nevin Scrimshaw and Moises Behar (eds.), Nutrition and Agricultural Development Significance and Potential for the Tropics (New York: Plenum, 1976). For a vivid demonstration of the latter point in the text above, see Harold M. Skeels, "Adult Status of Children with Contrasting Early Life Experiences," Child Development Monograph Series 31 (1966), a report on a 21-year study of orphanage children.

[57] Manocha, pp. 77, 96, 106-117, 151; William D.

Other researchers have not appeared as convinced of the prenatal malnutrition-retardation relationship. While agreeing that low birth weight has significant correlations with perinatal mortality, retarded development, the mother's height, the mother's smoking habits, poor social conditions and fetal growth during the last trimester, Bergner and Susser claimed that there exists no proven association regarding low birth weight with dietary habits in other than famine conditions. Manocha, on the other hand, found significant correlations with the protein content of the mother's diet and the length of her baby at birth. Less important seems to be the amount of calories in the mother's diet or her height,[58] although Durnin and Passmore found that during pregnancy a mother normally converts about 80,000 kcal more than usual, as body fat and the metabolic rate increase and energy is needed to form the baby and placenta.[59]

Protein adequacy insures that myelination continues. Myelin is an extremely stable material that protects the nerve fibers, including all the connective elements in the brain. Protein deprivation may affect adversely the

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Rushing, (abstract of) "Relationship of Malnutrition and Mental Functioning" (Southern Illinois University, 1975), in DAI 37/6, p. 3530-A, a study which related deficiencies in diet to deficiencies in perceptual abilities; and Latham.

[58] Lawrence Bergner and Mervyn W. Susser, "Low Birth Weight and Prenatal Nutrition: An Interpretative Review," Pediatrics 46 (Dec. 1970); and Manocha, pp. 80-84.

[59] J. V. G. A. Durnin and R. Passmore, Energy, Work and Leisure (London: Heinemann Educational Books, 1967), p. 96.

growth of several other organs besides the brain, especially the liver and the spleen, which contribute greatly to overall growth and health. In adults, calorie deficiency reduces the metabolic rates of hardworking organs such as the liver, which requires relatively large amounts of oxygen, particularly in recovery after illness. Finally, metabolic processes are damaged by reinforcing deficiencies of many other nutrients besides proteins as deficiency in certain elements reduces the rate at which another mineral is absorbed.[60]

Milk. For an energy analysis, the necessity of sufficient protein in diets has significance because greater energy resources are required to obtain, produce or cycle proteins than for other nutrients such as carbohydrates, lipids, water and various minerals.[61] For example, the best protein source for man, milk, requires animals to produce it, and therefore, extensive land to provide fodder for the animals and labor to care for them, or technological substitutes such as research which results in hybrid varieties of high-protein feed crops and fossil-fuel fertilizers to produce great quantities of feed on limited land areas.

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[60] Manocha, p. 180; Durnin and Passmore, pp. 34, 110; and Nevin S. Scrimshaw and Vernon R. Young, "The Requirements of Human Nutrition," Scientific American 235 (Sept. 1976).

[61] David Pimental et al., "Energy and Land Constraints in Food Protein Production," Science 190 (Nov. 21, 1975).

Fortunately, humans synthesize and secrete milk during the critical brain growth period immediately after the birth of a child. Even poorly-nourished mothers can supply most of a baby's needs, 400-600 grams of milk a day for as long as a year or more.[62] Although animal milk may provide a healthy substitute, many advantages have been demonstrated scientifically for mother's milk, including its cleanliness, consistent composition and right temperature, perfectly suited for the newborn's kidney and digestive system, and its high levels of lactose, cystine, cholesterol and linoleic acid. All contribute to rapid growth and development of the central nervous system. Mother's milk contains secretory immunoglobulin A, lysozyme, lactobacillus bifudas and lactoferrin, factors in preventing intestinal infection, scurvy, rickets and anemia. And, perhaps of greatest importance, breast-feeding itself contributes to intimate communication with the child and subsequent emotional health.[63]

Estimates differed as to the resources required to support a woman lactating, ranging from .8 grams of protein per kilogram of the woman's body weight per day up to 1.75 grams of protein per kilogram body weight, but

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[62] Manocha, pp. 199-200.

[63] Ibid., pp. 70, 264-266; Shneour, p. 120; and Derrick B. Jelliffe and E. F. Patrice Jelliffe, "Human Milk, Nutrition, and the World Resource Crisis," Science 188 (May 9, 1975). The latter reported that in market economies, providing human milk costs only one-third as much as buying cow's milk. The energy costs and savings might indicate even more economy.

they all agreed that a pregnant or lactating woman must increase her share of protein intake, which means she must have access to more of the local energy budget because protein requires more energy to cycle and acquire than other nutrients. After weaning, of course, young children also require high-protein diets in addition to greater kcal intake per kilogram of body weight compared to adults.[64] Failure to secure a proportionately greater nutrient intake during this critical growth period, age one to four, results in marasmus and kwashiorkor, the two malnutrition diseases which retard, debilitate, reduce resistance to infections and often result in death.

Ecological and cultural deprivation. At any given moment, several hundred million children are suffering from kwashiorkor and marasmus around the world, especially in poor countries where agricultural lands have been affected by unusually bad weather, drought or flood, or by local over-grazing and erosion of the land. On the other hand, many children suffer malnutrition because the mother must return to fieldwork or gathering, food-producing work away from the home, almost immediately after her child is born. Supplementary feeding may begin for the child before he reaches one month in age, and this food

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[64] Manocha, p. 201; Shneour, p. 128; Cravioto and DeLicardie, "Microenvironmental Factors...;" and Arnold E. Schaefer, "Nutrition Survey--Needs and Planning," in Canosa (ed.). Schaefer listed the requirements for every age group, by sex, and for mothers.

given him may lack in the quantity and quality of essential nutrients.[65]

Perhaps the most tragic cause of malnutrition, because it does not stem from environmental restraints nor economic necessity: various customs or taboos prohibit the ingestion of important nutrients though they are available to the women or child. Well-documented are Malay prejudices against fruits, vegetables and certain fish for lactating mothers and small children. Rural Cebuanos, in the Philippines, have similar customs, and, it has been observed, wean children on very diluted condensed milk, weak rice water and tea. Pregnant women of Tamilnand, India, avoid fruits and certain grains, saying that these foods might induce abortion, uterine hemorrhage, or exaggerated fetal growth which would result in a difficult delivery. In food-scarce India, 1.1 billion pounds of tobacco are produced each year for local consumption which requires 6.8% of the average family budget.[66]

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[65] Sara B. Nerlove, "Women's Workload and Infant Feeding Practices: A Relationship with Demographic Implications," Ethnology 13 (1974).

[66] Manocha, p. 225; P. C. Y. Chen, "Sociocultural Influences on Vitamin A Deficiency in a Rural Malay Community," The Journal of Tropical Medicine and Hygiene 75 (1975); Christine S. Wilson, "Food Taboos of Childbirth: The Malay Experience," and G. Eichinger Ferro-luzzi, "Food Avoidance of Pregnant Women in Tamilnand," Ecology of Food and Nutrition 2 (1973); Albert Ravenholt, "So Many Makes for Malnutrition" (The American Universities Field Staff: Southeast Asia Series Vol. 22, 1974). For other examples, see Thomas A. Langdon, (abstract of) "Food Restrictions in the Medical System of the Baraswano and Taiwano Indians

Energy and planned subsidy in nutrients. Attacking the causes of mother and child malnutrition requires extensive energy resources. Without effort in generating new information and disseminating it, food subsidies to the poor in land, finding ways to restructure social inequities in access to energy, and promoting wise use of resources, the alternative is cultural dissolution, suffering and premature death for hundreds of millions of people.[67]

A pioneering effort in India, "Project Poshak," illustrated both the extent of the problem and the complexity of energies involved in possible solutions:[68]

> Project Poshak was an integrated program designed to improve the nutritional status of preschool children and pregnant and lactating mothers in selected rural areas of Madhya Pradesh, India. It was designed and administered by CARE/India with the support, financial and other, of AID/India, UNICEF, the central government of India, and the state government of Madhya Pradesh. An integrated approach, involving the three inputs of

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of the Colombian Northwest Amazon" (Tulane University, 1975), in DAI 36/12, p. 8152-A; Luther P. Gerlack, "Socio-Cultural Factors Affecting the Diet of the Northeast Coastal Bantu," Journal of the American Dietetic Association 45 (Nov. 1964); and H. Jean C. Wiese, "Maternal Nutrition and Traditional Food Behavior in Haiti," Human Organization 35 (Summer 1976).

[67] J. M. Bengoa, "Malnutrition and Priorities for Its Prevention," in Berg (ed.); and Francis Keppel, "Food for Thought," in Scrimshaw and Gordon (eds.).

[68] Margot Higgins, "Non-formal education for the rural poor: Project Poshak as a case study for consideration," a paper presented during a workshop conference on the rural poor at Michigan State University, Sept. 26-Oct. 1, 1976.

> nutrition (food) supplementation, childcare education and augmented health/medical services, was adopted in order to achieve a synergistic effect and to ensure a stronger impact for the basic concept, which was that of a take-home dry ration food distribution to enrolled beneficiaries, using an existing infrastructure, the Primary Health Centers and their satellite subcenters as distribution points.

Scores of professional planners, scientists, medical personnel, administrators and politicians were involved in initiating and conducting the project. Training and baseline surveys of areas to be affected required months and involved more scores of local health center workers. Detailed demographic surveys were included because Project Poshak was designed so its feasibility for nation-wide application could be assessed.

The parent-education aspect of the project, the most critical element for success, required another large application of energies: media demonstrations, client communication and record-keeping by local health workers, and extra effort by mothers to make trips to clinics for the Poshak ration, then preparing and giving the supplementary food to her child, and keeping a growth chart on her child. Even with carefully-applied, culturally-specific modes of attracting parents to the program, only 55-to-60% of the target population participated. And despite all educational efforts, pregnant mothers invariably refused to take part. They either resisted the idea that they needed better diets during pregnancy, or in fact preferred not to have larger babies because complications might occur in delivery. And these poor villagers normally did not have access to the medical skills which could compensate for delivery problems.

Project Poshak was successful, in terms of improving the aggregative growth status of participant children and reducing clinical signs of malnutrition, episodes of illness and morbidity among the participants. But a follow-up study to ascertain effects on parent and child behavior has not been reported. It is important to know whether or not the demonstration succeeded in motivating parents to obtain better diets for their small children.

But from the magnitude of the energies involved, it could be predicted that the demonstration failed. Assuming that economic figures roughly represent relative command of energies, the cost of the program, not including the research portion, was $15 per client, and average per capita income in the area was only twice that amount. Only three-fifths of the parents could or would devote enough energy to get the supplement, give it to their children and keep growth charts. It was found that none could afford the time away from essential chores for large meetings. How could they possibly increase production on their small holdings enough to pay for or grow the extra ration for themselves? Or can the Indian leadership obtain and allocate the one to two billion dollars per year it would cost to implement the program nation-wide? Perhaps, however, this figure is small compared to the possible benefits which might accrue from the improved health and cognitive development of a whole generation.

Energy evaluation may offer more specific and extensive conclusions than indicated by the brief review of Project Poshak. In the following section, a method is suggested and its possibilities and limitations discussed.

Evaluating Energy in Learning Systems

As indicated in the preceeding section, prenatal and perinatal nutrition can be evaluated for each child by scientific understanding of dietary requirements and knowledge of energy and nutrient values for the various foodstuffs. The energy in communication-and-care received by a child may be assessed by observing the time and effort devoted to it. But little is known about individual requirements for other environmental information, such as that obtained by a child in playing with small objects. Objective, accurate means of measuring another's total informational gain have not been discovered. Manipulating and controlling genetic information has been performed in medical and biological research, at great cost in energy and with only rudimentary success.[69]

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[69] Thomas H. Maugh II, "The Artificial Gene: It's

Overall evaluation of energy with respect to learning input variables, therefore, remains technically non-proficient and scientifically immature. In the present section, a method of energy evaluation of learning is suggested and described in order to make an ecology of education both possible and practical. This effort is assessed and implications drawn in concluding sections of the chapter.

Technology and energy. In several areas, energy evaluation techniques have advanced in recent decades. Food energy conversion in human and animal activities has been measured, and the amounts of energy involved in the conversion of various organic, chemical and atomic fuels have been known for some time. The fuel and food crises have provided impetus to research in order to understand energy variables, and enough may be known to begin evaluating energy in activities to determine relationships with information obtained. Perhaps of more importance, the relative values of fuel technologies, manual skills and organizational relationships can be assessed for any activity, and learning planned to reflect the most advantageous in efficiency or total output, using energy measures.

In his discussions of sailing and the use of steam power, Cottrell illustrated clearly how man has used

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Synthesized and It Works in Cells," *Science* 194 (Oct. 1, 1976).

technology to release energy gathered by natural processes.[70] Converting this stored energy gives man more time for alternative activities and obtains for man more of the goods which satisfy his wants. Technology includes a variety of tools and processes developed since the discovery of the sail, but simple or complex, they all serve the same purpose, to save time or effort and provide more goods.

In evaluating alternative technologies in order to determine relative net output and efficiency as well as consumption of energy inputs such as food and fuel, an energy standard of value should become widespread among planners and educators. With increasing shortages of fuels and foods with respect to populations, an energy standard may become essential for allocation policies.[71] Very conveniently, the kilogram-calorie measure provides such a value. It can be applied in equivalent terms to fossil fuels, land and human labor,[72] virtually any movement or change in materials.

Cottrell called energy "...a part of the cost of achieving all values..." and Odum described at length how

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[70] Cottrell, pp. 46 ff., 86 ff.

[71] Bruce M. Hannon, "An Energy Standard of Value," *Annals of the American Academy of Political and Social Scientists* 140 (Nov. 1973). Patrick H. Irwin, in "An Operational Definition of Societal Modernization," *Economic Development and Social Change* 23 (July 1975), formulated a national development index based on the ratio of gross national product ouput to energy input.

[72] Pimental, *et al.*

economic processes and values may be restated and applied conceptually to energy. Boulding asked for a re-formulation of economic theory based on energy variables, which are more basic to activity and goods than the traditional "land, labor and capital."[73] Richard Adams referred to Nathaniel Guyal, who claimed that money is weak as a measure of production because it changes in value over time and place. Guyal wrote:[74]

> Energy data, and specifically data on the quantities of energy effectively used, could be substituted for either volume or value data in the productivity equation and might yield better results, because the physical volume of work performed in doing any given task at a given rate of speed tends to remain constant until there is a significant change in the technology of production.

Gilliland considered energy the "ultimate limit" because no substitute exists, it cannot be recycled as nutrients or materials recycle, all activity requires potential energy. She demonstrated how environmental damage or use can be costed, assigned a value, in comparing methods of obtaining energy from geothermal sources.[75]

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[73] Cottrell, p. 113; Odum, especially Chapter Six; Kenneth E. Boulding, "Economics for Good or Evil," Technology Review 78 (July/August, 1976).

[74] Adams, p. 112, quoting Nathaniel B. Guyal, Energy in the Perspective of Geography (Englewood Cliffs, N. J.: Prentice-Hall, 1971), p. 136.

[75] Martha W. Gilliland, "Energy Analysis and Public Policy." There is subsequent discussion of her article in Science 192 (April 2, 1976). Also, see David A. Huettner, "Net Energy Analysis: An Economic Assessment," Science 192 (April 9, 1976).

Human values and energy value. Any desired material or good may be compared in value as the energy cost to obtain it. This cost includes all the human time and effort required and all the food and fuels consumed by work animals or tools in the process. Not only necessities, such as food and shelter, can be valued, but achievements such as beauty, fit condition and justice require energy to acquire.[76] Though the computations may be lengthy and complex, the energy involved can be measured.

Economists also attempt to evaluate activities and processes, using money or its equivalents as measures. In a non-money or non-barter economy, however, such measures are difficult, if not impossible, to apply or assume.[77] Even in complex industrial societies, the "grants" economy dominates family life and relations among friends and affects internal transactions in all organizations and redistribution of goods through government or community action. With energy measures, in theory every transaction, activity, good or object of desire can be assigned an energy value in kilogram-calories (kcal). And as defined, a kilogram-calorie does not change in quantitative value

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[76] Nicholas Georgescu-Roegen, "The Entropy Law and the Economic Problem," in Herman E. Daly (ed.), Toward a Steady-State Economy (San Francisco: W. H. Freeman and Company, 1973).

[77] E. F. Schumacher, Small Is Beautiful Economics as if People Mattered (New York: Harper Torchbooks, 1973), p. 43.

whereas money values vary widely, often unpredictably, and sometimes destructively.

On the other hand, an object of desire, whether appraised in kcal, pounds sterling or clamshell necklaces, can hold different values for different people or different values for the same person at different times, when "value" means something ranked according to extent or strength of desire. One person will exert a certain amount of energy for object A and another will not and does not. Or, having achieved object A, that person desires it much less, and will not exert as much energy to achieve it again. Energy evaluation depends upon holding the object or goal at constant value and making a comparison of different methods of obtaining it. The evaluation procedure also depends upon observation of the various tasks and materials required and minumum skills in computation.

Norman Feather defined values as "...labels for human qualities and end-states found preferable by people, and not...concepts to assess the worth of objects."[78] Here the dichotomy is not perceived as significant. An amount of money or kilocalories may indicate the worth of an object <u>and</u> the amount of effort required to reach a preferred end-state or reinforce a human quality or habit.

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[78] Norman T. Feather, <u>Values in Education and Society</u> (New York: Free Press, 1975), as reported by Richard deCharms in <u>Science</u> 194 (Nov. 26, 1976).

Given food conversion values for the varying effort required for different activities according to a person's weight,[79] and knowing the time it takes to complete each activity, tasks with or without technology and organization can be compared as to types of energy and total energy required and time saved for other interests or leisure. For example, in learning the skills of economic production such as food processing or cooking in the home, the energies involved where children only observe activities can be compared to those where children are encouraged to question and parents like to tell about their work. To assess the relative significance of sources of information for various attitudes or behaviors, the energies involved in receiving information from various sources can be correlated by calculations about the time, effort and kinds of technology relevant to each source. Educational planners and allocation policy-makers, to determine the best way to promote agricultural productivity and/or rural employment, need only to obtain comparisons of output and energy conversion for various techniques used among or possible for the people who are to be assisted with planning, materials and teaching personnel.

Energy for water. To illustrate the methodology

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[79] FAO standards were reported by Supanee Milindankura and Melvin M. Wagner, The Demand for Thai Agricultural Products: A Nutritional Approach (Bangkok: Prachandra Printing Press, 1969); and in Durnin and Passmore. The latter also reviewed effects of tropical climate on food energy conversion, pp. 107-108.

proposed, consider the ways in which water might be obtained for personal use in a rural East African household.[80] In this hypothetical case, each household member requires ten liters of water per day to quench thirst and bathe. The only water source, a well, lies one kilometer distant over level ground.

Suppose the household possesses no containers suitable for carrying or storing water. Each household member must walk to the well four times a day to drink and wash. At a brisk pace, for she has much to do each day, the mother, who weighs fifty kilograms, spends ten minutes in walking each way. For four trips she requires a total of eighty minutes in walking. The effort consumes two kcal per minute, altogether eighty kcal of food energy. Willingness to make this effort indicates the value of the water to her, not considering secondary reasons for going to the well, such as the possibility of meeting friends and exchanging news or banter.

Now suppose that the woman possesses two long bamboo containers, each of which can hold five liters of water. She can obtain her daily requirements in one trip to the well. The light bamboo causes no delay in reaching the well, it requires only a moment to fill them, but the return journey takes five minutes longer because of the

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[80] Some data for this exercise came from Gilbert F. White et al., Drawers of Water Domestic Water Use in East Africa (Chicago: The University of Chicago Press, 1972).

weight of the water. Carrying and balancing the weight expends 2.2 kcal/minute, even at the slower pace. In this activity the woman consumes 53 kcal. However, the energy cost of obtaining the bamboo and vines to bind it, plus the energy used in shaping the material must be included, and then discounted for the number of times the material can be used. Assume that it took her two hours of light work, at 2 kcal/minute, to locate and prepare the materials for use, and that they can be used a thousand times, on the average, before breaking. The discounted energy input for one containment amounts to only one-fourth of a kilo-calorie, practically insignificant.

The value of the water, however, remains 160 kcal for the ten liters, the maximum effort the woman would demonstrate for this desired object. Using the materials, a technology, has saved two-thirds of the energy otherwise required. In addition, fifty-five minutes are available for whatever purpose the woman chooses. Suppose she uses the extra time in very light activity, such as rocking the baby, preparing vegetables for cooking or simply resting. At 1.5 kcal/minute, 82.5 kcal have been released from providing water. The value of the bamboo container technology totals 242 kcal, 189 kcal more than with no technology and more than four times as efficient, if efficiency is defined as the ratio of output to input. Table II-1 summarizes the accounting method.

Table II-1: Energy use, production and efficiency in providing water in a hypothetical East African rural community (all numbers indicate kcal)

	Four 20-min. walks to the well	One 25-min. trip with bamboo holding 10 liters	One 40-min. trip with donkey yielding 50 liters
L: human time and LABOR-energy expended	160	53	81
K: discounted CAPITAL and maintenance	none	.24	6.5
F: FUEL or FEED used per activity	none	none	500 (fodder)
I: total energy INPUTS (L+K+F)	160	53	588
V: perceived VALUE of object	160	160	800
T: additional TIME/ potential energy made available	none	82.5	540
N: ENERGY in food of fuel produced	none	none	50 (dung)
O: total OUTPUT value (V+T+N)	160	242	1390
P: net PRODUCT (O - I)	0	189	802
E: EFFICIENCY (O/I)	1	4.6	2.4

Next, suppose that the household owns a donkey, and that the donkey has the strength and agility to carry ten of the five-liter bamboo containers full of water.

But the activity takes forty minutes. The donkey must be found, harnessed and loaded, five minutes. Going to the well takes ten minutes, filling the containers and securing them require another five and the return trip fifteen minutes. Then unloading and placement of the containers at home take five minutes, including unharnessing and returning the donkey to its stable or pasture. The woman uses only 2 kcal/minute in everything except for filling, loading and unloading the water (five minutes at 2.2 kcal/minute). She expends 81 kcal altogether.

Although certain animals can convert much more energy in a given time than man, they require proportionately more rest. Four work activities such as carrying loads in a day may be as much as one can expect, averaged over the ten-year lifetime of the animal. If the owner averages ten minutes per day in caring for the donkey, the discounted maintenance energy cost per work activity equals 5 kcal, which must be added to the discounted capital energy cost of ten bamboo containers and the harness, about 1.5 kcal, for a total of 6.5 kcal. The fodder consumed daily by the donkey must be counted as input and discounted for each work activity. The animal feed, although inedible to man, may have other uses, such as fuel for cooking or compost. This hypothetical donkey eats 2,000 kcal each day, discounted to 500 kcal per activity useful to the owner. The total energy input for this technology amounts to 588 kcal.

Because using the donkey has yielded a five-day supply of water, the perceived value for this technology has quintupled, to 800 kcal. And without the donkey and any materials, to obtain this amount of water would have required 400 minutes over a five-day period. The woman has saved 360 minutes for other work or leisure, at 1.5 kcal/minute or a total of 540 kcal. Finally, the energy in other materials produced by using the donkey should be added to the output value. About ten percent of the feed caloric value becomes excreted by large animals. Assuming little or no dung is lost during the trip to the well, fifty kcal is produced, and, in this case, returned to the soil, to aid in replenishing the grass. But it also is assumed in this case that the donkey has no affection-value for the woman, nor does it sleep in the house to add warmth during cool nights. So the total value of the output, 800 + 540 + 50, equals 1,390 kcal.

Comparing the use of the donkey in providing water with making four trips to the well each day, the donkey technology yields 802 kcal more in value and appears more than twice as efficient. In comparison to the process where the woman carries the water, however, the donkey technology is only half as efficient. Its much greater net product makes the donkey technology preferable, but if the woman needed its pasture to grow vegetables, she could not keep the donkey. And if there were effort involved in obtaining, retaining and maintaining the

Table II-2: Energy use, production, and efficiency in providing water in a hypothetical East African rural community, continued

	One 65-min. trip with oxcart & ox yielding 200 liters	One 22-min. trip in own ½-ton truck yielding 200 liters	Turn on-off tap, diesel pump system for 2,000 families
L: human time and LABOR	134	51	2
K: discounted CAPITAL and maintenance	15	2000	15
F: FUEL or FEED used per activity	1000 (fodder)	2000	3
I: total energy INPUTS (L+K+F)	1149	4051	20
V: perceived VALUE of object	3600	3600	160
T: additional TIME/ potential energy made available	2302.5	2367	118.5
N: ENERGY in food or fuel produced	100 (dung)	none	none
O: total OUTPUT value (V+T+N)	6002	5967	278
P: net PRODUCT (O-I)	4853	1916	258
E: EFFICIENCY (O/I)	5.2	1.5	13.9

pasture land, using the donkey would be more costly. More calculations could be made to show the relative advantages of oxcart technology, automotive production and use based on cheap fossil fuels, and community cooperation to establish a pipeline system.

As the computations in Table II-2 indicate, evaluating fuel costs involves knowledge of the human effort required to obtain a given amount of fuel and the machinery to convert it for the particular operation. Some analysts figure the calorie amount of the fuel converted, which is actually unrelated to perceptions of human values. Fuels differ from tools in that fuels are totally consumed in each operation, whereas the energy cost in obtaining tools must be discounted for the number of times the tools can be used. The disadvantages with regard to rate of resource depletion can be compared by computing the energy of non-renewable resources required per unit of output. And given a money market and prices for labor, materials and land, a parallel exercise could compare economic production and efficiencies. This would indicate which energy resources among land, labor and fuels have prices reflecting their energy values.

Data for evaluation. Obtaining all the details about time, effort, fuel conversion and transactions within a family or community is a problem in itself. But George Axinn, a rural sociologist, and Nancy Axinn, a family ecologist, have developed a method for data gathering which combines the procedures of anthropology, communications science and local participation in scientific investigation. With their method, minute-by-minute records of family activities can be obtained, including description of the materials and fuels used in aid of learning, and the kinds and extent of communication involved in each activity.[81]

Results of research have been reported which indicate relative time, but not energy efficiencies and net product in learning systems. One investigator compared combinations of schooling and on-the-job training which produced skilled workers, junior technicians and assistant engineers in tool-and-die factories in Belgium and Argentina. For equivalent development of abilities he found that the more time spent in schools, the less overall time it took. But on-the-job training results in more economic production and this does not seem to have been considered.[82] The energy values of total output, however, might not compensate for greater fuel expenditures over time and more intensive use of machines in the factory.

Economic evaluation of learning systems or technologies poses great problems because so many of the non-fuel resources involved and the outputs obtained have no market price or equivalents.[83] For example, in

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[81] Axinn and Axinn, "The Indigenous Observer..." The Axinns reported results from using the methods advocated in "Communication among the Nsukka Igbo: A Folk-Village Society," Journalism Quarterly 46 (Summer 1969); and "An African Village in Transition: Research into Behavior Patterns," The Journal of Modern African Studies 7 (1969).

[82] J. Maton, "Experience on the Job and Formal Training as Alternative Means of Skill Acquisition: An Empirical Study," International Labour Review 100 (Sept. 1969).

[83] John M. Hunter et al., in Economics of Non-Formal

industrial societies, most children produce little or nothing of economic value. Laws exist to prevent children from taking part in laborious activities, and other economic roles require long periods of technical preparation. Yet the children require extensive resources in addition to purely material support, resources such as encouragement which have no price, but which may be measured in terms of the energy devoted to them.

Energy in learning to farm. In less industrialized societies, where agricultural concerns dominate life for most people, learning systems may lie even farther outside the money market. Anyone interested in studying the learning process or planning to improve it could resort to an energy analysis if economic measures do not suffice. Where children become productive assets at a relatively young age, and much learning occurs in productive activity, the energy analysis evaluates this productivity, although there may exist no external market for it.

Consider the farmer who wants his young son to

Education (East Lansing: Institute for International Studies in Education, 1974), discussed the problems; Marvin Grandstaff, "Nonformal Education: Some Indications for Use," Comparative Education Review 20 (Oct. 1976); and Maureen Woodhall, Cost-Benefit Analysis in Educational Planning (Paris: Unesco, I. I. E. P., 1970. Also, William S. Bennett, Jr., in "Educational Change and Economic Development," in Max A. Eckstein and Harold J. Noah (eds.), Scientific Investigations in Comparative Education (London: The Macmillan Co., 1969), concluded that education economists tend to neglect many outcomes of schooling, such as innovative abilities and motivation.

help in weeding and become as proficient and industrious in weeding as the farmer himself. Weeding increases the productivity of the garden and provides some feed for the pig. The work requires effort and concentration. Hoes cannot be used. Because of the thick foliage a hoe could sever a melon vine. Some kinds of weeds appear similar to some of the vegetable leaves. Farmers of the highland forests on islands of Southeast Asia provide status incentives to children by giving them their "own" plots and plants in every new clearing or re-clearing. Still too young to work the plot, nevertheless the children identify with it and contribute minutely but incrementally to its cultivation.[84]

With the help from the child, who has not yet learned to distinguish all of the hundreds of kinds of edible plants from inedible weeds, output declines per unit of total input. The child misses some weeds, and pulls some immature food plants, and the adult frequently re-weeds areas where the child has missed many weeds. The alternative, not allowing the child to work until much older and able to identify all specimens, could cause the child to lose interest and never take as much pride in

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[84] Harold C. Conklin, "Maling, a Hanumoo Girl from the Philippines," in Joseph B. Casagrande (ed.), In the Company of Man Twenty Portraits by Anthropologists (New York: Harper & Brothers, 1960); and Conklin, "An Ethnoecological Approach to Shifting Agriculture," in Andrew P. Vayda (ed.), Environment and Cultural Behavior Ecological Studies in Cultural Anthropology (Garden City, N. Y.: The Natural History Press, 1969).

industrious work. Accepting the output-input reduction for a few years insures that the child becomes skillful and hard-working, and perhaps at an earlier age than the alternative method. More detailed observation should provide enough data to make conclusions about choices of procedure for the farmer.

The best choice might vary when considering the relationship of the teacher to the learner. In the example above, the teacher-parent supports the learner-child, in effect "pays" for the child's energy applied to the garden with his own energy to produce food for the child. In an apprenticeship system where the craftsman does not support the learner to useful working age, and perhaps not much during the apprenticeship, the craftsman, from his own point of view, gains an energy source. On the other hand, to help their son become self-supporting, parents might have to devote far greater energies in training their own son by themselves than the energy devoted to the growth and subsequent maintenance of the son with a craftsman.

<u>Energy for schooling</u>. This kind of energy evaluation is most easily applied to comparison of formal learning systems, where teaching methods have been clearly established, observations of time already may be on record, efforts in obtaining electricity and other fuels are simple to calculate, and the materials required, such as buildings and books, primarily serve to support a

learning activity. Even without conducting an energy study in the field, discussion of several forms of learning clarifies some issues about community learning systems.

Take learning to read. For the child, given the expectations of significant others or perceiving the need to be able to read, the most energy-efficient method might be in having his own tutor and special reading instruction texts. But for the community, helping twenty-five children achieve a one-thousand-word reading vocabulary by age nine might be most energy-efficient with a central classroom and teacher for the children together.

Suppose it can be demonstrated that, given a tutor for 200 hours, and practicing with instruction materials for 300 hours, a child of average motivation can achieve the goal.[85] The child spends 500 hours in very light activity and, as a small person, converts only 1 kcal/minute, for a total of 30,000 kcal. The older and larger tutor expends 1.5 kcal/minute for 200 hours, or 18,000 kcal. This "service" energy must be accounted as part of the child's input, because, in a social system, the child "pays" for it one way or another, in love expressed or status-giving learned earlier in life, or by acting as a tutor to someone else later in life. Add 1,000 kcal for the reading materials, the energy cost to obtain them.

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[85] Paolo Freire could teach Brazilian peasants to read in just 20-30 hours: Everett Reimer, "Education for and by Conscience," in OISE-Unesco, Education on the Move (Toronto: Ontario Institute for Studies in Education, 1975).

There is insignificant fuel energy required, all the work being done during daylight.[86] The value of this learning system for reading amounts to 49,000 kcal.

In a class with twenty-four other children, it takes the student far longer to reach the same level, without considering the wastage, where, in some areas of the world, many children of average motivation drop out of school before achieving literacy. If it takes 1,250 hours, spread over four years in a class, the child expends 75,000 kcal. He gets at least one twenty-fifth of the teacher's attention during that time, worth 2 kcal/minute, for fifty hours or 4,500 kcal. The reading materials cost 1,000 kcal, but more must be added for the classroom, discounted for the durability of the building and the use by one child for 1,250 hours. Assuming this amounts to only 1,500 kcal, the capital, maintenance and service energy costs total 7,000 kcal for the one child. Total input is 82,000 kcal.

Making 82,000 kcal the perceived energy value of learning to read, then in comparison the tutorial system operates more than twice as efficiently as the classroom for the child, when 750 hours of saved time are included as output. On a community basis the efficiency decreases, but not by much.

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[86] The daylight cost, however, is the energy it took to secure the right to use the learning space, a few square feet of land area, discounted for the time taken in learning. Economists call this kind of cost "rent".

Table II-3: Community energy use, production and efficiency in teaching children to read, excluding transport inputs (data in thousands of kilogram-calories)

	Classroom teacher and 25 children for 1,250 hours	Tutoring 25 children 200 hours each, plus 300 practice	Tutoring 25 children 500 hours, no individual practice
L: human time and LABOR-energy expended	chil.1875 teach.112 sum 1987	chil. 750 tutor 450 sum 1200	chil. 750 tutor1125 sum 1875
K: discounted CAPITAL and maintenance	62	25 (books only)	25 (books only)
I: total energy INPUTS (L+K)	2049	1225	1900
V: perceived VALUE of object	2049	2049	2049
T: additional TIME/ potential energy	none	788*	12**
O: total OUTPUT value (V+T)	2049	2837	2061
P: net PRODUCT (O-I)	0	1612	161
E: EFFICIENCY (O/I)	1	2.2	1.1

* Children save 18,750 hours but tutor spends 3,750 more hours in effort than the classroom teacher.
** Children save 18,750 hours but tutor spends 12,500 more hours.

For twenty-five children to have tutors the total energy cost in learning to read becomes twenty-five times higher, or 1,225,000 kcal. The classroom system energy cost also increases twenty-five times, to 2,050,000 kcal. But the teacher loses, or spends, a lot of extra time, 3,750 hours, in the tutorial system, which must be entered as energy subtracted from the energy saved by the children. This causes some reduction in the efficiency advantage of the tutorial system, from the community viewpoint, compared to the efficiency advantage from the individual learner's viewpoint. Table II-3 summarizes the computations involved.

Questions about schooling. A tutorial system enjoys an efficiency advantage whether from the community standpoint or the individual learner's, even if it takes up to 500 hours of full-time tutoring to reach the objective of a 1,000-word reading vocabulary. Thus it may seem puzzling why school systems persist in nearly all cultures. But it should be recalled that schools may perform several functions besides that of promoting skills such as reading, especially the functions of social selection, reinforcement of cultural norms and custodial care.[87] These functions may be most appreciated by urban parents in an industrial society, who believe they need help in giving children marketable skills, access to peers, perhaps obedience training and safe haven from the streets. A thorough energy analysis might reveal, however, that all these functions may be performed more effectively and efficiently with systems organized differently from the

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[87] Everett H. Reimer, "Alternatives in Education," in Don Adams (ed.), Education in National Development (London: Routledge & Kegan Paul, 1971).

western-model school.

An economic analysis of the labor involved in school learning serves to explain why school systems persist. Societies put a very high price on the teacher's energy and a very low price on children's energy rather than prices reflecting their relative conversion rates of energy. Because children have little or no market value for their energy, it counts very little or nothing as input or time saved in a tutorial system. In learning to read, the classroom may operate almost seven times as efficiently as individual tutoring, when the children's energy has no current social value.

From several perspectives, then, the reasons become clearer as to why schools seem unimportant, relatively, for many people in rural agricultural communities. Children's energy has value, perhaps critical value during harvests. Alternative and more efficient learning systems already exist which build skills and reinforce values important in the community. Custodial care is no problem. Where schools serve as social selection mechanisms, and parents perceive their child has little chance of selection to a vocation outside the community, it makes sense to encourage or allow the child to quit school.

On the other hand, where agricultural societies are being rushed into farm mechanization and the use of imported fertilizers and biocides with the current and probably temporary availability of low-priced fossil fuel, schooling systems could become of great value. Developing fossil-fuel-based agriculture reduces opportunities for farm employment, forcing young and even experienced farmers into urban areas with no marketable skills. Schools might keep these youths engaged in "learning" while earning no income, absorbing production from the farms, but not re-inforcing the trend to mechanization by producing anything of value to the farm owners. In addition, students without income tend to remain unmarried, which may contribute to alleviating the population pressure. If the schools emphasize intellectual skills and social pleasures, the youth might develop energy-consuming interests competitive with that of raising children. Meanwhile, the students have established themselves as a reserve labor force, available for farm work when the cheap fuel is no longer available.

Consumption to balance production. These last remarks may not appear serious but they illustrate an aspect of any energy analysis, and sometimes economists consider it as well: how to consume the surplus energy which man often produces as a result of constantly making his technology more energy-efficient in terms of his own labor.

An excess of available energy usually results in population increases. Compared to most hunting-and-gathering cultures, agriculture produced a wealth of available food energy when man learned to cultivate storable grains. Elaborate religions and arts, complex governmental forms and even warfare helped to provide alternative ways to convert the extra energy. Then new transport technologies and later coal-power systems made available more energy surplusses, resulting in the current population explosion, pollution,[88] and rapid depletion of mineral resources. As man has tried to rid himself of warfare, the most rapid form of using up energy, scientific understanding has helped reduce participation in psycho-socially beneficial forms of converting excess energies such as organized religion, without promoting and spreading sufficient energy-consuming substitutes in time to prevent the population boom.[89]

These broad problems should concern the educator, the planner, the politician and the scientist. Anyone involved in helping people become more productive or efficient should consider the consequences of success. Just having additional goods and time may not enhance the quality of life or ensure a more comfortable or secure existence if all goes to increasing numbers of dependents. And if the lifestyle encouraged relies on vast quantities of minerals and fuels, rapid depletion hastens the day when an abrupt abandonment of the lifestyle or violent

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[88] As an anthropologist expressed it, pollution is simply failure to consume: Richard Adams, p. 141.

[89] Odum provided an extensive and technical discussion of energy consumption institutions, as in Chapter 8, "Energetic Basis for Religion."

competition for the remaining resources must occur. But consideration of the fuel energy and mineral resources available to the community in conjunction with an energy evaluation of various methods in the learning systems employed by people in the community could result in plans for improvement in learning while conserving scarce resources.

Summary discussion. A system of accounting and comparing of humanly-controlled energies converted in activity has been proposed and outlined. Any good, service or state-of-being may be assessed in terms of alternative amounts of food and fuel energy required to obtain it. Acquiring information and/or learning skills may be included as goals which can be evaluated with respect to energy efficiency and net product. While the most apparent utility may be comparison of different kinds of techniques, materials and organizations for planned learning, it is possible to compare learning efficiencies and net products where different amounts of communication-and-care are applied.

For example, after identifying expressions of love, status and encouragement specific to a culture, an investigator could compare the frequencies of occurrence of such expressions in families or classrooms to the time and effort required for children to learn a desired behavior or skill. Use and frequency of activity and expressions which produce unpleasant feelings in learners also may be observed and correlated with achievement in learning. Perhaps stressful emotions enhance learning where trial-and-error or negative feedback processes are necessary. But given the general objective of promoting democratic relations, which implies attitudes of mutual trust and care for others, it would seem imperative that parents and teachers act gently and tactfully, in correcting children, in order not to be associated with negative feelings.

A child may experience enough frustration and anger in everyday encounters with objects and situations. But not only are such activities difficult to observe and measure in energy terms, it again raises the question of including environmental information besides communication-and-care as an important variable in an ecology of education. Environmental energy as sense-impressions reach people constantly but there is no way to determine and measure what portion and amounts are absorbed and useful. In the evaluation procedure to determine efficiency and net product in learning, perceptual information must be relegated to be a constant and therefore assumed to be relatively non-consequential, or having a comparable effect on everyone.

Similarly, it is believed that genetic variations affect perception, mood and psychomotor reactions, all of which affect learning. But scientists are only beginning to observe genetic information. Presently, it can not be measured and it is not predictable or controllable. With respect to so-called "learning disabilities" such as dyslexia, for example, it is not known for sure whether they are genetic in origin or related to prenatal or perinatal environments.[90] For practical purposes, therefore, genetic information must remain a constant, only a theoretical construct, and useless in an ecology of education.

Without genetic information and environmental perception in general, how holistic or useful is the measurable ecology of education that remains? Do measurement and understanding of food, technology and communication-and-care energy relationships with learning facilitate prediction of and planning for rural life development objectives? The last several sections in this chapter are devoted to discussion of these concerns.

Energy for Rural Life Development

With several energy constructs in the ecology of education practically immeasurable with respect to a given activity or goal, the utility and import of the

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[90] Of course, educators may not be as concerned with the origins of dyslexia and other learning disorders as they are about its manifestations and treatment. For example, see Sandra F. Witelson, "Developmental Dyslexia: Two Right Hemispheres and None Left," Science 195 (Jan. 21, 1977).

remaining elements--food, technology and communication-and-care--may be reviewed. The discussion in the present section focusses on energy relationships and the four kinds of goals-activities defined for rural life development. Particular implications for potential rural educators are considered in the concluding section.

Global health. "For the first time in modern history, none of the four critical agricultural resources--land, water, energy, and fertilizer--is in abundant supply."[91] Rapid population growth, a consequence of prior availability of energy, may have surpassed its maximum sustainable rate in recent years. According to the Worldwatch Institute, whose director is quoted above, growth rates have begun to decline, but large numbers of people in many poor countries are in critical danger. Their agricultural land is fully occupied and eroding faster than nutrient cycling, factory-produced fertilizers and engineering can reconstitute or maintain fertility. In irrigated areas, water tables are falling faster than the environment can refill natural aquifers and man can build surface reservior systems. Extractable fuel reserves dwindle faster than man can create renewable solar or nuclear energy systems. Natural fertilizer deposits are being consumed faster than they are being replaced and manufactured substitutes depend on petrochemical supplies. In brief, there exists

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[91] Lester R. Brown, "Man, Food, and Environmental Interrelationships," in Scrimshaw and Behar (eds.).

a global shortage of usable energy resources with which to produce the food needed for the next two generations of people.[92] As detailed earlier in this chapter, food energizes activity and growth through nutrients such as proteins and trace minerals, water and oxygen. For food energy, there is no manufacturable substitute to promote and sustain human health.

On the other hand, analyses have been made of potential renewable energy, obtainable annually just through photosynthesis. It has been estimated that humankind can feed everyone and subsequent larger populations, and adequately for all to enjoy good physical health.[93] But it would require extensive organization, application of advanced technology, and global acceptance of equitable resource distribution. And the energy to organize, apply technology and promote acceptance of an equity ethic has not been, and perhaps can not be, computed with accuracy. After all, research, philanthropic, government and international institutions, to organize

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[92] During the past three years, the outlook has not improved. If anything, scientists have discovered more alarming facts. Compare a Pimental _et al_. _Science_ article from 1973 with one published in 1976: "Food Production and the Energy Crisis," _Science_ 182 (Nov. 2, 1973); and "Land Degradation: Effects on Food and Energy Resources," _Science_ 194 (Oct. 8, 1976).

[93] W. J. Chancellor and J. R. Goss, "Balancing Energy and Food Production, 1975-2000," _Science_ 192 (April 16, 1976); and Sterling Brubaker, _To Live on Earth_ (New York: Mentor, 1972), pp. 92-93. For a current estimate of costs to alleviate present malnutrition, see Nicholas Wade, "Inequality the Main Cause of World Hunger," _Science_ 194 (Dec. 10, 1976).

food distribution, to promote technology and health, and just to "improve" human conscience, have existed for decades. But no assessment of their effectiveness and efficiency exists which might indicate what multuple of current efforts must occur in order to prepare world population, or leaders, for imminent crises, or to alleviate worsening conditions. And awareness, acceptance and use of information remain so poorly understood and unpredictable that any assessment, if attempted, likely would be highly unreliable. On a global scale, therefore, the energy resources needed for adequate health have been estimated. But the energy to organize a global food-for-health system neither has been identified nor calculated.

Rural societies and health. On a local level, ecologies of education are more practical. With just a casual survey, even a stranger to a community could estimate food and fuel resources being used and popular involvement in various kinds of activities. Food for health needs could be calculated easily, along with the fuel, labor and solar energy requirements to produce or obtain, distribute and prepare the food. Furthermore, calculating the energies required for environmental protection and comfort is manageable for a small community. Finally, an estimate could be made as to the amount of additional energy required to enable everyone in the community to be full-time participants in economic and cultural activities.

To achieve overall good health requires more energy than that needed just for good physical health. Emotional or mental health and social health means, minimally, that people have a variety of peaceful interests, interpersonal associations, and leisure-time pleasures. And where environmental dangers exist, extra energy may be needed to support a medical specialist to treat other people in the community.

In quantitative terms, people can exist in a physically healthy state on an average 1,800 kcal balanced diet per person per day. An average of 1,800 kcal, in a given community, may be enough to cultivate and process all the foods for consumption, to construct and maintain adequate shelters, if needed, and to produce some clothing. But that is about all people can do besides just rest. Any kind of enjoyable, creative leisure requires more energy in fuel or food. And to compensate for illness or accident requires at least a food surplus, if not medicine, obtainable only with additional energy.

With enough energy available and converted for overall or comprehensive good health, the minimum conditions for learning also are satisfied. An ecology for education exists. But to promote learning for participation in and maintenance of the culture, a portion of the interests, associations and pleasures must be devoted to communication-and-care, with respect to the learning which must be encouraged for the new generation to maintain and perhaps improve the culture. Children simply can not be fed and otherwise ignored.[94]

In addition, with experience in the community and familiarity with a number of its inhabitants, an observer (or concerned resident) might be able to estimate with accuracy how much and what forms of new information would be desirable and accepted in order to promote better health or healthier lifestyles. Then, having an estimate of the form and amount of information, the fuel and effort to obtain the information can be calculated and alternative sources considered. The ecology of education becomes complete and holistic, predictive and useful, only with understanding of particular individuals and their respective situations.

Scientific planning. Absolutely essential for cultural, economic and political survival, some, if not all, rural community members must develop scientific understanding and planning skills. Without ability to evaluate contemporary forces, trends and processes,

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[94] No culture has been observed to lack communication-and-care, but certain cultures may lack concepts and expressions about intentions to learn. Among the Tallensi in Africa, for example, there were no teacher specialists nor overt interest by adults in a child's psychological or physical development or different skills. Nevertheless, adults communicated expectations to children, who in turn managed to become thoroughly familiar with their environment by age nine or ten, through processes of mimesis, identification with adult roles, and cooperation: Meyer Fortes, "Social and Psychological Aspects of Education in Taleland," in John Middleton (ed.), From Child to Adult Studies in the Anthropology of Education (Garden City, N. Y.: The Natural History Press, 1970).

rural people can not formulate and implement alternatives to the forms of urban pleasures, commercial pollution, government bureaucracy and political intrigue that continuously destroy opportunities to maintain or enhance psychological, and even physical, well-being.[95]

This is not to say that rural people totally lack scientific and technical skills. On the contrary, historians and social scientists have found that so-called "traditional" societies have included thinkers of extraordinary ability, events of discovery, technical and political change, normative developments and structural heterogeny. Given a generation or longer to gradually adjust, population groups have adapted to any ecological or social variation.[96]

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[95] For Americans, psychological well-being has been defined with indicators of satisfaction in life, general affect, and perceived stress. Investigators have attempted to correlate indicators of well-being with socio-economic variables such as extent of formal education, wealth and mobility: Angus Campbell, "Subjective Measures of Well-Being," American Psychologist (Feb. 1976); and Norman M. Bradburn, The Structure of Psychological Well-Being (Chicago: Aldine, 1969). Extensive evidence exists that certain modern institutions often destroy the cultural, political and material well-being of rural people in poor countries. For examples, see Edward H. Spicer (ed.), Human Problems in Technological Change A Casebook (New York: Russell Sage Foundation, 1952); and more recent studies such as Barbara K. Larson, (abstract of) "The Impact of National Government on Local Life and Politics in a Tunisian Village" (Columbia University, 1975), in DAI 36/12, p. 8152-A; and Peter W. Van Arsdale, (abstract of) "Perspectives on Development Among Irian Jaya's Asmat: Cultural and Demographic Correlates of Induced Change" (University of Colorado, 1975), in DAI 36/8, p. 5386-A.

[96] Paul Radin, The World of Primitive Man (New York: Henry Schuman, 1953); Joseph R. Gusfield, "Tradition and Modernity: Misplaced Polarities in the Study of Social

However, present-day environmental, demographic and political problems are too overwhelming to allow gradual, self-suggesting adaptations. And the modern institutions which could help individuals adjust, such as government-run schooling, urban industrial work experience, and mass media, actually help only a limited number, the most flexible, and often the wealthiest. Furthermore, these institutions tend to promote urban alternatives. The potential for rural life development remains neglected.[97]

Assuming the necessity for rural community science and planning skills, therefore, an energy-based analysis of promoting the goal may be attempted for a given locality. The analysis would be focussed on application of skills learned from schooling, apprenticeship training, mass media and agents of external organizations.

Change," The American Journal of Sociology 72 (Jan. 1967); Philip Mason, Patterns of Dominance (London: Oxford University Press, 1970); Ester Boserup, The Conditions of Agricultural Growth: The Economics of Agrarian Change under Population Pressure (London: George Allen & Unwin, 1965); and Robert Lawless, (abstract of) "The Social Ecology of the Kalingas of Northern Luzon" (New School for Social Research, 1975), in DAI 36/5, p. 2942-A.

[97] A large number and variety of sources contributed to these remarks, including Sylvia Scribner and Michael Cole, "Cognitive Consequences of Formal and Informal Education," Science 182 (Nov. 9, 1973); Alex Inkeles, "Making Men Modern: On the Causes and Consequences of Individual Change in Six Developing Countries," American Journal of Sociology 75 (1969-1970); Margaret Mead, "Our Educational Emphases in Primitive Perspective," in Middleton (ed.); and Gerald M. Erchak, (abstract of) "The Kpelle Early Learning Environment" (Harvard University, 1976), in DAI 37/4, p. 2272-A.

First of all, objective indicators for level of ability in scientific planning skills must be assumed. For a community, such indicators might include: productivity in goods for human and fuel energies converted; rate of environmental deterioration, such as topsoil depletion and falling water tables; and distribution of wealth in the community, where very inequitable distribution indicates poor planning ability overall. In comparing families, instead of distribution of wealth, a measure of household comfort and sanitation may be used.[98]

Then learning ecologies may be observed and correlated. From each adult in the community or household may be ascertained the extent of exposure to schooling, apprenticeship training, mass media and information-bearing transactions with non-residents. For each form of exposure may be calculated an energy equivalent, considering the time devoted to it by the learner. Finally, comparisons could be made between the learning measures and the indicators of scientific planning ability. Then conclusions may be reached as to the optimum mix of learning systems that most effectively result in planning ability for a particular culture or community.

With more time or resources for an investigation, the reasons why a certain mix is optimum may be found. The researcher could examine the nature of learning that

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[98] For an example, see John C. Belcher, "A Cross-Cultural Household Level-of-Living Scale," Rural Sociology 37 (June 1972).

occurs in each kind of learning. Especially relevant might be the extent and form of communication-and-care manifested, and assumed to have been the case when present-day adults underwent the same experiences. The kilocalorie and protein measures of childhood diet could be significant when compared to the indicators of scientific planning ability, if diet also can be assumed to have remained fairly similar over a generation in particular families or communities. And after sufficient studies have been made, it might be determined that early childhood diet and the home subsidy in communication-and-care can have far more significance for later scientific ability than any optimum mix of organized information systems, such as schooling or the media.

Diffusion studies have sought to derive the sources of innovativeness or significant variables in adopting innovations. Innovation, as a form of calculated risk, bears resemblance to scientific planning, which includes the ability to calculate risks. Diffusion of information studies and other studies of information systems and social change have concluded generally that empathy or identification with a source of information makes information more acceptable. But innovation studies have tended to neglect early childhood environments even while recognizing the importance of readiness to consider change or receptivity to new ideas, which could be a consequence of early childhood experiences.

On the other hand, ability to plan scientifically includes responsiveness to information _not_ in association with trusted, respected or loved contacts. And a recipient must be able to reject ideas from significant others as well, ideas which the recipient understands as having ultimately harmful or disadvantageous consequences to self or others. Mere receptivity to change because a trusted one recommends it often may not be indicative of scientific planning skills, and diffusion studies have not been clear on this point. Changes generally recognizable as beneficial to environment, economy and social structure provide the indicators of scientific planning skills which then can be related to variables concerning the acquisition and use of information. And if the studies are conducted as in-depth examinations of individual learning environments, useful conclusions can be derived about the levels and forms of energy that have significance for ability to plan scientifically.

Cultural creativity. Studies of and programs to enhance life for the rural poor have concentrated on aspects of physical health and economic productivity, including the distribution of resources. Little attention has been given to aspects of mental or emotional health and economic consumption, including individual variations in participation in religious, literary, artistic and recreational activities.

The assumption seems to have been that, with improvements in health and productivity, the rural poor will have leisure time and use it creatively and enjoyably. There exists little or no published evidence for this assumption, and studies are needed to determine whether or not and how rural people progress in creative consumption along with any progress in production, environmental quality and physical health.

Is loss of indigenous cultural pleasures the price of material advancement? Are advantages in having market information from modern media outweighed by the disadvantages in having mass commercial media drown out more active and unique forms of entertainment? Should rural people even learn to read when the only literature available concerns distant urban or foreign lifestyles, interests and individuals? Should ways be found to prevent urban or foreign manufactures from destroying incentives to maintain or improve native music, arts and skills in vocational crafts? And are there ways to stimulate and "improve" local religious beliefs, practices and participation to reflect universal values, in the face of competition from spreading commercial entertainment and material or hedonistic ethics?

The only answer suggested here to all the questions above is that creative individuals must exist in rural communities. These persons will not be content with all the leisure forms imposed from external cultures. The creatives will select from the external, invent their own alternatives, act to improve indigenous forms and stimulate others to participate and contribute.

The problem, then, is how to develop and encourage creative individuals in poor rural communities. Little is known about how people become creative in any culture. But creative traits and behavior can be identified and their manifestations observed. And, as in studying ability in scientific planning, variables in learning environments and information-carrying transactions can be measured and correlated.[99] It may be found that creativity mostly depends on simply having unfilled leisure time, and that extra access to energies such as solar energy in land or the information in technology provides the leisure and surplus energy to seek and find creative, pleasurable ways to occupy the time.

Another possibility worth considering is that creativity may develop in individuals mainly as a consequence of creative communication-and-care received as a child. In other words, creative adults insure that creativity continues in succeeding generations, by actively and constantly improving the quality of their attention to children. But again, for adults to have extensive energy to devote to children may be a function

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[99] Investigations of creativity have been undertaken but have been confined mostly to cognitive convergence and divergence in academic problem-solving. For an early review, see Liam Hudson, Contrary Imaginations A Psychological Study of the Young Student (New York: Schocken Books, 1966). Current research is reported in The Journal of Creative Behavior.

of access to solar energy or technical information. And it may be found that over-attention to children could result in relative lack of imagination and ability to think and act independently by the children.

From discussion of this and the previous subject, one may conclude that cross-cultural research among poor rural communities could provide, besides data useful for promoting rural life development, globally-applicable information about individual and communal skills as a consequence of varying conditions in learning environments. In high-energy, industrial societies, learning environments may change so often and extensively from generation to generation that only longitudinal studies provide evidence of the consequences of varying ecologies of education. But among the rural poor, where change occurs at a much slower rate, an opportunity is offered to discover the manifestations of learning ecology variables without taking so many years or decades. As for the rural poor, the sooner that learning environments become understood with respect to promoting rural life development, the better.

Democratic relations. Virtually all the empirical and evaluative studies of rural development reviewed agreed that democratic processes succeed best.[100] There

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[100] For outstanding examples, see Elliott R. Morss et al., Strategies for Small Farm Development, an Empirical Study of Rural Development Projects (Wash. D. C.: Development Alternatives, 1975); Carroll Behrhorst, "The

seems to be no substitutes as productive as mutual trust, consultation and consensus in decision-making, non-coercion and individual choice in cooperation and of means to achieve desired ends. But opportunity for democratic tolerance, compromise and expression does not guarantee participation.

Democracy places the greatest responsibility on the greatest number. Without widespread willingness to accept responsibility for mutual decisions, work and welfare, social structural freedoms decay. Democracy requires adherence to the highest or universal moral values and this adherence is a consequence of individual experience and learning, another kind of developmental process, according to Lawrence Kohlberg.[101]

Assuming that democratic behavior, as a manifestation of the highest moral values, is a consequence of learning experiences, it can be investigated in the same way recommended for cultural creativity and scientific planning. Energy constructs relevant to learning can be compared to indicators of democratic attitudes and

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Chimaltenango Development Project in Guatemala," in Kenneth Newell (ed.), Health by the People (Geneva: World Health Organization, 1975); Denis Goulet, The Cruel Choice; and Edgar Owens and Robert Shaw, Development Reconsidered: Bridging the Gap Between Government and People (Lexington, Mass.: Lexington Books, 1972).

[101] Kohlberg, "The Cognitive-Developmental Approach to Moral Education." For a general discussion of democracy, the nature of its institutions and the difficulties and efforts required to sustain it, a review of some of John Dewey's works is beneficial, particularly Freedom and Culture (New York: G. P. Putnam's Sons, 1939), and The Public and Its Problems (New York: Henry Holt, 1927).

relations, and implications derived. Again, rural communities which have changed little for a generation both are ideal for research and could benefit greatly from the findings.

Several broad questions may be considered for research designed to produce information of use in promoting democratic relations for rural life development. For a given culture, what optimal range of access to energy in fertile land and appropriate technology is most conducive to democratic relations? What particular aspects and amounts of communication-and-care in childhood stimulates both initiative in assuming responsibility and concern for others' welfare? Are cognitive consequences of nutrition as important for moral development as they may be for ability in scientific planning?

Relationships and limitations. The last question above touches on a matter with important implications for both understanding ecologies of education and promoting rural life development. With sufficient data for analysis, it may turn out that learning-energy constructs relate to all the elements of rural life development in nearly the same way. For example, with limited access to solar energy in land to grow food, and little devotion to communication-and-care, there may be similarly detrimental consequences for developing good health, creativity, planning ability and democratic relations.

Given the bare amount of data already available and reviewed, such an outcome seems highly probable, in fact. If similar consequences were the case, it would substantiate claims about energy forms and conversion as a useful basis for an ecology of education. However, one may not conclude that energy forms for learning are mutually substitutable. People always need some energy from nutrition and some subsidy in communication-and-care, for individual growth and overall development to occur.

But, if developments in health, creativity, scientific planning ability and democratic behavior are affected similarly by energy inputs, how important is it to distinguish these aspects of rural life development? Besides defining or indicating the comprehensiveness of the concept of rural life development, how do they differ with respect to forms of learning energy constructs?

First, it should be recalled that the four aspects of rural life development were never defined as mutually exclusive properties. They are conceptual distinctions for discussion of a complex phenomenon, the processes of human growth and social development. The processes actually occur in whole individuals and whole communities. The features of the process which are perceived as distinctive may be closely dependent upon and concurrent with a multitude of internal changes, some also distinctive but many, perhaps, not observable. In other words, individual and community health, creativity, planning ability and democratic relations may be dependent not only upon external energy and nutrient sources but also upon each other, implying a close developmental interrelationship.

It may be the case that limitations in energy for learning have similar consequences for all aspects of rural life development, but it remains to be demonstrated. The data have not been produced. But various kinds of communication-and-care have been identified, instruments to observe them have been tested, and technical means to measure nutritional intake and human energy conversion are available. Values can be placed on energy-saving technology and social organization, as illustrated in a previous section. And a variety of manifestations of rural life development have been suggested, and more can be formulated, for correlation with the learning energy constructs. Among the latter, it also would be desirable to include energy-related indicators of perceptual information for testing.[102] A multitude of important hypotheses can be conceived and some are suggested at the end of Chapter Four.

Finally, even if restraints in access to energy have similar consequences for different aspects of rural life development, it appears that over-exposure or over-consumption is manifested quite differently. For example, over-consumption of food energy is detrimental to health,

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[102] For example, the number of contrasting environments that a child or adult encounters daily and weekly can be observed and the time for each measured, along with the number of different individuals, contacts with media and other sources of information and perception.

but not necessarily to planning ability, creativity and democracy. Abundance of fertile land negates the need for democratic cooperation and perhaps scientific planning, but has no undesirable consequences for creativity or health. Incessant exposure to commercial mass media might inhibit creativity but not planning. Excess subsidies in communication-and-care might inhibit both creativity and planning ability but have no bad effects on health and democratic relations.

In sum, the energies converted in food, fuels and communication-and-care, all controllable inputs, can be calculated with respect to achievement of the psychosocial elements of good health, cultural creativity, scientific planning and democratic relations, and the implications can be derived. In this respect and to this extent, the ecology of education can be almost holistic, a comprehensive and practical approach of value in planning education for rural life development.

But few or no measures exist for calculating energies in forms of perceptual information not controlled by educators or learners. And variations in genetic information remain so unobservable that energy constructs hardly can be related. The uncertainty of the latter two factors leaves the ecology of education less than holistic for predicting trends and planning education for rural life development. The implications for rural educators of both what can be measured and what can not be done are discussed in the following, and concluding, section.

Implications of the Energy and Ecological Approach for Educators Interested or Involved in Rural Life Development

Millions of educators such as parents, teachers, local leaders and external change agents succeed in promoting good health, democratic relations, cultural pleasures and scientific planning without reference to, and often without consciousness of, energy or ecological concepts. For various reasons, many people value the elements of rural life development and strive to enhance them in the home and the community. The individuals involved may know simply from experience what resource limitations restrain their plans and achievements, and what combinations of resources, social or material technology, works best for them.

Furthermore, local educators may develop an intuitive grasp of energy efficiency relationships with respect to the learning of skills for rural life enhancement. They may perceive, for example, that years spent in school literacy programs may be wasted effort with respect to motivating or enabling children to participate in rural life. But energy analysis and an ecological view may reinforce and improve on intuition, casual observation and trial-and-error, with comprehensive, precise and policy-indicating measures of learning resources, processes and relationships. Furthermore, the kilocalorie provides a more fundamental, unvarying and widely-applicable value than do money units in economic analyses. At the moment, however, it appears that there have not been conducted enough empirical investigations with energy measures and ecological principles to establish a theoretical base with the magnitude and ease of access that economic literature provides. The present investigation only may suggest directions and approaches for further study, with illustration of its utility for the understanding and planning of education in promoting rural life development.

This section, which concludes Chapter Two, is a discussion of the possible utility of the previous findings to potential rural educators in poor countries. Four types of educators are considered in the discussion and a sub-section is devoted to each in turn: farmer-parents, village teachers, local leaders, and change agents from outside a rural community.

Farmer-parents. The masses of adult inhabitants of poor countries are both farmers and parents. As farmers they are also demonstrators of the arts and economics of food production, processing and trade. As parents they are also teachers of language, manners, religion, recreational pursuits, politics, sanitation and social relationships. No educators of greater importance or influence exist in rural communities.

Despite the enormous responsibility farmer-parents have as educators of their children, each other and themselves, conditions of poverty insure that they have little opportunity to experiment in, evaluate, plan or improve in their roles as educators. Ironically, then, lack of energy would prevent most rural farmers and parents from considering and applying energy constructs to enhance learning for rural life development. It appears, therefore, that the long discussion and the various proposals presented in this study are not directly useful to the people who ultimately should benefit from them.

Obviously, academic dissertations are hardly recommended reading among rural poor people exerting every effort just to survive. For the ideas contained herein or in any research to be considered, an extensive subsidy in the organized energies from some external source is required. The energy for broadcast media is insufficient. There must be energy to organize extensive demonstration of the concepts. There also must be practical suggestions specific to situations and culturally acceptable to the rural poor as to how individuals may conserve existing energy, convert it more efficiently or acquire new sources. Then rural people may have the means to experiment, reflect, evaluate and plan improvements in their own and their children's ecologies of education.

For demonstrations to be situation-specific and culturally acceptable, there must exist demonstrators who know the people, something about technology and learning, and are trusted by and in ready contact with the people. Perhaps local or village teachers could or do serve to stimulate rural life development by understanding and improving individual and communal ecologies of education.

Village teachers. It would seem that community teacher-specialists, where they exist, fit the description of an empathetic, knowledgeable, culturally-attuned stimulator of rural life development. The teacher knows a broad range, if not all, the families in a community. The teacher knows something about science, the arts, moral values and health. The established teacher has experience in local customs and ways of problem-solving. And to be a teacher means that there are sources of energy with which to function, from local clientele and/ or from an external institution such as church or state.

Given these fairly ideal conditions, there are still problems with respect to the possibility of local teachers understanding and using energy constructs in improving education. First, they would have to be aware of the concepts and procedures in observing individual cases. At the very least, a piece of literature or another source of information must attract their attention. To motivate usage there would need to be an element of discontent or dissatisfaction with present services felt by a teacher or expressed by clientele. Dissatisfaction may not arise in many cases unless, again, some information is received from or caused by events outside the community. Finally, use of energy concepts and analysis of learning would depend on the method appearing to a teacher as locally relevant, desirable and easily applicable, which means that someone has worked to present the method as such.

There may be functional problems as well. Religious teachers often are community-oriented and involved with individual learning. But they might be interested only in spiritual and moral matters. Creative or scientific problem-solving and physical health may not be of concern to them at all. And where the religion is stagnant in form or authoritative and uncreative, democratic relations may be discouraged. In addition, in some areas religious teaching may not extend to the poor who can not contribute to a teacher's support.

Secular teachers, on the other hand, may be providing lessons mainly of relevance to urban vocations and lifestyles. Where the economic structure is such that just the good fortune of gaining urban employment is perceived by the rural masses as offering escape from poverty and boredom, schools and teachers are oriented to a curriculum of literacy and rote memory of data. The best learners can advance by testing and literary competition for positions in government or commerce. Neither the teachers nor the clientele perceive any incentives to promote learning relevant to rural life development. Energy analysis might be of use, but only to improve efficiency and increase net product in teaching, testing of and governing the curriculum of urban life employment.

Finally, when children are considered old enough to attend school, they may be considered strong enough to help support themselves, often quite necessary for survival among the poorest people. So again, many of the people who most need a subsidy in energy may not have the margin even to go and get free, potentially valuable information from teachers. And rural community teachers in poor countries already may have so many responsibilities that they have no surplus energy by which to take and present information to the poorest when the latter are resting from work.

In sum, there are serious motivational and structural barriers facing the prospect of rural teachers acquiring and using energy constructs to improve learning for rural life development. References to energy have aided in discussing the barriers, but the barriers remain, and it seems that another source of energy is needed to overcome them. Teachers generally do not have the resources in and among themselves.

<u>Rural leaders</u>. Local adoption of an innovation often depends on opinion leaders accepting the new idea and demonstrating its feasibility and advantages. The idea of improving education through energy analysis, the

concept of learning for rural life development, and the possibility even that rural life can improve for all, are innovations in themselves. Without acceptance and initiative from local leaders, the proposals are unlikely to benefit the rural poor.

First, local leaders must cooperate if any research is to take place in a community and in households. As discussed previously, a wealth of rural data is needed in order to approach conclusions about the learning consequences of communication-and-care, nutrition and technology. Second, with culture-specific knowledge of learning consequences, local leaders might promote acceptance of any innovations recommended for individuals, a family or the community. A leader perceiving the innovation as threatening or inappropriate might hinder its acceptance as well.

The leader's position and influence derive from a command of energies, in information, in access to land or technology, or even in the ability to communicate concern and organize welfare for others. Any of these forms of energy may contribute, once enlisted, to the goals of rural life development.

But attracting and engaging the leader's energies require energy in themselves. Motivating information and the technical knowledge must be brought and presented in terms of value, tact and clarity to the leaders. Also, effort must be made by the researchers or planners involved to ascertain who the real influences in a community are. Some leaders may be nominal only, with little popular respect or trust.

All these concerns may be familiar to anyone with experience in rural research or development. The important point is that a local leader, far more than individual farmer-parents or teachers, has the potential energy, including comprehensive knowledge about the community, to help promote rural life development with learning schemes derived from the results of energy-related research.

But many poor rural communities do not have leaders with much more of an energy base than other inhabitants have. Or the leaders are determined to reserve their energies for their own advancement. In these cases, rural life development must depend on a still more remote energy source, the external change agent.

Educators from outside the community. In most poor countries where rural development programs are planned nation-wide, systems of expert specialists are created. The experts are supposed to have skills in communication as well as their technical specialty. They can contact people in a strange community, establish credibility, demonstrate a new skill or behavior, and then move on to another village, all very efficiently.[103]

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[103] The ideal characteristics and training methods for these kinds of change agents were described by Francis C. Byrnes, in "Credibility and Competence: Key Characteristics of Development Communicators," paper presented in

In the People's Republic of China, a different approach, based on local self-reliance, has been perfected. The people in the community, having obtained or been given enough land, are supposed to decide in consensus and by themselves how to develop, and they obtain any special expertise from outside by sending someone for it. Outsiders who enter the community are urban or Communist Party generalists, there either to learn and work or to build morale by describing the "big picture," how the community is integrated into regional and national affairs.[104] But the key to Chinese success has been radical land reform, where every worker has had equal and sufficient access to solar energy in land. And in many other countries, with or without expertise extension systems, the common reason for failure in rural development

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Information and Communication Problems in Development Section, Third World Congress for Rural Sociology (Baton Rouge: University of Louisiana, August 22-27, 1972), and, "Some Missing Variables in Diffusion Research and Innovation Strategy," an A/D/C Reprint (New York: The Agricultural Development Council, Inc., March 1968). How well this system has succeeded in the past was evaluated in George H. Axinn and Sudhakar Thorat, Modernizing World Agriculture, A Comparative Study of Agricultural Extension Education Systems (New Delhi: Oxford & IBH Publishing Co., 1972).

[104] Wilbur Schramm et al., "China's Experience with Development Communication: How Transferable Is It?", paper presented to the Conference/Workshop on Non-Formal Education and the Rural Poor (East Lansing: Michigan State University, Sept 26-Oct. 3, 1976). The most objective and comprehensive review of Chinese development was found in Michael Oksenburg (ed.), China's Developmental Experience (New York: Praeger Publishers, 1973).

has been lack of effective land reform.[105] Any externally-based advisors, researchers, educators or planners can and should perceive this essential relationship between access to solar energy conversion and rural improvement.

Next, potential outside contributors to rural improvement can and should consider how human energy derives from solar energy through food, and all the possibilities there might be to conserve and improve these energies through known and experimental technological efficiencies.[106] The outsiders then might adopt hypotheses concerning relationships between various kinds of energy for learning and subsequent values of rural life development, as operating assumptions for testing, demonstration and broadcasting among rural people.

It is suggested here that the approach above will enable generalist-type helpers to develop technical ideas of use to rural people. And the approach also will enable specialists to relate their interests to overall development goals. Energy constructs work as a common conceptual

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[105] There is much evidence for this assertion, and some has been cited. For more support, consult the papers in David Lehmann (ed.), Peasants, Landlords and Governments, Agrarian Reform in the Third World (New York: Holmes & Meier, 1974).

[106] The technical literature is growing large, and includes, for example, Arjun Makhijani, Energy and Agriculture in the Third World (Cambridge, Mass.: Ballinger, 1975); and VITA, Village Technology Handbook (Schenectady, N. Y.: Volunteers in Service to America, 1970).

base for all aspects of development, where and to the extent that rural life development is dependent on processes of deliberate learning. And deliberate learning is the means by which external agents act and promote desirable change among rural people. An agent also can use energy analysis to evaluate his or her own activity as a rural educator.

But where and to the extent that rural life development depends on fortunes and contrasts in perceptual and genetic information, energy constructs do not contribute. External educators can neither control nor predict the local learning consequences of variations in climate, terrain, political events and marriage bonds. The ecology of education is holistic enough or useful, however, if energy-based analysis of communication-and-care, nutrition and technology help rural educators to understand and plan for rural life development.

Tasks for Chapter Three. It can be argued that the discussions above lack specificity. They are possibilities, logic and generalizations from synthesis of a large and varied collection of material, including previous sections of Chapter Two. In the third chapter, a particular culture and rural communities are examined to find out whether or not the issues can be clarified. A second task is to see how much energy constructs improve cultural and community descriptions and arguments, and to what extent they do not suffice as useful descriptors.

The third, but main, concern is to learn whether or not people in a particular society can use and benefit from energy-based analysis of learning for rural life development. Who, in rural Thai communities, can understand energy constructs? Which constructs are feasible to analyze? Who might initiate research in energy-learning-rural life development relationships? And who adheres to rural life development values in Thailand?

Summary of the Chapter

Solar energy, a consequence of gravitational collapse, provides the power for plant photosynthesis, and air, water and other nutrient cycling, upon which human civilization depends for existence, in adapting to the energy and nutrient resources of the terrestrial environment. A kilogram-calorie (kcal) measure relates all matter-energy forms, and in conversion from one form to another, part of the energy becomes dispersed and unobtainable, in the process of entropy. Man has designed control mechanisms to reduce entropy, with tools and fuels, to compensate for the high entropy of his own conversion of food into external work.

With tools and fuels, however, man has created precarious structures, societies which despoil and deplete resources to the detriment of succeeding generations.

Technology and specialization enable more people to participate in and benefit from social systems but population increase currently threatens to overburden technological and organizational capacities and energy and nutrient resources. Man has not yet produced organization and technology which will keep his numbers constant with respect to renewable resources.

Man learns to control his activity and his environment by acquiring information, a form of energy and matter which makes a difference, has meaning or consequence. Information is derived, for each person, from genetic inheritance, movement in the environment, communication-and-care from other people, and often by technological skills with organization, tools and fuels. Information, as a form of energy, is entropic or becomes disorder without effort to preserve it, and man, with all his inherited and acquired skills, has discovered many ways to find, preserve and express information. Social systems, such as households, communities and economic production, serve to organize exchange of information and other energy and nutrient goods, for all to survive and to enhance well-being.

Social systems support and determine the mixture of elements that constitute each person's ecology of education, including the environmental information to which small children are exposed, and the ways in which others communicate with and care for the young. The child, born with complex and advanced learning abilities, quickly adapts to his ecology of education, and begins learning a variety of skills, attitudes, personal relationships and cultural information, including the kinds of goods, services and information the child must supply in exchange for help in his own development.

But processes in acquiring information and development are not easily observed or measured. With present technology the amount of information that individuals acquire in particular circumstances is too variable to be predictable. Nor do energy constructs relate genetic information to acquisition rates of useful or consequential information. But observation of the effort that people exert in personal transactions and forms of communication-and-care can be made and compared to subsequent behavior. With energy-based data about family and community transactions and communication-and-care, prediction and planning can become feasible for promoting good health, cultural creativity, ability in scientific planning and democratic relations among the rural poor.

With respect to the effects on learning of nutrition, on the other hand, scientific understanding already has become very useful, with a degree of predictive power. Chronic prenatal and postnatal malnutrition, or lack of sufficient kilocalories, proteins and minerals, inhibits growth in the neurological system, including components of the brain, which harms developing capacities for cognitive skills and creativity, which, in turn, limits achievement of the potential inherited genetically, in intellectual, emotional, moral and psychosocial maturity. Mother's milk and the natural foods collected in nomadic hunting and gathering cultures have proven to be excellent, balanced diets for developing learning capacity and health. Grain agriculture provides energy for large numbers of people but may be deficient in needed protein and custom restricts scarce protein foods from pregnant and lactating mothers and children in many societies. Preliminary studies have indicated that production, processing and distribution of essential proteins require considerably more energy than securing an equal volume of mere energy-providing foods such as carbohydrates.

Where family and community activities are easily observed, scientists, planners and educators may evaluate net output and efficiencies in learning activities in addition to nutritional achievements. Of particular importance, technologies and organizational techniques may be compared with respect to the fuel and food energies required to attain an objective, and the energy in time and effort saved as a consequence of using various fuels and techniques. Such an energy-oriented analysis may complement economic analysis or replace economics where market values do not apply, as within the family. Educational policy issues may be resolved with a fundamental standard, energy, in evaluation of school and less formal learning for different economic and cultural systems.

Hundreds of millions of rural people in poor countries lack the access to energy by which they might improve their conditions. It seems that the global ecosystem could supply the energies needed. But no one has explained how the energies can be organized and distributed, including the problem of acquiring the energy just to organize and distribute. On a community level, measurable energy constructs suffice to analyze learning ecologies relative to good health and its promotion. Overall health appears closely dependent on nutrition, communication-and-care, and technology, all of which may be evaluated with kilogram-calorie measures.

It is also useful to relate these energy constructs to understanding and promotion of ability in scientific planning, cultural creativity and democratic relations, and all rural life development values to each other. With enough cross-cultural and/or inter-group data accumulated, communication-and-care, nutrition, and use of technology may become precise and predictive for learning ecologies. Such studies also may increase understanding about measures and consequences of environmental information, without which ecologies of education must remain somewhat lacking in explanatory and predictive power.

Many people may act to improve ecologies of education for rural life development without any awareness or need to understand energy-related learning variables.

But such awareness and understanding may improve efficiency and increase net product in action. Farmers and parents, the most important educators in rural life, and who constitute the bulk of the rural population, may benefit the most. But the poor lack energy with which to obtain and respond to ideas about energy, learning and rural life development. Village teachers may have the surplus energy to demonstrate the advantages of such ideas, but usually teachers lack orientation to rural life and motivation to change.

Local leaders, trusted or respected in and oriented to community, are more likely than teachers to have the means to promote rural life development through innovations in approach. Poor rural communities, however, seldom have selfless and effective leaders. Educators from outside are required. And outside helpers, to have any lasting effect, first must understand and seek ways to improve access to energy resources among the local poor. Then the researcher, planner or agent may seek to promote rural life development by improving ecologies of education with ideas from energy-related analysis.

CHAPTER THREE

RURAL LIFE DEVELOPMENT FOR THAI PEOPLE

The village is hardly an island by itself even less a fossilized deposit of an ancient civilization. It is a vital going concern, that partakes of a regional religious, artistic and intellectual culture; from within it produces personnel who are the carriers and transmitters of wider traditions.

S. J. Tambiah
"Literacy in a Buddhist Village in North-East Thailand"

A self-sufficient subsistence economy, irrigated rice farming, a central-village Buddhist temple, several influential kinship groupings, and common religious ceremonies (including the worship of spirits) are the most important characteristics of almost every Thai village.

Clark D. Neher
The Dynamics of Politics and Administration in Rural Thailand

...all agree that the uniform dreariness of the wilderness is far more depressing [than the city]. The variations are of season only, not of person, scene, or event--no stopping for a nip of liquor with a friend, no boat races on the river, no friendly gambling of New Year. Instead, there is isolation, with few occasions for gaity, and the foreboding blackness of night outside the bamboo shack.

Lucien M. Hanks
Rice and Man

Thai and western scholars have published a considerable amount of material about Thai culture, but no detailed energy analyses of the kind suggested in Chapter Two have been reported from Thailand. Much of the published material relates to arguments and generalizations made in Chapter Two. The present endeavor, then, is to find out how well the generalizations and arguments apply to conditions in Thailand, or to what extent data from Thailand substantiate the general case made in Chapter Two.

Particular questions are explored in respective sections. First, how can energy-related descriptors clarify Thai conditions in general? Do Thai people value rural life development? Can energy analysis help Thai farmers and parents? Would rural Thai teachers understand and apply energy analysis? Are local leaders receptive to innovative research and planning? And, in the concluding section, has experience with external change agents raised the potential for successful energy-based planning to improve ecologies of education in rural Thailand? All the questions above are closely relevant to the central endeavor of the present study, exploration of energy constructs for analyzing and improving ecologies of education for rural life development.

Introduction to Thailand

Some students of comparative or development education and many scholars of education in general may have little knowledge of Thai society. The following description may compensate for this. The main task, however, is to see how energy-related descriptors fit in and add to a comprehensive view of a particular culture. The method used is illustrative rather than analytical. Energy-related phenomena are described as part of the ecology, politics and economics of Thailand.

<u>Ecology</u>. Thailand lies entirely within the tropics, its southern border on the peninsula with Malaysia beginning at 5°30' North. Quite narrow in the southernmost four hundred miles, Thailand then spreads broadly, and includes: the fertile, well-irrigated Central Plain which surrounds the main waterway, the Chao Phya River; the less fertile Korat Plateau, circled on the east and north by the Mekong River and Laos; the northwest highland region of hills, fertile valleys and ethnic diversity; and a coastal strip to the southeast running down to Cambodia. Burma and more hills border most of the west. Thailand encompasses 514,000 square kilometers, an area smaller than Texas but larger than California. Thailand has over forty million people, seventeenth most populous

among all nations. The people live in 44,000 villages, about 500 small towns, and a sprawling capital city of four million, called Bangkok by foreigners and Krungthep by the Thai.[1]

Unlike the people of Java, Bangladesh and crowded parts of India, Thai people have not experienced serious over-population, although the usual problems of a tropical ecological system have been felt: year-round insect pests, with high temperatures and humidity; a mineral resource base low in fossil fuels; difficulty in storing any food except rice; and soils quickly leached, eroded and oxidized when exposed.[2]

Since World War II, rapid development in commercial agriculture and consumer goods manufacture and trade has had some detrimental impact upon the ecology. Pollution of the lower reaches of riverine systems has become common in Thailand. Over-cutting of forests has enhanced erosion and flooding. River damming has increased the incidence of liver fluke or schistosomiasis and reduced the numbers

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[1] FAO (Food and Agriculture Organization of the United Nations), Country Brief Thailand: Agriculture, Forestry and Fisheries (Bangkok: FAO Regional Office, 1972), p. A-1; and T. H. Silcock, The Economic Development of Thai Agriculture (Ithaca, N. Y.: Cornell University Press, 1970), p. 175.

[2] Daniel H. Janzen, "Tropical Agroecosystems," Science 182 (Dec. 21, 1973); P. A. Sanchez and S. W. Buol, "Soils of the Tropics and the World Food Crisis," Science 189 (May 9, 1975); Donald W. Fryer, Emerging Southeast Asia A Study in Growth and Stagnation (New York: McGraw-Hill, 1970), p. 54; and Karl J. Pelzer, "Man's Role in Changing the Landscape of Southeast Asia," Journal of Asian Studies 27 (1968).

of wildlife species. Urban concentrations in poorly-drained areas allow mosquito-borne diseases, such as dengue, or hemorrhagic fever, to spread.[3]

Modern medicine more than compensates for physical health problems caused by economic development, however. And the pleasures of urban life for many Thai may compensate for all the discomforts such as traffic jams, air pollution, street crime, high prices and political turmoil. With modernization, Thai people have experienced their share of alienation, reflected in recent times by labor strikes, drug addiction, inter-school rioting, political assassination and frequent changes in government leadership and organization.

History. Before 1932, kings ruled the Thai for many centuries. Nineteenth-century kings led negotiations which kept Thailand free from colonial rule, but which opened Thailand to Western trade and cultural influences. Before that, Thai history involved seemingly endless series of wars with surrounding neighbors, the Malays, Burmese, various Shan and Lao principalities, and the Cambodians, resulting in expansion of territory and population or sometimes loss, followed by intervals of peace and intrigue.

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[3] Gordon Conway and Jeff Romm, Ecology and Resource Development in Southeast Asia (New York: The Ford Foundation, 1973), pp. 21, 31; John E. Bardach, "Some Ecological Implications of Mekong River Development Plans," in Farvar and Milton (eds.), The Careless Technology Ecology and International Development; The Bangkok Post (hereafter abbreviated BP, April 9, 1974); and Sak Prachin, in BP (Nov. 2, Dec. 7, 11, 1974).

Originally from northwest China, and responding to the ebb and flow of Chinese fortunes, the Thai had established settlements in Yunnan, southwest China, then began penetrating the northern reaches of the Chao Phya River and its tributaries about a thousand years ago. Mongol expansion of Chinese administration forced Thai leadership out of Yunnan, and into a new era of southern expansion at the expense of Cambodian and Mon kingdoms which already had passed their peaks in vitality. As a result of all this expansion and assimilation, present-day Thailand includes minorities of Malay, Cambodian and Mon speakers, a large minority which speaks various Lao and Shan dialects, and small groups of so-called "hill tribes," isolated inhabitants of the western and northern highlands.

Although most of the ethnic minorities have become indistinguishable from the Thai majority, these minorities have made an impact on Thai culture. In the southward settlement and expansion, Thai people encountered and adopted Mon Buddhism, a Theraveda variant centered on monasteries and an ascetic, disciplined organization of monks who meditate, pray and perform rites for lay people. Adherents, in turn, maintain monastery buildings and support the monks with food, clothing and reverential status. Thai rulers learned and adapted for Thai use the Cambodian alphabet, administrative practices and Brahmin priests for courtly ceremonies. Various festivals, art forms and foods have been taken from Malays in the South, Shans in the North, and Lao in the Northeast.[4]

Politics. The modern era began during the lifetime of King Mongkut, a contemporary of Abraham Lincoln. Mongkut established treaty relationships with Europeans and had studied Western thought and language with Christian missionaries while still a Buddhist monk. The fourth in the dynastic line which established Bangkok as the southernmost Thai capital, King Mongkut led the reform of the Buddhist Order of Monks and had his children educated in Western science and politics. Mongkut's son, King Chulalongkorn, extended reform and modernization during a long reign, 1868-1910, as commercialization of the economy spread with Western trade and immigration of Chinese coolie labor. The latter's descendants, numbering ten percent of the present Thai population, are Thai

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[4] For more detailed explanation of Thai history and relationships with neighboring peoples, see John F. Cady, Thailand, Burma, Laos, and Cambodia (Englewood Cliffs: Prentice-Hall, 1966); Walter F. Vella, The Impact of the West on the Government of Siam (Berkeley: University of California Press, 1955) and Siam Under Rama III (Locust Valley, N. Y.: J. J. Augustin, 1957); and Harry J. Benda and John A. Larkin (eds.), The World of Southeast Asia: Selected Historical Readings (New York: Harper & Row, 1967). Woodworth G. Thrombley and William J. Siffin, in Thailand Politics, Economy, and Socio-Cultural Setting A Selective Guide to the Literature (Bloomington: Indiana University Press, 1972), provided numerous references to all aspects of Thai culture. And James A. Ramsay, in "Modernization and Centralization in Northern Thailand, 1875-1910," Journal of Southeast Asian Studies 6 (March 1976), described how modern Thai government assimilated a whole region far from Bangkok.

citizens, almost completely integrated, and lead the nation in domestic commerce, international trade, finance and education, and have great influence in the government civil and military services.[5]

Military leaders have dominated Thai government and politics since 1932, when the civil and military services combined to deprive the king of ruling powers. Civilian politicians have gained ascendancy from time to time, but always depended greatly on military officers who participate heavily in politics, become elected or appointed as popular representatives and assume cabinet positions. The national constitution frequently has been changed to reflect military interests and consensus among its leaders. The king has played mostly a passive role, although the present monarch, his Queen, and their children all enjoy widespread recognition and popularity. Even the so-called Communist insurgents, when captured or defecting,

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[5] James C. Ingram, Economic Change in Thailand 1850-1970 (London: Oxford University Press, 1971), pp. 17-20, 176-177; Silcock, pp. 40, 102. The following described Thai political development in the modern era: Fred W. Riggs, Thailand: The Modernization of a Bureaucratic Polity (Honolulu: East-West Center Press, 1966); William J. Siffin, The Thai Bureaucracy: Institutional Change and Development (Honolulu: East-West Center Press, 1966); and David A. Wilson, Politics in Thailand (Ithaca: Cornell University Press, 1962). And William G. Skinner, in Chinese Society in Thailand: An Analytical History, and Leadership and Power in the Chinese Community in Thailand (Ithaca: Cornell University Press, 1957 and 1958), presented the remarkable story of Chinese influence and integration into Thai culture. Ingram (above), Silcock (above), and David B. Johnston, (abstract of) "Rural Society and the Rice Economy in Thailand, 1880-1930" (Yale University, 1975), in DAI 37/1, p. 528-A, detailed the spread and changes in Thai rice agriculture.

stress their respect for the Crown.[6]

For the past several decades, rebellious groups have been conducting guerilla warfare against the central government, operating in isolated border regions of the north and northeast. Insurgent expansion appears to have been contained to several hundred villages, despite indications of strong support in weapons and training from Vietnam and Laos. A small group of Communist guerillas have had occasional success in mountainous areas to the southwest of Bangkok, about halfway down the Thai portion of the Malay peninsula. Of more spectacular notoriety currently, a non-Communist movement exists in the southernmost provinces of Thailand, among ethnic Malay people who believe that those provinces having Malay majorities should be allowed to separate, form their own governments, and, if they wished, join the Malaysian Federation.[7] The Thai government has vigorously opposed all separatist and rebellious groups, with modern weapons and tactics. But most Thai people have not been affected by these struggles, and express more concern for banditry and organized urban crime.

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[6] David Adelman, in "Sensitive, Benevolent King Remains on Pedestal in Thailand," The New York Times (Dec. 25, 1976), described the present king, his activities, political role and symbolic value to the Thai People.

[7] Nantawan Haemindra, "The Problem of the Thai-Muslims in the Four Southern Provinces of Thailand (Part One)," Journal of Southeast Asian Studies 7 (Sept. 1976).

Urban-rural problems and interaction. Rapid population increase, three percent per year from after World War II and until the early 1970's; fuel shortages and double-digit inflation; mechanization of commercial agriculture and the lack of any more good lands to clear and settle; and the spread of money ethics or consumer-pleasure expectations based on middle- or high-class comforts as pictured in the mass media; all have contributed to unwillingness to farm, rapid urbanization, and high unemployment among youths without particular job skills or creative interests. The consequences are evident in widespread burglary, hold-ups, drug addiction, gang warfare, cattle rustling, kidnapping, organized prostitution, and murderers-for-hire, reported daily in Thai newspapers.[8]

Escalating fuel costs may enable human labor in Thailand to become more fully-employed. But deterioration of the environment from over-tillage because of population pressures means that solar energy can not be employed efficiently to compensate for the lack of fossil

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[8] Robert E. Mitchell, "Similarities and Differences in Migration Flows to Urban Settlements in Five Southeast Asian Countries," Journal of Southeast Asian Studies 6 (March 1975); BP (April 7, 1976, Nov. 9, 1975); The Far Eastern Economic Review (Oct. 18, 1974); Brewster Grace, Population Growth in Thailand Part I: Population and Social Structure (American Universities Field Staff: Fieldstaff Reports, Asia 22 (1974); and Andrew Turton, "Northern Thai Peasant Society: Twentieth-Century Transformations in Political and Jural Structures," The Journal of Peasant Studies 3 (April 1976).

fuels to sustain the food energy needs of the people. Although all parts of Thailand receive abundant rainfall, control of runoff has been successful only in the north, where hilly terrain makes it possible for village groups to construct small canal and dam systems, and in the Central Plain, with commercial and government engineered and financed systems. The populous northeast or Korat Plateau region has been eroded badly, through extensive loss of its forest cover, poor terrain for control systems and lack of investment from commerce and the central government. Southern Thailand enjoys the highest rainfall, suitable terrain for water control and adequate forest cover, including numerous rubber tree plantations which substitute for forests in prevention of erosion and retention of ground water.[9]

The majority of Thai people do not encounter much contrast in climate and landscape during their lives. Rain occurs in dry seasons, and dry spells occur during the wet seasons. In all parts but the north, fans are needed year-round in homes to stir the warm air. Most of the terrain is flat, marked with rice plots, other crops in various stages of growth or tropical vegetation including palms and coconut trees. In recent years, sea shores and mountainous areas have become more accessible to larger portions of the population, with improved roads,

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[9] FAO, pp. A-16-18; Silcock, p. 136; Fryer, p. 36; and Yoshikazu Takaya, "An Ecological Interpretation of Thai History," Journal of Southeast Asian Studies 6 (Sept. 1975).

fuel imports and new leisure time and interests. But the city offers Thai people the greatest and most accessible contrast in environment.

Bangkok contains sixty percent of the urban Thai population and features of large cities around the world: tall buildings, modern hotels and streets filled with buses, taxis, trucks, private cars and motorcycles; factories and ports; large market areas, department stores and American-type shopping malls; every kind of entertainment imaginable, including cinemas, night clubs, international cuisine, local fairs, sports exhibitions and massage parlors; plus the appearance of constant bustling, movement and change, day and night. It is an adventure just to cross the city by bus, for Thai or tourist. About one-third of the inhabitants were born in rural areas, and many exist on very meagre incomes, in large slums of tiny shacks and raised wooden walkways, within sight of important market areas or government buildings.[10]

Bangkok exists because three-quarters of the national labor force produces enough food and feed, not only for the urban commercial sector but for overseas customers whose trade allows the Thai to import large quantities of consumer and capital goods. Bangkok businessmen operate this trade. The government supervises

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[10] Akin Rabibhadana, (abstract of) "Bangkok Slum: Aspects of Social Organization" (Cornell University, 1975), in <u>DAI</u> 36/12, p. 8156-A.

and engages in some business. And all act to maintain Bangkok as the central and largest concentration of commerce, communication and transport, higher education, government and politics, entertainment and even organized religion.[11]

Economy. Thai people cultivate one-fourth of their total land area, half of it in rice, the rest in corn, coconuts, sugar cane, fruits, vegetables, legumes, cassava, kenaf, cotton, tobacco and rubber. Sixty to seventy percent of the land is primary forest, second-growth forest, and marginal land. All the undeveloped land is being used carelessly, however, by timber companies, illegal wood cutters, charcoal makers, hunters, shifting cultivators and cattle raisers, with little regard for conservation of resources. Exploitation for immediate profit or subsistence overwhelms planning and government supervision for sustained yields.[12]

Whatever long-range effect such carelessness

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[11] BP (June 6, 1974), reporting on the 1970 Census; Laurence D. Stifel, "Technocrats and Modernization in Thailand," Asian Survey 16 (Dec. 1976); and Grace. Numerous Buddhist monasteries and learning institutions are maintained in the capital, and nearly all the ranking leaders of the Buddhist Order of Monks reside in these central monasteries: Carl T. Goldenberg III, "The Buddha Moves: The Thai National Religion in the Twentieth Century A Historical Study," unpublished M. A. thesis (University of Hawaii, 1969). Bangkok contains numerous mosques, Christian churches and Chinese Buddhist temples as well.

[12] BP (Jan. 3, 1976); Ingram, p. 261; Fryer, p. 138; and Grace.

produces, many in the present Thai generation have enjoyed an improving material life. For two decades, from 1950 to 1970, the gross national product, discounted for inflation, increased each year at more than double the rate of population increase. Productivity increased at a very high rate for non-rice agriculture in the Central Plain and for manufacturing in the Bangkok metropolitan area. Even in the poorest region, the northeast, people advanced in gross domestic product at a slightly higher rate than their population increase.[13]

Nevertheless, this apparent rise in material prosperity has accrued unevenly, a few improving their positions the most, some improving a little, and many improving not at all. In 1970, people in the central region, including Bangkok, had four times the average income than people in the northeast, where ten years before this disparity had been only a little over three times the difference. Outside Bangkok, the wealthiest ten percent obtain fourteen times more income than the poorest ten percent. And because of Thai market and tax structures, the agricultural sector transfers to the non-agricultural sector goods and services worth ten

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[13] Grace; Ingram, pp. 221-223, 235-237; FAO, sections B-III-VI. Recent Thai government estimates, as reported in Quarterly Economic Review: Thailand, Burma, no. 2 (for 1976), indicated that people in the Bangkok area maintained the highest per capita income for 1975, about $1,300. For the central region, excluding Bangkok, per capita income was about $410. It was $350 in the south, $229 in the north, and $149 in the northeast.

percent more than received, and average income in the non-agricultural sector remains 8½ times that of the agricultural sector.[14]

Up to twenty percent of the rice produced annually since World War II has been available for export, and easily marketed in grain-short Java, Singapore, Hong Kong and Saudi Arabia, to name a few of Thailand's steady customers. Most Thai farmers have not profited from this trade, however, as the government levied an export tax, or premium, on rice, to raise revenues, and to maintain cheap rice prices domestically, which has benefitted urban workers and the government civil service and military. Domestic prices have risen nevertheless, in recent years, because of inflation resulting from world-wide fuel and food shortages, and the Thai government reduced export premiums to encourage more production of rice. With higher costs for fertilizers and other agricultural inputs, however, the small farmer has not prospered from the rise in domestic prices of rice. Rather, larger producers and farmers changing to upland crops such as

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[14] Silcock, p. 188; Saeng Sanguanruang, (abstract of) "Net Resource Flow Between Agriculture and Non-Agriculture in Thailand in 1953 and 1963" (Indiana University, 1971), in DAI 32, p. 4187-A; and Medhi Krongkaew, (abstract of) "The Income Redistributional Effects of Taxes and Public Expenditures in Thailand: An Inter-Temporal Study" (Michigan State University, 1976), in DAI 37/2, p. 1124-A. The Thai newspaper Prachachat reported the average income in Bangkok as only four times that of average rural income, still a difference large enough to attract rural people away from agriculture, even with high urban unemployment rates and under-employment: BP (Nov. 1, 1975).

feed corn and soybeans have benefitted most, and small farmers have suffered from soaring land values.[15]

Agricultural structure. Because a cadastral survey never has been completed in Thailand, land ownership is disputed easily and often. The vast majority of the five million farming families in Thailand do not have permanent title to their lands. Speculators and development-minded businessmen, backed by lawyers and sometimes by Bangkok military and political influence, frequently gain access to blocks of land inhabited for generations by farmers who thought the land belonged to themselves. Without clear title, however, the farmers can not raise non-usurious loans with which either to develop their lands or to contest claims in court. The lucky ones obtain some compensation, enough, perhaps, to clear their debts and re-establish themselves on more marginal land. Some become tenants or laborers for the new owners. And some successfully fight the loss by joining others to petition directly to national leaders to intercede and obtain title for them.[16]

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[15] BP (May 6, Dec. 27, 1974); Turton; Silcock, pp. 17-21, 49-50, 197-198. For the long-range outlook, see Supat Wibulseth, "Thailand's Future as Rice Exporter Questioned," Foreign Agriculture 14 (April 5, 1976). In 1976, for the first time in decades, no rice premium was being levied on exports: The Far Eastern Economic Review (Sept. 10, 1976). And according to Quarterly Economic Review: Thailand, Burma no. 3 (for 1976), the Thai government maintained low rice prices in Bangkok by selling it at a loss in government outlets, at an annual cost of $22 million.

[16] J. Alexander Caldwell, American Economic Aid to

Cooperative effort has not been a prevalent feature of Thai agriculture, however, other than seasonal labor interchange among neighbors and relatives in areas of intensive and irrigated rice cultivation. Only about six or seven percent of Thai farm families belong to established credit, marketing, settlement, land improvement or multi-purpose agricultural cooperatives. And the established cooperatives tend to be dominated if not completely controlled by appointed officials from the central government Ministry of Agriculture and Cooperatives and agents of commercial businesses such as fertilizer supply companies. But less formal organizations exist, including over four thousand "Farmers' Groups," and about three hundred irrigation or water user's associations, involving nearly seven hundred thousand farm families. A generous estimate is that one in five farm families have some kind of organizational linkage.[17]

Thailand (Lexington, Mass.: Lexington Books, 1974), p. 84; Turton; Ingram, p. 266; Chaiyong Chuchart, "Principles and Practices of Land Planning and Development in Thailand," Monthly Review: Bangkok 12 (1971); Silcock, pp. 177, 203-204; and BP (Feb. 20, 1976). Issues of BP (for May 1, 3, 8, June 12, 1974) reported how five hundred farmers in a northern sub-district lost their lands to an agribusiness; and nearly every issue of BP in 1973, 1974, and 1975 contained stories of groups petitioning or demonstrating to retain their lands or rights as tenants.

[17] Glom Isarapandh, (abstract of) "A Comparison of the Legal-Economic Features of Cooperative Organization in the United States and Thailand" (University of Wisconsin, 1961), in DAI 21, p. 3296. Sources differ in reporting figures on membership and numbers of cooperatives, ranging from 269,704 members in 991 cooperatives, to 324, 013 members in 771 cooperatives: BP (Sept. 22, 1974, April 24, 1975); FAO, p. N-3; Royal Thai Government,

Perhaps easy access to new land has allowed Thai farmers to remain independent of the need to establish formal cooperative relationships. Thai Buddhist beliefs may reinforce this self-sufficiency. The Lord Buddha emphasized "looking within" for the source of one's behavior and knowledge, and Hindu beliefs, which dominate Thai Buddhist metaphysics, center around the theory that each person has complete responsibility for his actions and all difficulties and suffering occur as a result of previous misdeeds, perhaps in a former life, and current wrong thoughts. These few speculative statements do not explain Thai attitudes, behavior and social structure, however. The next section expands the discussion and there is an attempt to place Thai personality in relation to Thai ecology.

Energy descriptors. In this "Introduction to Thailand," it did not seem necessary to use energy-related descriptors to clarify, complete or expedite the discussion. It was not perceived, for example, that comparing access to solar kcal expressed social inequities any better than comparing per capita incomes. Comprehensively describing the ecology, history, politics, urban-rural

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The Third National Economic and Social Development Plan (1972-1976) (Bangkok: National Economic and Social Development Board, Office of the Prime Minister, 1973). Silcock, p. 125, described one association in one village. The Cooperative Marketing Organization of Thailand Press, 79 Ngamwonwan Road, Bangkhen, Bangkok, publishes detailed descriptions, in Thai, of the rules and organization of various types of cooperatives.

interactions and economy was accomplished efficiently without significant references to energy constructs.

Educational researchers and planners are accustomed to descriptions in the ordinary language of social science. Energy-related technical terms such as the kcal measure have not become prevalent and therefore do not seem appropriate in describing a culture. With more education research involving energy variables, however, and if energy analysis proves to have great utility, energy constructs may become common in educational literature, as they have begun to pervade the literature of anthropology and economics.[18]

Rural Thai People

How well do the values of rural life development correspond to the interests and needs of rural Thai people? This question is explored in the present section, after a review of literature about Thai personality and social relationships. These generalizations about rural Thai character also prepare for the subsequent discussions with respect to various kinds of educators and how they might use or respond to energy analysis.

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[18] For excellent examples, see Roy A. Rappaport, "The Flow of Energy in an Agricultural Society," _Scientific American_ 225 (Sept. 1971); and Charles A. Lave, "Negative Energy Impact of Modern Rail Transit Systems," _Science_ 195 (Feb. 11, 1977).

The Good Life. Among people of any given community, individuals probably differ more in expressed attitudes, desires, actions and reactions than the aggregate or statistical norms differ between communities, perhaps even between cultures. The unique study of Thai villagers by Herbert Phillips[19] does not result in a description of an unusual culture or strange behavior. Rather, reflection about the characteristics described might end in concluding that Thai people act and express themselves very rationally, and in similar fashion to people of many other cultures and communities. In any case, Phillips' conclusions do not conflict with more casual observations of Thai personality, nor with those of the present writer, who has spent more than thirteen years in association with Thai people of many backgrounds and in varied contexts.

The "Good Life" for rural Thai people, Phillips found, consisted of fun, physical comfort and security, intellectual simplicity and practicality, and a perception of the moral ordering of the universe.[20] "Fun" means participation in the activities most enjoyed in company--visiting and chatting with friends, drinking liquor and playing games, flirting with the opposite sex, traveling

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[19] Thai Peasant Personality The Patterning of Interpersonal Behavior in the Village of Bang Chan (Berkeley: University of California Press, 1965).

[20] Ibid., p. 16.

to unusual scenery, attending local fairs, and shopping for small luxuries. "Physical comfort and security" means delicious and satisfying food; a cool, dry place to rest, away from bothersome insects; and, of course, escape from debilitating disease and physical handicap.

"Intellectual simplicity and practicality" reflects a lack of interest in complex social issues or problems, including political processes and business administration, and a preference for discussion of easily-described phenomena and for involvement in tasks that individuals can accomplish even when in company. "Moral ordering of the universe" means satisfaction when social relationships are clear, when observed social behavior conforms clearly to ethical ideals, and when the moral center of the universe, one's self, is not affected adversely by surrounding events.

Achieving the Good Life, according to 77% of Phillips' peasant informants, depends on having personal wealth. Forty percent cited high status as another condition for the Good Life. Only twenty percent insisted that one must be a "good person" to enjoy the Good Life,[21] not surprising given the prevalent metaphysical belief that one's store of merit accompanies the soul into the next life. A person might act very immorally in this life, but exhibit great wealth and happiness because of good deeds in a past life, many Thai believe.

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[21] *Ibid.*, pp. 195-197.

A child is born with a stock of merit and sin, and a fairly well-defined character, in the quality of his "soul-stuff," his psychobiological motive power, and his "heart" or empathy for others, according to Phillips' sources. This personality may not be affected by the actions of others. So children may be indulged without danger, or ignored, punished or manipulated without worry about the consequences. This attitude transfers, as tolerance or indifference to the behavior and situations of other people (unless it inconveniences oneself), considering that whatever others do or whatever problems others have occur because of their free actions, previous sins, and sole responsibility.[22] With this belief and reasoning a person may feel justified in lack of concern for the fate of others. But in everyday behavior and social interaction, Thai people seem about as sympathetic and concerned for others as do people in different cultures. Without mutual sympathy and interest, family, friendships and community just do not survive.

<u>"Loose" community</u>. Community life in Thailand centers around village Buddhist monasteries, which often lie on the highest ground and always contain the largest

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[22] <u>Ibid.</u>, pp. 34, 88; Konrad Kingshill, <u>Ku Daeng--The Red Tomb A Village Study in Northern Thailand</u> (2nd ed. rev.; Bangkok: Christian College, 1965), pp. 7-10; Lucien M. Hanks, "The Corporation and the Entourage: A Comparison of Thai and American Social Organization," <u>Catalyst</u> (Summer 1966); and Koichi Mizuno, "Thai Patterns of Social Organization: Note on a Comparative Study," <u>Journal of Southeast Asian Studies</u> 6 (Sept. 1975).

and most enduring structures in the community. In addition to its functions for religious activity, the monastery may be a place for recreation, receiving medicine and education, agricultural stores, a home for the aged, a library or information center, meeting hall, guest house and employment agency. The handful of permanently resident monks, most of whom come from the locality, cooperate in maintaining these social functions, besides pursuing daily prayers and study and providing religious rites and services to laymen.[23]

However valuable the monastery as a social center to Thai villages, each function itself appears informal and often uncoordinated, or as John Embree characterized it and Thai society, "loosely structured."[24] Established

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[23] Colin S. Freestone, The South-east Asian Village A Geographic, Social and Economic Study (London: George Philip & Son, 1974), p. 12; B. J. Terwiel, "A Model for the Study of Thai Buddhism," Journal of Asian Studies 35 (May 1976); J. A. Niels Mulder, (abstract of) Monks, Merit and Motivation: An Exploratory Study of the Social Functions of Buddhism in Thailand in Processes of Guided Social Change (Dekalb: Center for Southeast Asian Studies, Northern Illinois University, 1969), in Thrombley and Siffin, p. 100. For more detail about monastery life and value to the community, see Religion Department, Research Section, "Research about Nuns in Thailand," in Royal Thai Government, Summaries of Educational Research of the Ministry of Education (in Thai; Bangkok: Coordinating Committee for Educational Research of the Ministry of Education, Khurusapha Ladphrao Press, 1970); Kingkeo Attagara, (abstract of) "The Folk Religions of Ban Nai, A Hamlet in Central Thailand" (Indiana University, 1967), in DAI 29/1, p. 196; John E. deYoung, Village Life in Modern Thailand (Berkeley: University of California Press, 1958); and Goldenberg.

[24] "Thailand--A Loosely Structured Social System," in Hans-Dieter Evers (ed.), Loosely Structured Social Systems Thailand in Comparative Perspective (Yale University: Southeast Asia Studies Cultural Report Series No. 17, 1969).

individual status relationships rather than rules or organization determine initiative and responsibility. Individuals determine their own degree of participation in any given activity, often according to mood at the moment, because social activity-tasks usually can be accomplished by individuals working separately or serially. Even membership on the lay committee to coordinate maintenance of the monks and monastery property depends on volunteer interest. Election of a village headman may be just as informal, with interested adults reaching consensus through casual discussion as to who should have the responsibility.[25]

Physical mobility loosens institutional bonds, and the Thai always enjoyed access to unused land, which prepares them to sell or abandon property or leave parents for a new location. In recent decades, urban employment opportunity has substituted for the reduction in access to new land. Thai people do not part from happy relationships any more easily than other people, but the Thai show flexibility and easy mobility in leaving or breaking status relationships in order to gain some advantage, to pursue another interest, or simply to end an unpleasant situation. For convenience, even children may be left with grandparents, near kin, and sometimes friends, or shunted around among them. Families can break up or

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[25] Steven Piker, "'Loose Structure' and the Analysis of Thai Social Organization," in Evers (ed.).

join without much upheaval.[26]

The importance of status. Thai status relationships, in contrast to friendship or love relationships, depend on material advantage for establishment and continuance. The lesser partner provides services to the higher and receives goods or a position with which to obtain goods or services. Whenever the superior improves his position socially, favored inferiors may expect to improve their situations as well. When it is perceived that the superior, whether a family member, a teacher, an administrator, a military officer, or a business colleague, will no longer advance or can no longer provide the subordinate with advantages, it is expected that the subordinate will seek a new patron or patrons.[27] As Phillips wrote, "Much of the time Thai fulfill each other's expectations, but this is because they want to, not because others expect it of them or because the situation demands it. It is the individual that is primary,

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[26] Phillips, pp. 25, 77-83; Evers (ed.), p. 120; Lucien M. Hanks, Rice and Man (Chicago: Aldine-Atherton, 1972), pp. 81-86; Steven Piker, in "Friendship to the Death in Rural Thai Society," Human Organization 27 (1968), and Brian L. Foster, in "Friendship in Rural Thailand," Ethnology 15 (July 1976), offered observations about the nature and extent of Thai friendship.

[27] Phillips, pp. 80, 157; and Mizuno. Howard K. Kaufman, in Bangkhuad: A Community Study in Thailand (New York: J. J. Augustin, 1960), listed some of the status relationships common in rural Thai villages, including abbot-monk, monk-lay person, village headman-farmer, district officer-village headman, head teacher-teacher, teacher-pupil, teacher-villager, doctor-patient.

not the social relationship."[28]

In Thailand, services to one's status superior includes, besides performance of work ordered or expected by the superior, deference to all his opinions, overt attention to his statements, small gifts on appropriate occasions, visits to his home, accompaniment in recreational activity, and expression of a variety of signs of respect such as bowing with one's hands joined as if in prayer, using special status-showing words and phrases in speech, and keeping one's head on a level lower than the superior's head while together. Various status signs are often the first expressions taught to young children.[29]

Familiarity and friendship reduce the felt need to display status signs, even in status relationships. But signs of status and other polite forms alleviate tension and anxiety where disagreement may arise. As in other cultures where home and recreational environments may be crowded, Thai people make every effort to avoid overt conflict, challenges to pride such as blame for mistakes and criticism for an action or opinion, and indirect association with unhappiness on the part of another such as conveying bad news, initiating an end to a pleasant activity or opening a serious discussion.[30]

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[28] Phillips, p. 60.

[29] *Ibid.*, p. 33.

[30] Phillips found that villagers demonstrated an "extraordinarily low tolerance" for interpersonal conflict

Avoidance of unpleasantness often takes the form of physical separation from social bonds, reinforcing the appearance of "loose structure" in Thai family, community and economic life. But among Thai people, one is expected to avoid unpleasantness for self and others. Phillips found that only one-fifth of the adult villagers worried about others' activities as detrimental in some way to themselves. The greatest source of anxiety, and for the majority of informants, was personal health, considered entirely one's own responsibility.[31] Since Phillips' analysis, other investigators have confirmed that these attitudes and relationships have not been affected significantly by modern material changes.[32]

Social "looseness," characterized by physical mobility and the prevalence of individually-determined, rather than legally- or institutionally-determined status relationships in economic and political life, has provided a flexible structure of high survival value,[33] making Thai society adaptable to change, including the commercialization of agriculture, urban industrialism,

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and latent concern with aggression and social conflict: *Ibid.*, pp. 9-10, 30, 70.

[31] *Ibid.*, pp. 91, 177.

[32] Hanks, "The Corporation and the Entourage...;" Steven Piker, "Sources of Stability and Instability in Rural Thai Society," *Journal of Asian Studies* 27 (1968); and Brian L. Foster, "Continuity and Change in Rural Thai Family Structure," *Journal of Anthropological Research* 31 (Spring 1975).

[33] Embree.

frequently-changing political leadership, government organization and constitutional law, and the assimilation of non-Thai minorities.[34] Thai villagers accept agricultural innovations readily but with pragmatic selectiveness and consideration of cost, efficiency, market conditions and personal effort factors.[35] In Bangkok, former villagers exhibit similar patterns of mobility, relationships and attitudes that Western anthropologists have observed in rural areas.[36] Even the urban Thai intelligentsia tend to be "literati," moral philosophers rather than self-critical and objective analysts. And in academia and the higher civil service ranks, they maintain and work under status bonds similar to status relationships prevalent among villagers, in the Buddhist Order of Monks, in the military services and in commerce.[37]

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[34] Silcock, pp. 30, 39; and Brian L. Foster, (abstract of) "Ethnicity and Economy: The Case of the Mons in Thailand" (University of Michigan, 1972), in DAI 33/11, p. 5104-B.

[35] Rose K. Goldsen and Max Ralis, Factors Related to Acceptance of Innovations in Bang Chan, Thailand (Ithaca: Cornell University, 1957); Phillips, p. 98; and David P. Gisselquist, (abstract of) "A History of Contractual Relations in a Thai Rice Growing Village" (Yale University, 1976), in DAI 37/7, p. 4491-A.

[36] Susan and David Morell, Six Slums in Bangkok: Problems of Life and Options for Action (Bangkok: United Nations Children's Fund, 1972).

[37] Phillips, pp. 40-43. Robert B. Textor, in Shared Image of Thai Model Personality Held by Peasants in a Central Plain Community (Calcutta: UNESCO Research Center on the Social Implications of Industrialization in Southern Asia, 1956), summarized how Thai people have characterized themselves: Buddha-like, easy-going, fun-loving, generous, untrustworthy, self-centered, tolerant-indifferent,

Rural Thai goals. Given such a flexible, loosely-structured society, what general estimates can be made as to Thai receptivity or adherence to assumptions about rural life development, particularly the values described in earlier chapters as most important for rural life? For example, the goals of good health conform highly to personal concerns and efforts of Thai people, although, like elsewhere, the Thai seem overly obsessed with physical health, and comfort, tending to ignore aspects of personal health related to emotional stability, cognitive growth, and moral development or social harmony.

Individual Thai exhibit cultural creativity, the social "looseness" perhaps encourages it, especially in the arts, religion and forms of recreation. The Thai have been as successful as the Japanese in maintaining and developing traditional forms of creative expression while experimenting with and adopting foreign forms.

Scientific planning as a personal habit or as an institutional process does not appear common in Thai society, except for the formalistic, statistical, and often unrealistic plans formulated at the highest levels of Thai government as social and economic policy. Most Thai people are not oriented towards self-evaluation in the sense of reflection about one's desires, the

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hierarchical, fast-embarrassed, polite, unobtrusive, lack efficiency and lack progress.

possibilities for creating a lifestyle in which to fulfill most desires and the consequences of one's efforts for others. On the other hand, Thai people formulate goals for themselves, their children and their followers, and very pragmatically manipulate the environment and others to promote these goals. And Thai people respect the notion of avoiding situations which will cause stress to others, however short-sighted or self-centered the reasons may be at times. In addition, Buddhist philosophy encourages people to "look within," to consider one's desires, if only for the purpose of squelching "wrong" desires. The process of rational, data-based, long-range planning among Thai people, however, appears subordinate to impulsive decisions and actions based upon momentary expectations of enjoyment and physical comfort or health.

Democratic relations may be the most difficult aspect of rural life development to promote in Thailand, because of the prevalence of patrimonial Thai status relations. Self-concern, at most identification with a few friends and family loved ones, operates against community-orientation or behavioral adherence to a set of democratic principles. The availability of land and other energy sources in Thai society has facilitated anarchic tendencies and lack of any need for strong personal commitment to community, institution, or ideas. But with a 2.5 percent population growth per year,[38] Thai

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[38] BP (April 7, 1976). Prior to the mid-1970's and since the mid-1940's, population grew by 3% per year.

people have begun to experience declining access to energy, and more cooperation may become necessary. And, to some extent, Thai paternalism works democratically, in that relationships are established, maintained and broken voluntarily, without violence or excessive economic pressure. Superiors and subordinates must communicate and consider each others' feelings, goals and abilities. And on the national level, for three years in the mid-1970's a House of Representatives was established by constitutional convention and elected by popular ballot. Ordinary Thai people have always been able to gain direct access to Members of Parliament. At times, with patience, tact and sometimes intermediaries, even when military officers have ruled by decree, the people could express their needs at the highest levels of government. And the press, though conservative and under some restraints of censorship, provides another avenue for popular expression and interests. There are institutions, therefore, which have the potential for promoting democratic relations, although the institutions, including branches of government, political parties and the media, have tended to be located among and dominated by urban elite groups such as the military, the civil bureaucracy and the business wealthy.

<u>Preliminary conclusions</u>. In sum, rural Thai people generally do <u>not</u> hold strongly to the values characterized for rural life development in this study. It is concluded that except, perhaps, with respect to

cultural creativity, rural life development normally does not nor would not occur, given just the availability of optimum material resources for it. For a rural revival to become widespread in Thailand, there must be more people committed to rural life development values and with the human resources to adapt, demonstrate and promote the values among the rural poor.

In the introductory section of this chapter, it was apparent that rural life development is very much needed in Thailand. Environmental deterioration, lack of farm organization, widespread banditry, soaring fuel costs and decreasing access to fertile land and urban employment opportunities, all point to the necessity for promoting rural planning, cooperation, cultural interests and overall well-being. If a Thai rural revival is highly desirable, therefore, but more people are needed to promote it, who will be the promoters?

If the Thai national leadership were as oriented to rural life development as the leadership of China, Tanzania or even India, there would be no further cause for discussion. But Thai government resources are committed overwhelmingly to political and military security, organized education for government employment and commercial enterprise, urban welfare and industrial development. Rural life enhancement remains primarily the domain of individual farmers, local leaders, village teachers and some agents from outside rural communities.

The four sections following are discussions of these potential rural educators in Thailand. References to energy may help describe resources available and conditions prevalent for each type of educator. But the main purpose is to evaluate the potential benefits of energy analysis for promoting rural life development in Thailand.

Thai Farmers and Food Energy

Thai farmers provide enough nourishment for four times their number, including their young and elderly dependents, all the non-agricultural families in Thailand, and a substantial number of customers abroad. Between 12 and 13 million agricultural workers cultivate between 12 and 13 million hectares of farmland in Thailand, with almost as much land of marginal value employed for grazing and as a source of firewood and charcoal. Thai government policymakers intend to reserve half the total land area for forest and flood control. But with irrigation, as about four million hectares already have, agricultural production on present acreage can be increased greatly, perhaps more than doubled.[39] Whether this expansion occurs, however, depends on the energy sources and conversion

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[39] Silcock, p. 202; BP (Aug. 1, 1975, June 29, 1974); and Royal Thai Government, The Third National...Plan, p. 121.

mechanisms available and acceptable to the farmers, including the amount and quality of food obtainable by them, feed for draught animals, fuels for particular mechanical operations, and information which would stimulate or promote the desire to expand production.

Disparities in access to energy. From the information above it would appear that Thai farmers enjoy an abundance of solar energy, each, on the average, with a hectare of land space where crops can receive sunlight and concentrations of water. Almost another hectare provides fodder for draught and meat animals, fuel for the hearth and some materials for construction. But reality seldom conforms to statistical ideals. Land is becoming unevenly distributed among cultivators in Thailand, in terms of who actually controls the product outputs from the land, and with respect to differences in product amounts or yields obtained. For example, rice yields in the northeast region of Thailand are two-thirds of yields in the Central Plain and family holdings in crop land in the northeast are half the size of holdings in the Central Plain.[40]

The lack of water runoff control and storage systems in the northeast makes it difficult to improve yields and extend cultivation into marginal land. Large-scale

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[40] Fryer, pp. 138-140; and Horace L. Lefferts, Jr., (abstract of) "Baan Dong Phong: Land Tenure and Social Organization in a Northeastern Thai Village" (University of Colorado, 1974), in DAI 35/12, p. 7457-A.

projects thus far have not improved the situation. For example, the Nam Phong reservior in the northeast stores just enough water for electric generation, partly because the spread of water hyacinth results in an evaporation rate three times normal. The reservoir displaced thirty thousand local inhabitants, many of whom simply disappeared from the region. The full development of the Mekong River Basin would result in an irrigation system for only 11% of the cultivated land in the northeast. The potential exists for effective schemes on a small scale, however. The Huay Sithon reservoir in Kalasin province allows double cropping on two thousand hectares for 127 families.[41]

Production disincentives. In the more productive Central Plain, a tenancy trend began fifty years ago as rice production was commercialized. Second-generation Chinese rice millers and merchants introduced innovations such as steel ploughs and steam-powered mills, monopolized trade and credit and gained control of the land through debts and cash offers. Civil and military officials and professionals such as doctors, teachers and lawyers, who enjoy steady cash incomes, also have invested in land. The net effect has been that over half the farmers in

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[41] BP (Dec. 20, 1974); Conway and Romm, pp. 13-14, 24-25. Silcock provided detailed statistics on each Thai province as to land area, area in crops, percent irrigated, population and yields, for 1964. Villagers have begun to resist some reservior schemes: BP (May 29, July 27, 1974).

the Central Plain have become tenants, often paying up to fifty percent of their crops in rent. Tenancy has increased in the north as well, since the completion of all-weather road systems to and within that region. Villagers who had farmed freely for generations suddenly have encountered landlords demanding rent.[42]

The credit, tax and market price structure in Thailand amounts to a disincentive against diligence or productivity for rice farmers. For the current prices obtainable, one-third of the income goes to rent, taxes and paying off debts. One-third pays for capital and current costs of fertilizer, biocides and the equipment for them, leaving one-third of the harvest, all required for the labor energy in ploughing, transplanting, maintenance, harvesting, processing and transport.

The price of rice doubles from farmer to retail customer. If a farmer must sell all his rice to pay debts and buy it back on the market for food, he enters a spiral ending in bankruptcy. The land sells for only about the equivalent of a year's gross harvest, a low price for paying off accumulated debts, but a very high price for capital- and credit-short farmers. On the

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[42] BP (Nov. 16, 1974); Silcock, p. 40; "Agro-Business '75," in The Far Eastern Economic Review (June 20, 1975); M. C. Williams, (abstract of) "Thailand: The Demise of a Traditional Society," Journal of Contemporary Asia 3 (1973), in World Agricultural Economics and Rural Sociology Abstracts 16 (1974). Silcock, p. 40, claimed that many Central Plain farmers choose tenancy because the high returns from the fertility of the flood plain more than compensates where rent prices are fixed.

other hand, to be the sole and minimum provider for a family at current wages, a farm laborer must work land nearly twice the size of the average holding in Thailand. Therefore, to profit enough to give his family some modern comforts and his children some advantages, a Thai farmer must own the land he works, his land must be refertilized through natural processes such as flooding, and his crops must be naturally resistant to local pests and diseases. And the farmer himself must be frugal in regard to personal pleasures such as the enjoyment of alcohol, tobacco and commercial entertainments, all of which are heavily taxed.[43]

For the Thai farmer, energy control inputs such as irrigation, credit or fertilizer, are expensive, and the

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[43] On rice prices: BP (June 22, Dec. 30, 31, 1975). On family income: BP (Jan. 3, 1976). On input costs and labor wages: BP (May 10, 1974, Jan. 4, 11, 1976). On fertilizer use: BP (Sept. 17, 1975); Ingram, p. 269; and Halvor J. Kolshus, (abstract of) "Modernization of Paddy Rice Farming in Northeast Thailand with Special Reference to Use of Fertilizer" (University of Kentucky, 1972), in DAI 33/10, p. 5377-A. On taxes and credit: Krongkaew; Pantum Thisyamondol *et al.*, *Agricultural Credit in the Northeast, Thailand* (Bangkok: Faculty of Economics and Business Administration, Kasetsart University, 1973); Kingshill, p. 35; Ingram, pp. 250, 259; BP (Feb. 19, May 15, 1974); Arb Nakajud, *A Study of Provincial and Local Government in the Province of Udornthani, Thailand, with Special Reference to Agriculture* (Bangkok: Department of Agricultural Economics, Faculty of Economics and Business Administration, Kasetsart University, 1973), pp. 63, 73; Silcock, pp. 5, 17; Alexander Caldwell, p. 84; and Pichit Lerttamrab, (abstract of) "Liquidity and Credit Constraints: Their Effect on Farm Household Economic Behavior--A Case Study of Northern Thailand" (Stanford University, 1976), in DAI 36/12, p. 8191-A. On land prices: BP (June 13, 1974); Ingram, p. 263; and Turton.

energy he can market, his crops or his labor, sell cheaply. In a commercial economy but with little profit, a farmer has difficulty demonstrating to his children and colleagues the advantages in farming or incentives to improve his methods. Yet the quantity of agricultural exports and quick market responsiveness indicate both diligence and intelligence among Thai farmers, that they must be enjoying some inexpensive energy inputs in information which provide both motivation and the knowledge by which to take advantage of fluctuating market opportunities.

Incentives. A modern market system in Thailand supplies motivation, in the form of highly-desirable consumer goods and services, and knowledge, through rapid transportation and the presence of agri-business agents in close communication with export and urban market centers. Government strongly supports the market system, offering tax incentives to agri-business investment and local consumer goods manufacturers, and organizing trade negotiations with foreign customers such as the Saudi Arabians, who may be willing to reduce crude oil prices in order to obtain high quality Thai rice. The Thai government, until 1973, also forbade union organization and provided police protection for businesses against striking workers, which helped restrain inflationary tendencies and kept locally-produced goods reasonably priced for agricultural workers.

When civilian leaders resumed political power in late 1973, however, urban labor began organizing. It managed many successful strikes and contributed significantly to the wage-price inflationary spiral initiated by the rise in foreign oil prices. Transportation and urban electricity is heavily dependent on foreign oil as Thailand produces none. But inflation has been alleviated by cheap electricity from dams built in Thailand during the 1960's, and by the disorganization of farmers and consequent inability to raise food prices as fast as consumer goods increase.

Unfortunately, detailed investigation of the effects of these recent events have not been made so far for individual farm families. The best literature available reflects efforts by social scientists in the 1960's and early 1970's, before current political and economic changes in Thailand. But some of these reports provide insights about energy use by Thai farmers and about effects on rural perceptions and learning.

Production energy analysis by experience. Michael Moerman spent several years among rice farmers in one northern Thai village, gathering data on labor, other energy and material inputs and subsequent yields, for various methods of cultivation.[44] The villagers of Ban Ping had fields irrigated by storage dams, canals and ditches, fields flooded by a stream which overflowed

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[44] Michael Moerman, Agricultural Change and Peasant Choice in a Thai Village (Berkeley: University of California Press, 1968).

during the rainy season, and fields which received only rainfall. Seed broadcasting was used as well as the transplanting of rice plant sprouts in cultivation. Tractor plowing was being used on newly cleared land and plows drawn by buffalo or oxen were used on established fields. But by aggregating labor input data, Moerman discovered, as many villagers were beginning to realize on their own, that tractor plowing gained little or no advantage in yields per labor input. Naturally-flooded fields yielded more than irrigated fields for the labor required, although irrigated fields, because water is carefully controlled and available for more of the year, produced the most rice per hectare. Similarly, the broadcast method of planting rice seeds achieved higher yields for the labor than transplanting, but transplanting produced more on a given piece of land.[45]

When Moerman returned to Ban Ping five years later, he found settlement stabilized in extent, and labor constraints less of a problem. Ban Ping farmers rarely used tractors for plowing and had reduced broadcasting to a minimum, to achieve the highest productivity. Some were experimenting in applying chemical fertilizers on seedbeds to limit the area needed for seedbeds.[46] Knowing the prices of all inputs, the scarcity of labor, the land

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[45] Ibid., p. 182. Hanks, who gathered reports from a number of investigations, reached similar conclusions: Rice and Man, pp. 56-64.

[46] Moerman, pp. 185-187.

available, the relative fertility for each field according to cultivation methods used, and the relative efforts they had to make themselves, with little or no outside advice and without serious difficulties, the farmers of the village experimented with tractor energy, learned from their experiments and chose to farm for maximum net product rather than maximum return for personal effort applied. Despite the "looseness" or lack of formal organization in the community, it is apparent that the farmers learned from each other and knew how to learn from their own activities.

Furthermore, as Moerman observed and Nakajud confirmed, eighteen- and nineteen-year-olds were already full participants, some owning and operating their own plots. One may conclude that the farmers educated their children for economic activity in much the same way as it has been observed by anthropologists in other cultures, by example and casual demonstration, perhaps the most efficient use of energy for helping others to learn.

From experience, therefore, Thai farmers know the most energy- and cost-efficient and output-maximizing methods of obtaining energy and nutrient needs, and of helping children to obtain the same knowledge. It seems probable that most farmers could and do understand and evaluate demonstrated efficiencies and production increase with respect to other kinds of activities and learning objectives. But with limited or non-existent access to energy-controlling financial credit, energy-saving technology, and energy-converting fertile land, the poorer Thai farmers cannot respond to perceived advantages nor experiment to discover new alternatives.

Nutrition and food processing. Perhaps a different or stronger conclusion might be reached by examining data about Thai nutrition, diet-related health and meal preparation. How effective is the rural Thai female parent as an educator or provider of learning energy for herself and her children? Thai men often participate in the selection and preparation of foods, but women in Thailand take the most responsibility in these tasks. And it should be mentioned, in reference to the preceeding paragraphs, that although men take the primary responsibility for agricultural tasks, and do nearly all the plowing and transport, one-fourth to one-third of the full-time agricultural labor force are women,[47] and most women in farm families take part in the transplanting of rice, crop harvests and post-harvest processing.

In rural Thailand, meal preparation has been observed to be very time-consuming, requiring an average of six person-hours per day for a medium size household of seven or eight people. Nearly every ingredient in each recipe must be altered--cut, pounded, grated, strained or peeled--

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[47] BP (Nov. 22, 1975).

before frying, boiling or roasting. Charcoal or wood must be obtained and tended carefully while burning and cleanliness is critical in a tropical climate. Despite the complexity of meal preparation in rural Thailand, however, Hazel Hauck and her research associates found that six-year-old children could cook rice and twelve-year-olds made "creditable" meals,[48] which means that rural Thai women provide sufficient energy in information, incentives and other nutrients for children to learn well the customary methods of meal preparation.

According to a variety of sources, however, rural Thai diets have been lacking in the nutrients which enable people to achieve maximum growth and best health, which, referring to the research reported in the section on nutrition in Chapter Two, may have the effect of reducing human learning potential. Investigators from the late 1950's to the early 1970's agreed that Vitamin A, riboflavin and thiamine deficiencies commonly occur among all Thai people, and that protein deficiency affects many among the very young. At one time beriberi was known to be the tenth most common cause of death in Thailand.

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[48] Hazel M. Hauck, et al., Food Habits and Nutrient Intakes in a Siamese Rice Village, Studies in Bang Chan 1952-1954, Cornell Thailand Project Interim Report Series Four (Ithaca, New York: Data Paper Number 29, Southeast Asia Program, Dept. of Far Eastern Studies, Cornell University, 1958), pp. 31-32; Hanks, Rice and Man, p. 76; and Anita Lindskog, Information on Some Aspects of Village Life in Nongkoon and Nam Om, Ubon Ratchathani Province in Northeast Thailand (Bangkok: Food and Agriculture Organization of the U. N. Regional Office for Asia and the Far East, 1973), pp. 8, 13.

Lack of phosphate in the diets of northern and northeastern children causes serious cases of bladder stones. Iodine deficiency develops into enormous goiters for almost the entire adult population in certain isolated villages.[49]

Causes of malnutrition. In nearly all Thai investigations, the reasons for the deficiencies in diet were cultural as well as economic. The proper foods were available, even plentiful, but customs dictated dietary restrictions for pregnant and lactating women and children were not supposed to eat eggs. In weaning, a very protein-deficient mixture of rice soup and crushed banana was given. Incidence of beriberi increased in areas of commercial rice milling which stripped important nutrients from the grain.[50]

Economic poverty in Thailand sometimes was indicated as the main cause of nutrient deficiency. One survey reported that first and second degree malnutrition affected more than 50% of the pre-school children in ten poor villages of Ubol province in northeast Thailand. Nearly all the ten- and eleven-year-old school children in one Central Plain village were missing their noonday meals,

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[49] BP (Dec. 11, 1975); Jacques M. May with collaboration of Irma S. Jarcko, The Ecology of Malnutrition in the Far and Near East (Food Resources, Habits and Deficiencies) (New York: Hafner, 1961), pp. 156-157; Hauck et al., p. 68; and FAO, p. I-1.

[50] Lindskog, pp. 15-16; May, p. 144; and Hauck et al., pp. 42-44.

and in a large provincial capital in the north, ten percent of the primary schoolchildren missed their lunches, while all the secondary school children had lunches. The secondary school enrolls children from richer families, on the average, than the primary schools. All studies indicated much higher protein consumption among city dwellers than among rural dwellers in Thailand.[51]

Western observers have claimed that these deficiencies affect the appearance of Thai children and their growth. One doctor described the infants and pre-schoolers he examined as flabby, listless and "generally retarded." With age, more signs of nutritional deficiencies were noticeable, indicated for up to 25% of all the children he encountered. Accurate measures have revealed that, although Thai birth heights and weights were equal to that of middle class American whites, by six months of age Thai babies were ninety-five percent of the American babies' height, seventy-five percent in weight, and by age six and ever after the Thai children were only ninety percent as tall and seventy percent as heavy.[52]

No Thai studies have been found, and perhaps none have been attempted, which link poor diets and growth to measured mental retardation or limited learning

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[51] BP (Oct. 3, 1974); FAO, p. A-34; Royal Thai Government, Report of the Interministerial Working Group for the Development of National Food and Nutrition Policy Guidelines for Thailand (Bangkok: n.p., 1973), pp. 42, 61; and Hauck et al., pp. 39-40.

[52] May, pp. 157-158; Sohan Manocha, Malnutrition and Retarded Human Development, p. 52.

abilities. As in nations with many more advanced research institutions, this linkage probably may never be established without question, because the factors surrounding human development are almost too complex for isolation and longitudinal observation and experiment on children is absolutely immoral and illegal in many countries, including Thailand. But some discussion is merited by the data presented above.

Problems in evaluation for parents. Nutrition has such a long-range effect on development that it is too much to expect rural Thai parents on their own to associate infant diet with adolescent intelligence or even children's physical growth rates and achievement, in contrast to the more immediate effects observable in crop cultivation practices. It is possible, but the investigators reviewed do not discuss it, that deprivation in infant diet relates to an unvoiced if not subliminal survival ethic derived from generations of experience that the newborn and small children must demonstrate the strength to overcome nutritional handicaps. High fertility, even among the rural poor, insures that a weakly infant soon can be replaced.[53]

Despite these observations, it readily becomes obvious to any investigator that rural Thai parents become

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[53] Nibhon Debavalya, (abstract of) "A Study of Female Labor Force Participation and Fertility in Thailand" (University of Pennsylvania, 1975), in DAI 36/12, p. 8328-A.

as attached to their little children and concerned about their children's health as parents do in any culture. They are almost as quick to adopt popular fads such as bottle-feeding and canned, highly-processed and sugary baby foods as do their urban relatives. As in every culture, the problem of improving mother-and-child nutrition lies as much in detecting misinformation in prejudice, gossip and popular media as it does in obtaining scientific information from authorities and the more responsible media. And in this respect the rural Thai parent is poorly prepared to evaluate such information. It can be concluded that Thai parent farmers lack energy, as information and as the means to obtain information, either to improve diets for their children or to know that the diets should be improved.

Phrasing one conclusion in energy-related terms does not make such terms critical to every analysis of farmers as educators for themselves and their children. From the information presented in this section one might conclude without reference to energy that Thai farmers can and do educate well themselves and their children for the improvement of agricultural production but not so well with respect to nutrition. Therefore good health and its enhancement, a key element of rural life development, requires more attention. In recommending an alternative or solution, however, reference to energy expedites explanation: the parents need information, an example before them, which just does not appear on command. Even if the parents perceived the need, someone or some organization must have the means to respond to it.

Potential for energy analysis. For food production and learning about food production, Thai farmers already understand efficiencies and net outputs with respect to labor inputs and the relative advantages of technology, credit and access to land. They appear to have little difficulty learning how and knowing when to work more diligently or efficiently and to risk limited resources in experiments or innovations. Therefore, Thai farmers are receptive to demonstrations and arguments involving energy constructs. Probably no other basis for learning serves as well as energy concepts for small farmers whose entire lives revolve around the acquisition and application of energy. Among poor Thai farmers, parents and rural laborers, money is perceived in terms of the days and seasons of effort to obtain a little cash. With minimal land or no clear title to it, credit consists of neighborhood loans in labor. Investment is contributing one's own labor to neighbors or for a community project. Capital includes energy-controlling land, tools, and information.

On the other hand, it is difficult to create demonstrations of the potentially-critical, long-range consequences of nutrition, communication-and-care, environmental exploitation and commercial organization. Who in rural

Thailand commands the understanding, motivation, opportunity and credibility to present convincing demonstrations, arguments and suggestions to farmers and parents? Poor rural Thai farmers themselves do not have the resources but they could understand and benefit from such energy-related demonstrations, arguments and suggestions.

That leaves Thai teachers, leaders and outside agents to consider. What kind of demonstrations could and would they sustain for farmers and parents? Do energy constructs even have meaning for non-farmers?

Rural Teacher Perspectives

Two distinct kinds of village teachers are common in all parts of Thailand: the Buddhist monks and government school officials. Motivation for each to promote rural life development is evaluated in this section. Of particular relevance are the relationships between monks, school teachers, and rural farmers and parents. But the most important concern is to determine whether or not village teachers can learn about and demonstrate, in meaningful, energy-related terms, the consequences of nutrition, communication-and-care and technology, for individual and community life development.

School teacher roles. The Thai people have erected an imposing system of elementary, secondary and vocational schools, teacher training colleges, technical training institutions, and universities. The Thai expect schooling to make them or their children literate, moral, cultured, modern, intelligent and skilled for nearly every conceivable occupation, particularly in commerce, government work and teaching. However, despite the institution of classes in agriculture, agricultural schools and colleges, and university faculties devoted to agricultural development, and some evidence that formal study contributes to agricultural productivity, most Thai people do not consider that schooling is a preparation to be a farmer.[54]

But school teachers fulfill roles in rural communities other than that of classroom instructor, as parents, part-time farmers, religious leaders, and advisors or go-betweens for sources of information for a variety of interests: health, law, politics, the arts and community development. People in rural areas award teachers respect almost as much as they respect Buddhist monks, and people expect the teachers to exhibit high moral character, no more than average material ostentation, but more than

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[54] Chalio Buripakdi, (abstract of) "Education for Agricultural Development: An Attempt to Plan Education to Improve the Productivity of Rice Farmers in Thailand" (Stanford University, 1971), in DAI 32/3, p. 1180-A; Dharm Tesna, (abstract of) "A Model for Education in Agriculture in the Private Agricultural School" (University of Wisconsin, 1968), in DAI 28/7, p. 190; Prudhisan Jumbala, editorial, BP (Aug. 19, 1974); and Chi-wen Chang, Rural Asia Marches Forward Focus on Agricultural and Rural Development (Los Banos, Laguna, P. I.: University of the Philippines, 1969), pp. 30, 40.

average community spirit, in addition to wisdom in learned matters.[55]

On the one hand, therefore, school teachers are supposed to act as the model citizen, a diligent, community-oriented example for all, but at the same time provide aid for the children to virtually escape the community, to become educated "above" the farmer and succeed in fulfilling an urban, non-laboring position, able to participate in all the modern consumer roles and pleasures. The ambiguity, if not contradiction, in these expectations leads rural teachers to become hypocritical, inconsistent and ineffective in their work. The schooling system in Thailand may be characterized as one with enormous waste of energies with respect to its potential value for rural life development, and perhaps with respect to overall economic growth as well.

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[55] James L. Compton, (abstract of) "Factors Related to the Role of the Primary School Teacher as a Mediator-Facilitator in the Communication Process between the Rural Village Community and the Larger Social System in Northeast Thailand" (University of Michigan, 1972), in DAI 33/11, p. 6044-A; Frederick J. Baker, in "Community Development in Northeast Thailand: A Descriptive Study of Radio Station 909, Sakon Nakorn, As an Educational Vehicle for Change," unpublished Ph. D. dissertation (Michigan State University, 1973), p. 117, described the activities of one business and agricultural development-oriented teacher. The career of an almost-saintly, devoted young woman as a teacher in a Bangkok slum has been followed closely in the press: BP (April 19, Dec. 29, 1974, April 9, 1976). Thai citizens, students and journalists become incensed at the slightest indication of misbehavior among teachers or possible corruption among school officials: BP editorial pages (for Nov. 5, 1974 and June 17, 1975).

Teacher behavior. Other than for non-farm employment, Thai parents do not perceive formal school learning as contributing to any aspect of rural life development which will benefit themselves. Rural parents have not been reported to articulate a view that, through extended learning, children achieve better health or skills in planning, or become more creative or democratic.

Even if parents considered and supported these values, evidence exists that Thai schools, teachers and activities hardly begin to promote such values, despite official pronouncements and curriculum statements that raise such objectives at every level of formal education.[56] In classes, children are exposed to dull lectures and texts, perhaps once a week, on good health practices. Outside class, teachers do not exhibit any more superior health or nutrition practices than others in the community. Creativity is not rewarded at all in Thai schools. But teachers, having more leisure time than people in other professions, tend to lead others in promoting and participating in community cultural activities. As for scientific attitude and planning skills, most Thai teachers rarely approach even science subjects with experimental or problem-solving techniques. In the community, teachers do

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[56] Royal Thai Government, Ministry of Education, Syllabus for the Lower Elementary Education, -Upper Elementary Education, -Lower Secondary Education, -Upper Secondary Education (Bangkok: Kurusapha Ladphrao Press, 1969); and any catalogue or student handbook from a Thai university.

not exhibit any more success in planning their lives than their neighbors. And often, teachers are relatively isolated from everyday community life, as the government allocates funds to provide teachers with free housing on school property.

Thai teachers may lecture about democratic institutions and constitutional rights, but in class, like many teachers in other cultures, they tend to be very autocratic, demanding absolute attention, obedience and respect. They rarely encourage disagreement, individual inquiry, and cooperative ability to reach consensual harmony in a heterogenous group. Outside the classroom teachers may participate more in local and national political activities than the average citizen. But attitudes range from the very conservative who favor military control and repression of populist movements to those who support radical socialist ideas and farmer participation and power in government. In sum, in and out of the classroom, most Thai teachers demonstrate preferences for urban locations, vocations and leisure activities, and seldom exemplify for students or neighbors interest in or promotion of rural locations and agricultural work.[57]

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[57] Arom Tanpraphat, (abstract of) "A Study of the Relationship Between Creativity, Academic Achievement, Scholastic Aptitude, Sex, and Vocational Interests of Tenth Grade Thai Students" (University of Northern Colorado, 1976), in DAI 37/1, p. 119-A; Boonyuen Chiraphongse, (abstract of) "A Study of the Characteristics of Elementary Science Teachers in Thailand and the Competencies Needed for Improving their Teaching" (Kansas State University, 1975), in DAI 36/9, p. 5967-A; Paitoon Sinlarat,

As boring, static, uncreative, non-analytical, and irrelevant as most classroom activity is in relation to current student and community interests, few Thai teachers recognize the reasons for student apathy, ignorance and lack of progress. Teachers are apt to blame the official curriculum as unclear, overloaded or inconsistent with aims, or teachers complain about low pay, excessive administrative duties and bureaucratic restraints, or teachers consider the home or social environment as the cause of student failure and unrest.[58]

Lack of direction. Foreign researchers or advisors, many of whom have spent little time in rural

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"Education and Contemporary Thai Society," in Louis J. Setti and Amnuay Tapingkae (eds.), Education in Thailand Some Thai Perspectives (Wash. D. C.: U. S. Dept. of Health, Education and Welfare, 1973); Suchart Sawadsri, "Life in the University," in Setti and Tapingkae (eds.); Vinita Diteeyont, (abstract of) "Consistency Between Teaching Methods and Teaching Purposes of Instructors at Silpakorn University, Thailand" (University of Northern Colorado, 1976), in DAI 37/4, p. 1957-A; and the present writer worked for six academic years in Thai rural secondary schools and a regional university, and during that time lived in close association with Thai teachers of all levels, backgrounds and interests. Robert Gurevich, in Khru: A Study of Teachers in a Thai Village (Pittsburgh: University of Pittsburgh, 1972), confirmed the assessment above. Gurevich worked and conducted research among rural Thai elementary school teachers for many years.

[58] Somporn Buatong, A Study of the Primary School Curriculum in Thailand (Summary) (2nd ed. rev.; Bangkok: Bangkok Institute for Child Study, 1968); Niphon Kantasewi, "Some Aspects of Education and Economic Development," in Setti and Tapingkae (eds.); BP (Dec. 20, 1970), reporting a lecture by Phayom Wanasiri; and Royal Thai Government, Ministry of Education, Instructional Support Department, Research Section, (summary of) Situation of Teachers in Thailand 1959, in Royal Thai Government, Ministry of Education, Summaries of Educational Research....

Thai schools and communities, often accept these teachers' views at face value.[59] But more perceptive Thai researchers and administrators have pointed at fundamental problems in the quality of teachers and the lack of supervision and cooperation to improve teaching and inspire teachers to become better examples for students and their communities. Primary and secondary teachers are not expected to organize classes any more scientifically, creatively, democratically and with rural interests in mind than they observed in training or higher education.

Research has indicated that lecturers and professors in teacher training institutions and faculties of education in Thailand do not provide a good example for those who would become rural teachers. Rather, these higher instructors are urban-oriented and tend to provide academic material for further study rather than preparation for competent classroom practitioners. Few of them even originated from farm families. And supervisors at all levels, including higher education, also do not exhibit any behavior, other than verbal exhortation, to inspire teachers or the teachers' teachers to promote rural life

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[59] For examples: Nicholas Bennett, "Primary Education in Rural Communities: An Investment in Ignorance?" Journal of the National Education Council 6 (Thailand: Oct. 1971); Audrey W. Gray and Alton C. Straughan, Jr., Education in Thailand A Sector Study for USOM AID (Bangkok: n.p., 1971), p. 235; and William P. Fuller, "Research for Educational Planning in Thailand, Comments and Suggestions for the National Education Council" (mimeo; Bangkok: National Education Council, 1972).

development. In any case, teachers seldom encounter supervisors who have an active responsibility to improve teaching.[60]

On the other hand, no evidence has been located which indicates that teachers, at all levels, conduct themselves in any way other than that which people in the society expect. Rural bias lacks visible expression. Journalists, politicians and professors who proclaim the need to promote rural life development or just agricultural productivity do not show the way by example. Agricultural vocational school and college lecturers devote much more effort preparing students for higher study and displaying their own preferences for an urban lifestyle than in trying to help students become scientific, creative farmers. But in this they are conforming simply to demand and their own desires to gain higher degrees, the prevalent ambition among all levels of teachers. Higher status and higher salaries depend only on academic qualifications, longevity in service and ability

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[60] Chiraphongse; Kantasewi; Ratana Tamboonteck, An Analysis of College Teachers' Conceptions of Goals in Relation to Their Practices with Implications for the Improvement of Secondary Teacher Education in Thailand Bangkok: Khurusapha, 1969); Wisit Chumvaradhayee, (abstract of) "College Teachers' Perceptions of Needs in Their Instructional Role in the Preparation of Secondary School Teachers in Thailand: Recommendations on College Staff Development" (Columbia University Teachers College, 1976), in DAI 36/12, p. 7999-A; Gurevich, p. 193; Niched Suntornpithug, (abstract of) "A Study of the Evolution of Teacher Training in Thailand: Toward a Model for Development" (University of Southern California, 1974), in DAI 35/5, p. 2832-A; and Royal Thai Government, Summaries of Educational Research..., pp. 2-3.

to pass civil service examinations, not scientifically- or objectively-evaluated competence or diligence in teaching.[61]

Given the close conformity of teacher's behavior with social expectations, and research which indicates that in Thailand reading and other academic achievement relates highly to family socio-economic status, one may wonder just what impact teachers have on rural youths and rural communities. No evidence has been found that the extensive upgrading in teacher education and training has had any effect for the better (or worse), in relation to patterns of achievement, attitudes or ambitions by students. After several decades of rapid expansion in training institutes and higher education, with the result that nearly all teachers now have training or degrees or both, the effort has had little, if any, impact.[62]

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[61] Royal Thai Government, Situation of Teachers...; Delbert W. Shirley, "Normative Expectations Held by Agriculture Teachers and their Significant Others of the Professional Role of the Agriculture Teacher in the Vocational Agriculture Schools and Colleges in Thailand," unpublished Ph. D. dissertation (Michigan State University, 1966); and Harold Freeman, (abstract of) "The Role of Agricultural Education in the Economic Development of Thailand" Stanford University, 1965), in DAI 26, p. 154.

[62] Chancha Suvannathat, Niyom Kamnuanmasok, and Ladtongbai Bhuapirom, Summaries of the Study of Social Influences on the Development of Thai Children in the Village of Ban Pranmuen and U-meng (Bangkok: Kurusapha Ladprao Press, 1971); Boonying Charoenying, "A Study of Children's Social Relationships in the Classroom," in Summaries of Three Studies...; Willis P. Porter, The College of Education, Bangkok, Thailand A Case Study in Institution Building (Pittsburgh: Graduate Institute of Public and International Affairs, 1967), p. 9; Royal Thai Government, Ministry of Education, Educational Planning Office, Report on Education

It would be difficult to establish in Thailand that the school-college-university structure generates economic growth or development. The indications, from the data reviewed for this study, are that the formal educational structure actually inhibits rural life development.

Attempts to reform. In recent years, however, stronger efforts have been made among some in the academic and government leadership in Thailand to promote literacy and productivity among the rural poor. Three Bangkok universities are cooperating to investigate the economic, ecological and social structure of an entire river valley southwest of the capital, inhabited by two million people, in order to determine the soundest development policy for the region. The Rockefeller Foundation contributes advice and funds for this effort. Projects to promote knowledge about agricultural technology, family planning and current events have been instituted in selected rural communities in every region, in an organized attempt to distribute popular and scientific media beyond commercial and government administrative centers. But non-formal education in the provinces remains heavily oriented to academic achievement and urban vocational skills. And despite criticism and suggestions (but not demonstrations) from Thai researchers and authorities, higher education remains remote from rural life development and organized

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for the Year 1971 (Bangkok: Khurusapha Ladphrao Press, 1973), tables 10, 11, 13; and Fuller, p. 28.

community education for rural dwellers.[63]

Also in recent years, Thai intellectuals have attempted to provide a foundation for scholastic and academic reforms by investigating, explicating and relating Buddhist religious philosophy and practices to Western psychology, pedagogy and philosophy. Saroj Buasri, the pioneer of this movement, compared scientific problem-solving to Buddhist logic in approaching solutions to unhappiness, and found many parallels. Buddhist

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[63] International Council for Educational Development, Education in the Nation's Service Experiments in Higher Education for Development Final Report (New York: ICED, 1975), p. 5; South East Asia Ministers of Education Organization, Seminar on Non-Formal Education Final Report (Bangkok: Allied Printers, 1971), various reports by Thai participants; Royal Thai Government, Ministry of Education, Education in Thailand 1971 (Bangkok: Kurusapha Ladprao Press, n.d.), p. 61, and Report...1971, pp. 19-22; Karl W. Deutsch, in "Social Mobilization and Political Development," in Jason L. Finkle and Richard W. Gable (eds.), Political Development and Social Change (New York: John Wiley & Sons, 1966), and BP (June 19, 1975), reported on media circulation in Thailand; Chamrieng Bhavichitra et al., The Study of Socio-Economic Aspects and Leadership Characteristics of Rural Youths at Mu Ban Manao Wan, Tambon Manao Wan, Amphoe Phatthana Nikhom, Chagwat Lop Buri (Bangkok: Dept. of Sociology and Anthropology, Thammasat University, 1974); Royal Thai Government, Ministry of Education, Dept. of Vocational Education, Vocational Promotion Division, Mobile Trade Training Schools and Polytechnic Schools 1970 Report (Bangkok: Bangkok Polytechnic School, 1970); Tongyoo Kaewsaiha, (abstract of) "Towards a National Model of Adult Functional Literacy Education in Thailand" (The Florida State University, 1975), in DAI 36/12, p. 7809-A; BP (Sept. 9, 1973), remarks by Boonrod Binson, Minister of the State Universities Bureau; Pragob Kunarak, (abstract of) "An Analysis of Processes for the Development of a Comprehensive Master Plan for Community Education in Thailand" (Kansas State University, 1975), in DAI 36/5, p. 2540-A; and Vichit Chandhrakul, (abstract of) "The Community College Concept: Implications of Its Functions to Teachers' Colleges in Thailand" (University of Southern California, 1976), in DAI 37/3, p. 1423-A.

belief in intelligence and wisdom are compatible with democratic ideals of sharing, cooperation and participation, Dr. Saroj argued. Self-realization, civic responsibility, ethical human relationships and other virtues of the Good Life were shown to be learning experiences under the Noble Eight-Fold Path to Right Living in Buddhist thought. Subsequent advocates concentrated on current learning theory and the Buddhist goal of seeking Nirvana, Non-Self, through perception, understanding, meditation and intuitive insight, in order to achieve inner peace, develop compassion for others and become a morally whole, non-self-centered person.[64]

Local Buddhist monks. So far, Thai Buddhist theorists have not established any connection to popular Buddhist learning practices centered in village monasteries, which, according to one observer, "...did not have any special aim or philosophy." Monks and former monks were often the only literate rural inhabitants, the monastery contained the only collection of literature, and the monks preached and taught each other and the villagers,

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[64] Saroj Buasri, Buddhism and the New Education (in Thai; Bangkok: Khurusapha Press, 1967); Amnuay Tapingkae, "The Buddhist Theories of the Learner and of the Teacher," in Setti and Tapingkae (eds.); Saeng Chandrangarm, "Some Principles of Education in Buddhism," in Setti and Tapingkae (eds.). Bateson speculated that Buddhist forms of meditation, Yoga and other Eastern practices lead to or are "Learning III," or "learning to learn to learn," because fundamental personality changes may be a consequence: Steps to an Ecology of Mind, pp. 301-305.

operating the only organized learning center in rural life. But the learning itself tended to be very basic: literacy training, rote repetition of religious language, and listening to simple moral messages. In rare instances, monks with extraordinary leadership ability might become community developers, but those with unusual learning skills were and still are promoted to urban, then metropolitan monasteries devoted to the "highest" intellectual interests.[65]

Most monks of village origin and career monks sent to be abbots of village monasteries have so much routine activity, in daily prayers, religious rites for the laity, annual festivals and learning by rote, that very seldom is any kind of community learning center for self-development established, and then only for the few years that the leader remains a monk or in the vicinity. Monks have important moral, emotional, and cultural functions to perform in rural communities, but the intellectual mode in which they usually operate and their particular interests have little to do with the values of rural life development formulated in this study.

Monks are concerned with moral conformity, not cultural creativity. They are organized hierarchically and oriented to obedience to authority and paternalistic

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[65] Patya Saihoo, "Education and Society," in Setti and Tapingkae (eds.); S. J. Tambiah, "Literacy in a Buddhist Village in North-East Thailand," in Jack Goody (ed.), Literacy in Traditional Societies (Cambridge: Cambridge University Press, 1968); and Baker, p. 122.

superiors, though concern for the well-being and development of inferiors is a democratic attribute. Thai monks demonstrate good health in abstaining from liquor but indulge heavily in tobacco. In any case, Thai people tend to view ascetic practices in moral terms, not important for physical health. And, as indicated above, scientific planning or problem-solving methods have been related only at the most intellectual levels. Ordinary village monks have little or no contact with the literature, nor have the promoters demonstrated how such ideas may become operational or relevant for rural communities.[66]

Teachers' potential energy. Rural Thai school teachers, as described in previous pages, and like rural Thai monks, are seldom action-oriented to community development, although the village school, like the village monastery, exists as a potential center from which to promote rural life development. Energy in the structures has been invested already and villagers are oriented to both school teachers and monks as potential sources of

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[66] J. A. Niels Mulder, Monks, Merit, and Motivation: Buddhism and National Development in Thailand (Dekalb: Center for Southeast Asian Studies, Northern Illinois University, 1973); Jane Bunnag, Buddhist Monk, Buddhist Layman: A Study of Urban Monastic Organization in Central Thailand (Cambridge: University Press, 1973); and Charles F. Keyes, in "Buddhism and National Integration in Thailand," Journal of Asian Studies 30 (May 1971), described the political relationship of the Buddhist Order of Monks and the Thai government. For a review of the structure, function and philosophic base of Thai Buddhism, see A. Thomas Kirsch, "Complexity in the Thai Religious System," and articles by three other authorities, in Journal of Asian Studies 36 (Feb. 1977).

information and guidance. But school teachers mainly promote urban values or information most useful in urban life, and monks serve mainly as preparation for one's next life, as villagers commonly and fervently believe that supporting and listening to monks increases one's store of moral merit, the best way, perhaps the only way, to improve one's station in the next life.

The strength of villagers' beliefs and expectations regarding the services that monks and teachers should provide have helped to prevent any apparent success in plans designed to prepare and establish teachers as promoters of rural development, such as the "Thai-Unesco Rural Teacher Education Project." Teachers given all kinds of training and inspiration to become development leaders soon find themselves isolated from examples, strangers to the community and lonely for the urban peer pleasures they enjoyed for so many years, and suddenly realizing that development leadership is a lifetime task, not an attribute automatically inherited by being appointed a teacher.[67]

Thai teachers need just a little information but no new learning skills to use energy analysis to determine their net product and efficiency among alternative teaching methods. But because school budgets, teachers' salaries and the organization of schooling are not based

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[67] Gurevich; and Ronald C. Nairn, International Aid to Thailand The New Colonialism (New Haven: Yale University Press, 1966).

on and are seldom relevant to the local economy, the local teacher does not have much control over the methods he may or may not use. The analytical procedure suggested in Chapter Two might establish that individual or family tutorial systems have energy advantages, and with respect to farm children, economic advantages, compared to the constituted school-centered system. But an enormous amount of additional information would be required to alter the beliefs of not only those who control the finances, regulations and planning of the present school system, but the popular and long-held associations that going to school prepares one for going to a city job. This information has begun to accumulate, in the form of rural community research and media reports about urban violence and unemployment because of fuel and food price inflation. But, in Thailand, academic research results enjoy little influence among political decision-makers, and the popular media remains of questionable credibility, if little exposure, among rural audiences.

On the other hand, there are few serious energy restraints against a Thai teacher who decides to become a stimulus to rural life in the community. The teacher possesses several advantages over a farmer for this role: a secure and adequate income with which to provide self and family with food and environmental protection; information about how to obtain various kinds of information; and a trained learning capacity with which to translate information into plans and evaluative data or tools, including at least an awareness that such a thing as scientific method exists and might be relevant to any task.

The most serious energy restraint lies in the lack of communication-and-care encouraging the rural teacher to become a patient and imaginative promoter of rural community life. Significant models for behavior to the teacher, former teachers and current administrative superiors, are themselves not rural educators and do not demonstrate the rewards of so being to the school teacher. Community neighbors, if it occurred to them, do not encourage such behavior. And the teacher's own family may be actively discouraging, hoping for administrative, educational, and what may appear to be geographical advancement to ever-larger urban centers or scholastic institutions.

A second restraint for teachers consists of receiving insufficient or misleading information about their potential role as a development promoter, while in training under those with little experience in or understanding about rural life development. Most Thai training programs or sub-programs for teachers concentrate on agricultural productivity, as if Thai farmers were not already productive, quick to respond to market opportunities, and technologically innovative when the advantages are clear. But potential development promoters receive little or no information about the value of and how to become examples of and encourage in others a healthy, creative, scientific and democratic lifestyle, one which is compatible with society in a rural Thai village or small market community.

Perhaps the most difficult problem is democratic leadership: how to develop it personally and encourage it in others. Rural Thai communities, with a plentitude of solar energy, probably tend to anarchy in more activities than to cooperation, and urban influences, where they intervene, may tend to promote competition. Teachers stationed in rural communities can not expect to become leaders or encourage leaders who promote cooperative activity and solidarity unless the teachers are motivated to spend decades in the neighborhood. It takes patience to learn about the people and find ways to encourage or enhance the best in everyone. Only outstanding motivation results in an outstanding example of an honest, fair, empathetic and community-oriented person. A teacher with motivation has the greatest opportunity to know people and relate to their problems, because the teacher has close association or immediate access to almost every family in the community, through their children.

Conclusion pessimistic. But from where will the motivating energy or information be derived? The surrounding material environment may depress or bore more than it stimulates or pleases. Significant others, one's own teachers and administrative superiors, provide only counter-examples. And ordinary villagers expect an urban orientation.

Ordinary farmers also know more about and probably would respond more adroitly to energy-related analyses than village school teachers with urban and commercial backgrounds or ambitions. Without extensive intercession by supervisors or higher academics, it appears unlikely that teachers would attempt to resolve questions or employ findings about nutrition, communication-and-care and technology, even to improve school learning. And for rural teachers to become participants in rural life development, the normal expectations of both their clientele and their superiors have to change radically.

This assessment may seem unduly pessimistic. One may argue that many rural teachers exemplify very rational, creative, empathetic, frugal, hard-working, and community-oriented behavior. And most Thai people, even in poorer areas such as the northeast, have access to teachers. It would follow that, if exemplary teachers only were aware of the potential benefits and methods of energy-based analysis for promoting rural life development, these teachers would be enthusiastic to experiment with, demonstrate and broadcast findings.

Unfortunately, no published evidence has been located to support this argument. But if it were true, there still would remain the problem of resources with which to make rural Thai teachers aware of possible energy, learning and rural life development relationships. Then the concerned teachers would need resources for experiment and to exchange information with farmers and parents.

But another rural resource has not yet been considered, the local leadership. Elected headmen, appointed government officials and respected elders are significant to village teachers and local farmers alike. Leaders can sway opinion and inspire support for projects. A teacher or anyone with an idea of potential benefit to the community might attract considerable material and moral commitment from a leader. The possibility is discussed in the following section.

Rural Leadership

In whom do villagers place their trust for political and economic leadership? How do rural Thai leaders function? Would they understand, approve and support energy-related research and experiment? How interested would they be in change to community learning for rural life development? These are the essential questions to resolve in the present section. The guiding assumption for this discussion is adopted from the diffusion studies of Everett Rogers: to promote worthwhile innovations in learning or any activity, opinion leaders in a group first must be convinced about the advantages. And because of the prevalence of patrimonial relationships among Thai people, it is very risky to try to bypass traditional or local leaders in promoting new ideas or projects.

Who the leaders are. A Thai village farmer suffers no lack of candidates who might become the farmer's leader for all economic and political matters: a hamlet headman, a prosperous kinsman, the traveling fertilizer salesman, the market produce-buyer and moneylender, a monastery abbot wise in worldly affairs, an ambitious professional teacher, herb-doctor, policeman or government extension agent, or the local campaign organizer for a Bangkok political party, several or many of these kinds of potential leaders may be located in or near every village in the country. Paternalistic and factional rivalries in business and politics extend down to and throughout rural community life and account for much of the present violence in Thai society.

But a villager has use for leadership and therefore must choose a leader carefully: "At every level, patron-client entourages carry out the political functions of disseminating information, allocating resources, and organizing people, cutting across bureaucracies and extra-bureaucratic structures."[68] Without effective and considerate

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[68] Clark D. Neher, The Dynamics of Politics and

leaders, no vital information reaches the farmers and they are unprotected against political and economic exploitation. It happened to three thousand farm families in notorious Thung Son sub-district. Expecting to receive title to about twenty acres each of the land they had been working for years, they found instead that most of the property went to local teachers, headmen, administrators and other government officials.[69]

It would seem that the village or hamlet chief could serve the community best, as a permanent resident who knows everyone in the neighborhood, as an official and respected spokesman for the people, and recognized by government administrators. But Neher found that northern Thai villagers disliked being headman because of all the conflicting pressures, the lack of renumeration for the time given and the real danger from economic lords, criminal elements or political factions attempting dominance in the area. The most effective chiefs, Neher concluded, were those of superior wealth and status among villagers, who did not have to depend on an external patron for security. A poor villager chosen chief would likely be or become dependent on outsiders and identify

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Administration in Rural Thailand (Athens, Ohio: Ohio University Center for International Studies, Southeast Asia Program, 1974), pp. 73, 84.

[69] BP (Dec. 11, 1974). Turton found that "gun law" prevailed in many northern rural districts, that merely ten percent or less of all homocides ever reached the courts. Only about half the homocides even were reported to authorities.

with the patron in conflicts of interest. Hanks noticed a similar effect in central Thailand, that the closest relationships among villagers occur when significant differences in wealth are present and one person becomes the leader-benefactor of all.[70]

Effectiveness. Independently secure economically, a villager can delegate responsibilities in operating his own farm and carry out the duties of headman. Duties consist mostly in interceding in external matters on behalf of fellow villagers. The latter may lack the energy in subordinate labor and information with which to represent their own interests in conflicts or in securing rights with landlords, lawyers, merchant moneylenders and government officials. But the numbers of successful headmen have not been extensive. With the improvement in road transport and increasing demand for agricultural produce, landgrabbing and tenancy have become rampant in northern Thailand. As northern farmers had been relatively egalitarian in wealth and not subject to commercial pressures, they had not developed a core of effective headmen. Only in recent years northern villagers

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[70] Leading Hanks to conclude that "...social stability in Thailand...may be better served by encouraging the development of differences in wealth rather than by striving for social equality:" Hanks, Rice and Man, pp. 117, 89; Neher, pp. 46-47, 53. Mizuno summed up rural Thai characterizations of a good leader: one who is relatively wealthy, honest, moral, well-educated, devout in Buddhism, unselfish, gentle, condescending in manners, generous and benevolent to followers, and full of persuasiveness.

have begun to increase their use of headmen. A large proportion come from the "rich peasant" class and have proven to be enterprising and ambitious.[71]

Why must rural Thai people rely on fellow villagers for protection? Does the law and constituted government not serve their interests? Many villagers believe that government has legal and moral obligations to aid and protect them. When government officials display willingness to help, Thai villagers tend to cooperate, as long as they perceive that the government aid does not incur an unusually heavy obligation. Traditionally, however, villagers avoided any involvement with officials. As Hanks observed, the people "...accepted the government community very much as they accepted the occasional cobras that crawl in shaded paths and lurk along the canal edge. If one were normally wary, nothing much happened in meeting them." Comparing sixteen studies of Asian governments, Uphoff and Esman ranked the Thai next to last in strength of downward and upward linkages, last in nearly all indicators of rural political-administrative participation, electoral participation, popular control of the bureaucracy and popular influence in rural development policy and resource allocation, fourth from last in the provision of services by local organization, and in the next to last of five groups with respect to access to

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[71] Michael Moerman, "A Thai Village Headman as a Synoptic Leader," Journal of Asian Studies 28 (May 1969); and Turton.

justice and protection from natural disaster and violence.[72]

Paternalism and centralized organization restrain government officials from becoming more closely identified with villagers, their problems and their progress. Officials depend on personal relations with superiors for promotions in responsibilities and transfers to more comfortable locales. To avoid any chance of making a mistake and consequent embarrassment for patrons, subordinates tend to refer decisions to higher levels. Where decision is unavoidable, officials rely on laws, regulation, procedures or precedents established by the Bangkok government or ministry authorities, allowing no regulatory flexibility with which to meet local differences, and stifling initiative in response to individual problems. Unfortunately for the villagers, often they must refer to government officials in order to resolve intervillage disputes and to repress banditry.[73]

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[72] Baker, p. 24, and on pp. 35-36, reviewing Stephen B. Young, The Northeastern Village: A Non-Participatory Democracy (Bangkok: n.p., 1966); Neher, p. 81; Hanks, Rice and Man, pp. 110, 142; and Norman T. Uphoff and Milton J. Esman, Local Organization for Rural Development: Analysis of Asian Experience (Ithaca: Cornell University Development Committee, 1974), pp. 28, 46, 56, 126.

[73] Herbert J. Rubin, "Will and Awe: Illustrations of Thai Villager Dependency Upon Officials," Journal of Asian Studies 32 (May 1973); and David F. Haas, (abstract of) "Interaction and Role Making in the Thai Bureaucracy" (The University of Wisconsin-Madison, 1976), in DAI 37/8, p. 5366-A. Daniel Wit, in Chapter V, A Comparative Study of Local Government and Administration (Bangkok: Kurusapha Press, 1967), described Thai government antecedents, influences, processes and changes through the post-World War II period.

In modern times, however, as many as half of the administrative offices in district centers have some kind of social service as their prime responsibility, rather than regulation. Among 145 community development projects that Fred Baker and his Thai counterparts investigated during a two-year period in the northeast, 84 were initially stimulated from some government source, and 46 actually were led by government administrative officials. In two of the three northern districts which Neher studied, officials had helped organize farm marketing groups and a district-wide irrigation association. Village organizers or advisors from the Community Development Department at district centers receive incentives to stay overnight in the villages assigned to them. The central government assigns community development tasks to military units. The government requires doctors who received scholarships to serve in the countryside. And the government has been operating, for many years, mobile health and sanitation teams to tour poor areas in the northeast. In 1975, the government under Prime Minister Kukrit Pramoj made a special allocation of $150 million for local sub-districts to propose and carry out community development projects. As a result, more than 41,000 projects in 5,000 sub-districts were completed, improving irrigation, roads, schools and health facilities.[74]

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[74] Baker, pp. 50-51, 61-67; Neher, pp. 16-17, 61-64; Toshio Yatsushiro, The Village Organizer in Thailand A Study of His Needs and Problems (Bangkok: USOM, 1964);

At every level of local, sub-district and district leadership, therefore, scientific, creative, community-oriented and moral examples _may_ be found. Without new data, however, it can not be concluded that a large proportion or a majority of villages enjoy such leadership. From reviewing Neher's study and others, a fair, safe estimate would be fifty-fifty. About half the villages in Thailand have good leaders at one level or another, the other half lack protection and helpful services.

Receptivity to energy research and experiment. Scientific understanding of energy constructs and of the possibility of relationships with individual learning and community development presents no obstacle for Thai leaders at any level. Higher officials have the academic background, secondary education and often more, to consider the variables. Village officials have the experience, in farming, in organizing labor and as practitioners of building empathy and communication, to relate the concepts. And Thai leaders, like most rural Thai people, are quite pragmatic. With understanding and no perception of a threat to their own security or that of their followers, they approve of social research. Rural Thailand has been

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Alexander Caldwell evaluated government community development schemes in the northeast as well as efforts to instil a service orientation at the Thai government District Officer's Academy; and _BP_ (March 17, 18, April 8, 25, 28, 30, July 6, 1975).

a most fertile field for both Thai and foreign scholars.

Social experiment, similarly, is not objected to as such. Leaders would approve of apparently beneficial suggestions to farmers and parents involving the conservation of energy through technology, increasing adult communication-and-care activity with children and improving diets for all. But the patrimonial character of Thai relationships can restrain social experiment.[75]

Thai leaders are more oriented to suggestions from superiors than from followers. Rarely, in fact, do inferiors dare to make any suggestions to leaders. For example, a teacher who also is not an established leader in the community would feel very inhibited both in expressing ideas for experiment and in organizing such activity. Secondly, experiments must not appear to infringe upon status. As in many other cultures, in Thailand leaders take great pride in distributing largesse. If an experiment involved giving out nutrient supplements, literature, or new tools, the leader must be involved, or the leader's status would be undermined and an unpleasant situation could arise.

If an educator has information or material to distribute as part of an experiment, however, a local Thai leader would be quite willing to contribute resources to

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[75] One scholar devoted a volume to discussing the problems of Thai patrimonialism: Norman Jacobs, Modernization Without Development Thailand as an Asian Case Study (New York: Praeger Publishers, 1971).

aid in distribution. The leader's prestige is enhanced and the educator's own resources are conserved. No other approach works as efficiently in Thailand.

Convincing a leader to change his lifestyle or personal behavior, as demonstration to others, is another matter entirely. Alcohol and tobacco are detrimental to health and patrimonialism generates rivalry and factionalism, but all are valued in both rural and urban Thai society.

Acceptance of rural life development. Energy analysis could show the proportion of resources devoted to obtaining and consuming alcohol and tobacco and to status-building transactions and competition in a rural community. Such an analysis might convince some Thai farmers, teachers and leaders of the wastefulness, if it also can be related to poor health and destructive relationships. But the best analysis and argument is insignificant compared to the constant approval of "modern" pleasures and "strong man" ideology displayed in Thai media and demonstrated at all socio-economic levels in Thailand.

Certainly there are some Thai leaders and many individual teachers, farmers and parents who choose healthier pleasures and cultivate egalitarian relationships. But they have not been noticed. No data have been gathered to assess possible trends in this direction. It would be easier to show that rural Thai people continue to expend scarce energies on tobacco, alcohol, gambling and guns, while their health, their children's health, their lands and other resources deteriorate and are lost.

No new approaches to overcome these barriers to rural life development are suggested. Thai leaders may espouse the ideals of rural life development overwhelmingly. They may understand perfectly energy-based analyses which recommend behavioral changes and learning programs to facilitate individual and community development. But they probably still would choose to retain present leisure pleasures and patrimonial status. Alternatives must be as personally enjoyable and advantageous or more so. And it is unlikely that leaders content with their positions and lifestyles would be seeking alternatives.

To summarize the problem: rural life development for many Thai communities may be hindered by the unwillingness of local leaders to demonstrate lifestyles which conform to rural life development values. Thai leaders normally are amenable to energy-related research, suggestions and subsidies. But they are unlikely to become actual demonstrators of cultural creativity, democratic relations and healthy living. Therefore, educators from outside are needed, either to inspire established leaders or to serve as demonstrators themselves. Various kinds of outside educators are described in the following section.

Hopeful, Helpful Outsiders

In Thailand, urban professionals, university academics and students, government and foreign technical experts and foreign missionaries, all are involved to some extent in improving rural conditions. Would energy-based analysis aid in their attempts? Could they relate energy-learning constructs to rural life development values, and demonstrate the implications? After these questions are discussed, a brief, overall assessment of energy analysis for rural Thai educators concludes the section and the chapter.

Resources for research. Since the end of World War II, rural research has been widespread and varied in Thailand. Experts from Thai government ministries, foreign scholars and technical experts, and, more recently, scholars from Thai universities, have been active and eager to accumulate data about rural Thai people and conditions. Now there are enough competent, experienced and motivated technicians and academics in Thailand to sustain research without foreign support.

The Bangkok Institute for Child Study, located on the Srinakharinwirot University central campus, and the Agricultural Economics Department of Kasetsart University, have been among the most productive groups in gathering and interpreting rural data. Various government departments gather a lot of information but tend to do little with it. Annually in Thailand there are produced reams of statistics which appear neither to affect policy and programs nor to change in quality and direction.

On the other hand, there have been many lost opportunities to gether important information. Foreign Christian missionaries have been working in remote and poor areas for decades, even generations. They have established schools, clinics, orphanages, churches and handicraft centers. In the process, missionaries have accumulated an enormous amount of information about rural Thai people and conditions. But little of this knowledge has been organized or published.

For nearly twenty years, university student volunteers have been spending summer vacations in the countryside, helping villagers to build schools, health clinics, meeting halls, wells and roads. In 1975, for example, about nine thousand students participated in one hundred fifty work camps, including fifty in the northeast. But the students do not seem to function as learners when they are in rural areas. According to one investigator, the students view themselves as sources of superior information which villagers are supposed to accept along with the free labor.[76]

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[76] BP (March 17, 1975); and Suvit Yodmani, (abstract of) "An Evaluation of Community Development Practices of Development Volunteers in Five Universities in Thailand According to Criteria of a Validated Model" (Boston University School of Education, 1973), in DAI 34/4, p. 1573-A.

In sum, for rural Thai research, the institutions, the talented personnel and the opportunities exist in abundance. Gathering data on energy resources, conversion methods and consequences for learning and community development can be accomplished with minimum effort or no more than the effort required to obtain standard economic data. The problem remains, at least in Thailand, of using the data, any data, to benefit the people from whom the information came. Energy-related data from Thailand would contribute to cross-cultural theory and general recommendations about nutrition, communication-and-care and fuels and tools. But in Thailand, there has been very limited success in translating social theory and generalizations into significant experiments and demonstrations.

Resources for experiment. About eighty government agricultural experiment stations and a dozen university-level farms have been established in Thailand, with highly-educated technicians and sufficient workers to operate the institutions. A lot has been learned about food and fibre production potential in Thailand. Since the fuel energy price increases of 1973, some experiments have been conducted with solar, wind and methane fuel power generation. Thai interest in "appropriate technology" for agriculture is growing.

But a comparable system for experiment in education has not been organized in Thailand. There are no established programs to search for and try better ways to enhance learning skills in the family and in the rural community. There are some facilities to test new texts and instruments for school learning. There are individual educators who attempt innovative approaches in pedagogy. There are projects which qualify to be called experiments in learning for rural development, including the university student work-camp programs, the radio station 909 broadcasts to farmers in the northeast, and village newspaper centers organized by the Adult Education Department. But none have been evaluated as experiment, to find out what consequences the programs have had for rural life development or any kind of significant change. And there is no indication of who might evaluate these experiments, how, and with what criteria.

However, there are resources which could function as "educational experiment stations" in Thailand. Scattered around the country are about thirty teacher training colleges, with well-educated faculties, well-built facilities, and numerous students from villages and small towns. The primary responsibility of these colleges is to train elementary school teachers, although most colleges also have programs to prepare secondary teachers. But to orient part of the programs to experiment, investigation and evaluation would require a fundamental re-orientation of the leadership, and changes to the curriculum. However, if interest in, willingness and the means to change become widespread among college personnel, perhaps teacher training college demonstration activities could be broadened and extended as well.

Resources for demonstration. In contrast to very limited resources presently oriented to experiment in education, there are a variety of resources for demonstrating new skills and ideas in Thailand. But among agricultural extension agents, village-level workers, foreign experts and missionaries, and agricultural school participants, very few are effective as demonstrators.

Foreign missionaries have the most effective approach, which is a long-term commitment to live among rural people, and according to the values espoused. And these western Christian doctors, ministers and teachers tend to be scientific, creative, democratic and healthy. Rural life development has been promoted successfully among minority groups such as Karen hill tribes, small-town Chinese, Shan and Lue farmers in the north, and Mon farmers in the west.[77]

Christian missionaries convert capital from foreign countries into communication-and-care among rural people. Their central belief in the power of love is the converting mechanism. And they tend to seek out the economically and politically poorest people, those with the least access to energy resources.

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[77] Kenneth E. Wells, History of Protestant Work in Thailand, 1828-1958 (Bangkok: Church of Christ in Thailand, 1958).

Despite the characterization above, it does not mean that missionaries experiment with or consider energy constructs to analyze and promote learning for rural life development. But missionaries are in a position, perhaps the best position, to study energy deficiencies and find ways to improve situations. Other kinds of potential educators from outside, the government extension workers, agricultural school teachers, and foreign experts at all levels, simply do not have sufficient contact with farmers and rural parents.[78]

Energy and urgency. The missionary's lifetime commitment and foreign support are undeniable advantages. On the other hand, an approach oriented to energy measures and analysis can provide understanding and suggest experimental and demonstration programs very quickly to experts who are limited in time and material support. If the experts and advisors are willing to spend some time in rural communities, then understanding of energy analysis and rural life development values insures that the time is used as effectively as possible.

First, the researcher, experimenter or demonstrator approaches the community with two questions, "Who has

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[78] Yatsushiro; Freeman; Pote Boonruang, (abstract of) "Graduate Curriculum Development for Preparing Extension Personnel in Thailand" (Louisiana State University, 1973) in DAI 34/6, p. 2906-A; Boonton Dockthaisong, (abstract of) "Community Development in a Thai Village" (U. S. International University, 1974), in DAI 35/3, p. 1780-A; and Orlin J. Scoville and James J. Dalton, "Rural Development in Thailand: the ARD Program," The Journal of Developing Areas 9 (Oct. 1974).

access to how much and what kinds of energy?" and "To what extent are the people scientific, creative, democratic, and healthy?" Even a brief survey would indicate what kind of and among whom demonstrations, experiments or further investigation should take place. Secondly, in surveying and organizing a demonstration, experiment or research, the outsider's approach itself must be healthy, creative, scientific, and above all, democratic. Rural Thai people are not so desperately poor that they can not reject help, or so naive that they can not recognize hypocrisy.

Finally, the longer that the outsider can work in and with the community, the more he or she can learn about ways to promote rural life development. Some of the methods advocated to obtain energy-related data, such as employing indigenous diary-keepers, require careful preparation and operation. Experiments in improving nutrition, communication-and-care and technology may take years to evaluate. And it often takes years of consistent and good behavior for demonstrators to earn the people's trust and respect, in Thailand as elsewhere.

Fortunately, rural Thai people can afford a few years to wait for rural life development promoters with energy-efficient, resource-realistic and culturally-acceptable approaches. The Thai government is organized to protect itself and the people from the ideological and military threats of neighboring countries. There are inequities, but not yet crises, with respect to population and fertile land. And there are pockets of awareness about energy constructs and their potential for improving analysis and suggesting alternatives. Thai agricultural scientists are evaluating tools and fuels. Thai social and medical scientists are studying nutrition. But more needs to be done, more could be done and perhaps more will be done.

Overall assessment. Many Thai people are adversely affected by changes in land, labor, food and fuel supplies. Rural Thai people, especially, are attuned to energy-related issues. If energy analysis seemed likely to offer suggestions about conserving resources or better means to achieve desired ends, almost any Thai adult would approve, cooperate, and perhaps invest resources in the attempt.

Thai farmers evaluate their own use of energy in agricultural production, processing and marketing. But they do not analyze successfully with respect to communication-and-care and nutrition in the family or in relation to becoming more creative, scientific, healthy and democratic. And at the moment, there do not appear to be educators in or from outside the community who demonstrate to farmers and parents any better application of energies to promote rural life development. There are only potential demonstrators, such as village teachers, local leaders, extension agents and teacher training college personnel. But these groups lack orientation either to a comprehensive concept of rural life development or to using energy constructs in analysis and formulation of experiment and demonstration.

It can not be predicted that pockets of interest in alternative energy sources and nutrition will become widespread attention to energy constructs. It also seems unlikely that missionary dedication and methods in promoting rural life development soon will affect other groups that are supposed to be helping rural communities improve. Perhaps ecological and social problems must become more serious in Thailand before there is enough stimulus to examine energy-related variables for possible solutions. And when Thai people realize the economic and cultural dangers that exist because of rural inequities, discontent, migration and unemployment, perhaps enough support for rural life development will occur.

But if and when the need arises, energy analysis and energy-related suggestions may help Thai people. And Thai people, because of their experience as farmers and parents or their formal education, are prepared to understand and respond to energy analysis.

Summary of the Chapter

The questions posed at the beginning of the chapter may be answered in brief. Energy-related descriptors do not clarify Thai conditions to any important extent. And Thai people presently do not value rural life development as such. Energy analyses help Thai farmers but not parents, but it could help parents and other Thai educators. Village teachers could understand energy constructs and analysis but are not likely to employ them. Local leaders would be receptive to energy-related research, and to experiment and demonstration if advantageous to themselves. But rural educators from outside Thai farm communities generally are not oriented to energy-related research, experiment and demonstration, or, unfortunately, even to rural life development values.

The most striking contrast to observers of Thai culture is the apparent disparity in lifestyles between rural and urban inhabitants. Urban Thai people seem to have all the advantages in recreational pleasures, access to higher education, easy jobs and comfortable homes. Central government and commercial enterprises seem to dominate all the relationships with rural people in interchange and control of resources and decision-making about policy, plans and processes. The traditions of absolute monarchs have been assumed by civil and military officialdom in Thailand and are manipulated by commercial and financial enterpreneurs.

But in certain respects, the system has benefitted greatly all Thai people. Thai leadership has avoided the colonial exploitation, economic destruction in international conflicts, loss of religious and other indigenous cultural institutions, and the civil or internal class wars which have affected neighboring countries in Southeast Asia. The current problems, including the domination in bordering Indochina of hostile ideologies, the escalating prices of imported energy, the still-high population growth rate, ecological deterioration, and the increasing level of violence of crime, urban labor and student activist groups, do not overwhelm the capabilities of Thai leaders to respond and plan effectively to alleviate the problems. In fact, these problems do not affect rural people so much as they only detract from the attention that government leaders might devote to positive enhancement of rural life.

It was concluded that rural Thai people have some institutional resistance to the values of rural life development, but this resistance might be overcome with the information of personal example and communication-and-care from leaders. Most rural farmers already participate in a market system which supplies them some scientific information and consumer incentives to plan and operate more productive farms, leading to better income, and therefore better environmental protection and health. This system needs to be more evenly distributed, however, to compensate for farmers in areas of poor water control or bad ecological deterioration. The rising population and lack of new good land to settle is forcing Thai farmers into greater participation in cooperative activities that extend beyond the confines of the neighborhood, hamlet and village. Rural villagers still maintain and promote cultural activities and institutions with enjoyable and creative elements. But more information is needed to overcome tendencies not conducive to rural life development, such as: patrimonial dependency relationships which inhibit initiative and promote rivalry; inability to reflect scientifically about one's needs and pleasures and possible alternatives in promoting an optimum life-style in accordance with one's reflections; the urban bias of mass media and other urban contacts which convey the impression that an enjoyable or satisfactory life is possible only in an urban setting; and harmful conceptions about diet, especially for pregnant and lactating women and small children.

Among Thai farmers there are regional and often community disparities in energy resources for agricultural production, processing and marketing. But Moerman's analysis indicated that Thai farmers are fully cognizant of and able to evaluate energy variables in agriculture and they also demonstrate energy efficiency in learning about agriculture. It follows that Thai farmers would respond positively to energy analysis in other aspects of rural life development. It appears that they need suggestions and demonstrations about nutrition and communication-and-care and with respect to learning for health and democratic relations. But poor farmers and rural parents lack the energy with which to carry out research, experiments and demonstrations for themselves.

Rural teachers and Buddhist monks often demonstrate the empathy and the skills needed but have basic orientations in other directions than the enhancement of rural life: school teachers for urban life and monks for "Nirvana" or the next life to which one's soul is destined. In these non-rural orientations, teachers and monks only may be fulfilling popular expectations. Thai government rhetoric and policies and programs to orient teachers to rural life have failed for want of credible examples in training and supervision. There would be no intellectual or social difficulties for teachers interested in using energy constructs and analysis, however.

Rural Thai leaders have been hospitable to scientific research. And because many are farmers, they would understand research about energy variables. But their support for experiment or demonstration would depend on whether the activity also maintained their own positions. And Thai leaders might not provide the best examples of rural life development values. At the moment, counter-examples prevail in Thailand, as represented in the media, by urban elites and through commercially-manufactured pleasures. The best demonstrators of rural life development values, foreign Christian missionaries, have had little impact on Thai society as a whole.

Thai government ministries and academic institutions have achieved a self-sustaining capacity for rural research. Much information is collected but seldom applied. Perhaps data on energy variables and learning would be more stimulating or suggestive than the kinds of economic and social data presently collected. Organization in Thailand for experiment in learning and energy is very limited, however. But for demonstration of knowledge about energy, learning and rural life development, there are many potential resources in Thailand, including an agricultural extension system, agricultural schools and colleges, foreign volunteers and technical experts, and provincial teacher training colleges. Many of them are in contact closely and frequently enough to learn about energy variables in family and community life. But to demonstrate energy conservation, new resources and application for learning and rural life development, they must find more time for the rural poor.

Fortunately, the rural poor in Thailand could afford to wait a few years for educators to begin asking more relevant questions and making more helpful suggestions. International, social and environmental threats have not yet reached catastrophic proportions. For poor rural Thai families, however, relevancy and help are greater access to energy resources and better use of them.

CHAPTER FOUR

CONCLUSIONS AND RECOMMENDATIONS

This has been an exploration of the use and limitations of energy constructs in analysis of learning for rural life development. In the first chapter, five constructs were posed for consideration as consequential for learning: environmental information, genetic information, communication-and-care, food, and technology. It was hypothesized that these five elements constitute an "ecology of education." If all were measurable and their effects known, then the ecology of education would be holistic. A comprehensive and predictive ecology of education would exist.

Rural life development was defined as both the processes and the values of good health, cultural creativity, scientific planning and democratic relations. It was argued that these processes and values must be promoted to counter world trends in environmental deterioration, fuel and mineral resource depletion, disparities in levels-of-living and demoralization of rural cultures. To promote rural life development, however, requires learning and learned rural people. If educational processes and achievement could be better understood, then learning for rural life development might be planned and improved. It was hoped that understanding of the energy variables related to learning would lead to clearer conceptions about, and analyses of, education.

The present and final chapter is an evaluation of the work accomplished. First the essential information and conclusions of previous chapters are reviewed. The second section is a discussion about the goals and criteria posed in Chapter One, with reflection about the extent of success of the study. In the last section, a set of hypotheses are recommended for further study. These hypotheses represent a re-formulation of the ideas and possible relationships connecting energy, learning and rural life development.

Review of the Findings

Enormous gravitational forces cause the material collapse, fusion process and escape of radiation that scientists call solar energy. It is the main energy source for life on earth, through heat and plant photosynthesis and as the generator of air movement and rain re-cycling. A measure of kilogram-calories indicates the amount of potential energy present as heat or moving force in any material, including and especially organic substances. In every process involving two or more substances, energy in kilogram-calories becomes transferred between the materials, some remains stored in each substance, and some energy is lost to the materials, radiated or diffused into the environment, in the process called entropy. In human beings, for example, only about twenty percent of the chemical energy in food can be converted to mechanical or work energy applied to external materials. The rest maintains internal metabolic processes, generates growth and becomes waste heat. In death and decay, all one's energy is lost to entropy or captured by other organisms. For any organism, even the most sedentary, to live, a continual source of energy is required, to replenish energy lost by entropy.

The direction of energy conversion and transfer among substances depends on the kinds of substances present in the exchange. Each substance has its own organizational and molecular arrangement, "a difference that makes a difference," especially in living organisms which depend on certain elements and chemicals and arrangements of them, to direct the flow and conversion of energy in life processes and activities. Every substance consists of a nutrient structure which governs its capture, use and release of energy, and an amount of potential energy in heat, its sub-atomic and molecular bonds and sometimes momentum in relation to other materials. Converting the energy moves or in other ways changes the substance, in addition to releasing heat as entropy.

Knowledge, or retained and retrievable information, has these same properties, and can be expressed quantitatively in kilogram-calories (kcal). A "bit" of information is the smallest "difference which makes a difference" which can be recognized by humans without mechanical aid. Information has a structure, carries energy, and requires energy for its conveyance. Learning is the process of acquiring and storing information that makes a difference to the organism. In this respect, an organism learns through its genetic endowment, the nutrients it acquires in food, and the perceptions received through its nervous system. Genes, food and sense-perceptions are all nutrients bringing structure and energy, information, to the organism. A newborn human infant already enjoys a complex learning system, and learns almost immediately to distinguish between warmth and coolness, quiet and noise, hunger and fulfillment, restraint and free movement, and the presence and absence of a caring and communicating person.

But it is these qualitative or nutrient structural differences that have significant consequences for learning, not the kcal amount of energy generated or received in a perception. Even if the technology existed to accurately measure the energy of information received and retained by individuals in all circumstances, it would not be usefully predictive of what and how much the same individuals would learn in subsequent and similar situations. There are too many other important and complex variables involved, including genetic information, the totality of one's previous experiences, present emotional and biorhythmic states, and several aspects of developmental growth. Most of these variables are in constant flux or undergoing continual change. Any acology of education for learners, therefore, must remain much less than holistic, or not comprehensively predictive and plannable.

In several areas, however, scientists are discovering minimum, optimum and maximum ranges of energy for learning. "Communication-and-care" is human effort in subsidizing others with information, services, goods, expressions of love and indicators of status. Children do not survive, learn and develop without receiving communication-and-care. Family, friendship, and community bonds are maintained and strengthened with communication-and-care. The human energy devoted to communication-and-care can be observed and measured, and it appears that for learning and social change, the energy amounts are significant as are the forms or kinds of communication-and-care. Preliminary research into home environments has identified "provision of appropriate play materials" and "emotional and verbal responsivity of mother" as some of the most important forms of communication-and-care.

Energy measures are particularly useful in studies of nutrition. The kcal values of various diets are easily estimated and investigators have established critical relationships between diet and learning ability. Where the nutrient structure of the food is critical, the energies required to produce or obtain and process different kinds of food can be compared. For example, it has been determined that acquiring proteins takes more energy than it does for other foodstuffs, and proteins are the most consequential nutrient for growth in cognitive abilities.

People convert fuels and use tools to save time and their own energy and to produce more and better goods. Input-output or cost-benefit analysis of the energies involved can determine the comparative advantages and disadvantages of alternative means to accomplish tasks. Energy analysis may be particularly useful in rural areas where markets are relatively undeveloped and all the variables do not have price values. Similarly, in the home and in other important learning environments, most transactions can not be evaluated with money measures. But energy values may be calculated for any activity and use of tools, fuels and organizations.

Indicators of scientific planning ability, cultural creativity, overall good health, and democratic relations may be formulated or adapted from research instruments already developed. For individuals, households and communities, aspects and levels of rural life development then may be compared to analyses of the prevalent learning system technologies and the energies invested in communication-and-care and nutrition. From evaluating a number of individuals, households and communities, the optimum energy, nutrient and technological mix for learning which results in rural life development can be derived and demonstrated for particular rural groups, communities and cultures.

Rural people in poor countries both can benefit greatly from such demonstrations and can provide the best conditions for studying energy, learning and rural life development relationships. Learning ecologies have changed the least, or for the worst, among the rural poor. And the rural poor are in the greatest danger from current ecological, political, cultural and economic trends which aggravate poverty and helplessness.

But poverty and helplessness reduce capacities for research, evaluation and demonstration by the rural poor themselves. As agricultural workers, the rural poor may understand product maximizing and energy efficiencies in food production and processing. But they need educators with the extra resources to experiment in and demonstrate innovations in use of energies to improve learning and promote development.

Village government school or religious teachers usually have the time, intellectual abilities and contact with rural people to conduct energy-oriented research, experiment and demonstrations. But teachers may lack orientation to rural life development values, motivation to change and the methodological tools by which to proceed. Local leaders may have even more resources than teachers, plus orientation to rural life development values. Leaders can facilitate research and demonstration projects. The rural poor, however, often lack access to, or consideration from, effective leadership.

It remains for educators from outside poor rural communities to provide the energy in information and materials to organize research, suggest experiments and give demonstrations. Outsiders must consider fundamental relationships between: access to solar energy and poverty; nutrition, communication-and-care and learning; and technology and energy conservation. With experience and understanding, the educator can formulate energy-based, resource-realistic and culturally-acceptable approaches for testing and demonstration, and in the process, promote rural life development.

The people of Thailand would benefit from both revival and reform in rural culture. There is a large agricultural population, growing faster than cultivable land and urban employment become available. Thailand has no significant fossil or nuclear fuel reserves. Ecological deterioration occurs because of urban and commercial pollution and from over-exploitation of forest cover, watershed vegetation and easily-eroding tropical soils. Urban-industrial money ethics and machine-supported leisure activities and vocations are increasing. Social violence is prevalent with disparities in political and economic opportunities. And there is military danger from neighboring countries dominated by radical economic and political revolutionaries committed to violent agrarian reforms along communist lines.

Historically, Thai people have enjoyed competent leadership and a flexibility with which to resolve economic and political crises. The leadership in 1977, well-educated commercial, military and civil bureaucratic elites, have the capacity to turn events in whatever direction seems beneficial. But historical success and present talent do not guarantee the forestallment or even understanding of future and greater crises. Promotion of rural life development, beginning with individual, motivated educators, at least improves the potential for resolution of the crises impending from current trends in Thailand. And analysis of rural learning using energy constructs would aid in suggesting ways and means to promote rural life development in Thailand.

It appears that no other conceptual approach would find the rural Thai poor as responsive, because their whole lives are focussed on the acquisition and conversion of energies. Thai parents need information about applying energy for nutrition and communication-and-care with children, though. And the rural poor lack the resources to obtain information by themselves. But Thai farmers and parents have been cooperative with researchers and demonstrators. And rural Thai people are quick to innovate where advantages to self or family are clearly perceived. Over the past generation, however, there have been few or no innovations in ecologies of education among rural Thai people. Therefore rural Thailand provides excellent conditions for studying energy, learning and rural life development relationships. And the people could be helped by and would be receptive to suggestions resulting from such studies and experiments.

Rural Thai community teachers are not likely to initiate, conduct or use results from energy-oriented research. Government school teachers are money-oriented and function to prepare and select children for urban employment. Thai Buddhist monks are oriented to religious services and moral self-improvement and they are not supposed to be concerned with mundane matters such as health, scientific planning and democratic relations. But if local teachers were inspired to promote rural life development values, they have the material and intellectual resources to study energy constructs, relations and innovations in conservation and improvement.

Local leaders may provide inspiration to Thai teachers, farmers and parents. There are Thai leaders who strongly support overall rural development goals, values and behavior, despite the prevalence of media, urban and commercial counter-examples. But effective, scientific, creative, healthy and democratic leaders are rare in Thailand and usually inaccessible to the rural poor. On the other hand, most local leaders in Thailand have been hospitable to rural researchers. They would understand energy-oriented endeavors. And they would approve experiments and demonstrations which enhanced or at least did not detract from the leaders' own patrimonial status.

In Thailand there are several kinds and an adequate number of educators from outside rural communities with the material, intellectual and motivational resources to conduct research, initiate experiments and demonstrate innovations. Already there is organized scientific interest in energy for agriculture and in child and maternal nutrition. There are agricultural extension systems, experiment stations and schools, and numerous teacher training colleges in the provinces. All could become active with respect to energy-learning constructs in and for promotion of rural life development, if current trends continue in ecological degradation, economic depression, monetary inflation, population growth rates, rural crime and political dissidence. At the moment, however, urgency is not apparent among Thai educators, either to improve rural life or to intensify and extend energy-related experiment.

Attainment of Objectives

In the introductory chapter of this study, a set of experiments was proposed as an exploration of energy, learning and rural life development relationships. Goals were refined and other questions raised during the course of Chapter One. Now the exploration has ended. What has been accomplished? The present section is an evaluation of all that occurred in previous pages. The purpose is to decide whether or not hypotheses were resolved, goals were achieved and questions were answered.

The first and most important experiment proposed was to seek energy constructs for a possible and holistic ecology of education. Difficulties in this endeavor were encountered early in Chapter Two. It was hypothesized that all the energy sources and energy conversion and control mechanisms related to processes of learning could be described. But genetic information could not be described satisfactorily. Too little is known about the information and energy conversion processes in genes.

It was hypothesized that the energy-learning constructs could be expressed and evaluated with common and equivalent energy measures. This was found to be impractical for genetic information and useless for environmental information. It was concluded that the kcal value of perceptions or information has little or no consequence for learning.

Then, it was hypothesized, energy constructs provide a basis for analysis of achieving learning outcomes. Because genetic and perceptual information could not be included, energy-for-learning analyses would not be holistic. But a useful degree of predictability appeared obtainable with the energy constructs which can be observed and are easily measurable in kilogram-calories. Aspects of communication-and-care, nutrition, and technology were shown to be consequential for learning. Empirical studies to measure the variables and relate them to achievement of rural life development would be feasible, fruitful, and might further substantiate the hypothesis.

The second experiment was to consider energy analysis for use in rural Thailand. It was found that the potential utility of energy analysis in Thailand approximated the potential utility outlined for the rural poor world-wide. Rural Thai farmers analyze energy-technology factors in agricultural production, which supports the hypothesis that the Thai benefit from energy analysis. But another hypothesis was not supported. On their own, Thai farmers and rural parents can not employ energy analysis of nutrition and communication-and-care to promote rural life development. They might understand the approach, but they lack the resources to initiate experiment and demonstration and analyze the results and suggestions.

An overall experiment involved working with data from diverse fields. It proved not to be conceptually difficult. An energy standard of value someday may unite science and the humanities. The problem is not ethical, aesthetic or logical, but scientific or technical, as so many significant energy processes are unobservable or practically immeasurable. Hypotheses were substantiated that environmental science can be related usefully to education and that energy constructs can be applied to analysis of achieving humanitarian values. In any case, it was found that social scientists, especially anthropologists and economists, increasingly are using energy variables in theory, description and evaluation.

Educators may follow the lead of other social scientists. Analysis of energy constructs and consequences for learning may point the way toward peaceful, evolutionary policies and demonstrations to revitalize the multitudes who perceive few advantages or limited alternatives in rural life. But much remains to be learned before educators can provide the policies and demonstrations.

After all, such questions as "What environmental conditions encourage or inhibit learning to be scientific?", "How much and what forms of energy are needed to promote creativity in people?", "What kinds of transactions support democratic relations?", and "What other forms of energy besides food energy are necessary to develop and maintain good health?", were not conclusively answered in this study. But methods to secure the data with which to derive answers were discussed and recommended. And these methods were found likely to be acceptable by the rural people in at least one society, that of Thailand.

This does not mean that the end-values recommended for rural revival also are accepted by Thai people or their educators. On the contrary, there are some Thai institutions and behavior prevalent and hostile to creativity, democratic relations, scientific attitude and overall good health. These values can not be imposed by fiat or argument. And rural educators who accept the values can not expect clientele to conform also. For rural farmers, parents, teachers and leaders to accept, the values must be demonstrated as advantageous, whether by energy analysis, personal example, or by simply pointing to the danger of alternatives.

The considerations above were made clear at various points in chapters Two and Three. They are repeated here to suggest that the moral dimension in research discussed in Chapter One has been followed. And Margaret Mead's injunction that social scientists only define directions in planning, which other people are free to choose or reject, also has been obeyed.

Therefore, nothing very specific has been insisted upon, other than the fact that the rural poor have limited access to energy. The poor do not have enough extra energy to invest for improving their respective situations.

So rural educators must find ways to demonstrate to the poor how they may improve their energy bases, where energy includes land, nutrition, communication-and-care, and technology.

The possibilities and limitations of energy, learning, and rural life development analysis have been demonstrated, however. Further experiments will refine the methods, improve understanding of the variables discussed, substantiate relationships, and define the resources, conditions and learning necessary to improve rural life for individuals and communities. To contribute to these goals, hypotheses for subsequent research, evaluation and demonstration are presented next, as recommendations to other educators interested or involved in rural life development.

Action Hypotheses

To conclude the chapter and the study, a number of hypotheses are listed. The hypotheses include ideas changed because of arguments or contrary data, new ideas to consider, and re-statement of ideas not fully explored in earlier discussion. Figures are sometimes given as suggestions to stimulate exploration and refinement with empirical analysis.

General propositions. The central theme and main purposes of the study already have been discussed earlier in this chapter and require no repetition. The hypotheses that follow, therefore, do not completely outline the theoretical foundations of energy-learning analysis.

1. Goods, money, services, information, expressions of love and expressions of status are control mechanisms for energy. They provide energy, and require energy to acquire.

2. Because securing information from environmental perceptions is poorly controlled or predicted by people, it rarely can be included in energy analyses.

3. Predicting how much and what kinds of things a person will learn is a function of intimate and scientific knowledge about that person. Acquiring that knowledge is very costly in energy.

4. There is an optimal information acquisition rate for people. Too fast is energy-wasteful and structurally disrupting or confusing. Too slow is energy-efficient but structurally stagnating, and a person becomes inflexible, endangering survival.

5. Learning faster requires proportionately much more energy.

6. In learning, the use of technology and any mix of fuels, tools and organization, always decreases overall energy efficiency but increases net production up to the point at which maximum rate of retrievable information storage occurs for individuals.

7. The most efficient learning system is the one in which information is the only reward provided to motivate the learner. The least efficient learning system is the one in which stress is applied to punish the learner for lack of response.

8. Children require more energy in communication-and-care as they grow. The attention must intensify though the time given in attention may decline.

9. Effort in communication-and-care, although the recipient may perceive that only he gains in advantage, results in some benefit for the communicator, which the latter perceives as rewarding and which reinforces the disposition to be empathetic to others and provide them information.

10. Babies should be held, played with and conversed with at least three hours but no more than six hours each day (In this and following hypotheses, the figures given are speculative only, for the purpose of provoking inquiry, and not based on published findings.).

11. Elders should organize play environments for children at least once but not more than twice a day.

12. Parents should take part in children's play at least twice but not more than four times a day.

13. The optimum variety in play materials for children is six different kinds of objects and the acquisition of four new kinds of play objects each year.

14. Punishment and restriction require much energy but are productive in learning to avoid dangers.

15. In adults, learning efficiency and net output are optimum when forty food kcal per kilogram of body mass are consumed per day, mass remains constant, and the adult is neither underweight nor overweight for height.

16. In adults, overall learning efficiency and net output are optimum when ten percent of food energy is converted through strenuous exercise or work (about ten kcal/minute for a 75-kilogram person), or forty percent of food energy is converted through mild exercise or work (about 5 kcal/minute for a 75-kilogram person).

17. Chronic early childhood malnutrition and/or chronic malnutrition of the child's mother during pregnancy results in adult retardation, including skill-learning disabilities, poor understanding of abstract concepts, limited attention span, imagination and creativity, short stature, health problems, emotional instability, and moral immaturity.

18. a. Globally, there are enough renewable energy resources available to maintain all people at high levels of health, creativity, scientific ability and democratic relations.

b. But presently, to motivate institutional change globally and actually to re-organize world institutions for global well-being, the information, perhaps even the energy to obtain the information, has not been brought under control.

Method in rural research, evaluation and demonstration. Means to learn about rural energy, learning and social change relationships ought to be energy-efficient and enhance net learning outcomes. Costly, complex means may never be acceptable to or feasible for rural educators.

19. Any good is evaluated most fundamentally as the human energy allocated to obtaining the good. In energy analysis, accounting fuels as the human labor to obtain them is more reflective of human value than accounting fuels at the kcal rate of consumption of the fuels.
20. The most energy-efficient method of obtaining information on learning outcomes related to rural life development in rural communities is observation and testing of adults, using adaptations of current test instruments.
21. The "Indigenous Diary-Keeper" method is the most energy-productive method of obtaining detailed rural data about daily transactions, conversion of energy and learning in households and communities.
22. For promoting rural life development, the most learning-efficient and significant questions on which to focus are "Who has access to how much and what kinds of energy?" and "To what extent are the people scientific, creative, democratic and healthy?"
23. Local leaders do not object to, often cooperate with, and may contribute resources to energy-for-learning research, experiment and demonstration, if the project is

perceived as advantageous to villagers and not disadvantageous to the leader.

24. Urban academics and professionals command the energy resources to conduct energy analysis of learning processes in rural households and communities.

Achieving rural life development values. Where culturally-acceptable or the benefits can be demonstrated, educators may suggest forms and amounts of communication-and-care, nutrition, and social organization to improve learning. Experience and evaluation will improve the suggestions that follow.

25. In food production and processing activities, output per person or per hectare declines with deficiencies in energy sources for learning, just as output declines with undernutrition or loss of a nutrient supply medium such as topsoil.

26. In family learning of technical tasks, the energy allocated to subsidy in communication-and-care increases total learning output, from zero application to thirty percent of the total controlled input energy, above which output declines.

27. In family learning of democratic relations, the energy allocated to subsidy in communication-and-care increases learning efficiency, from zero application to forty percent of the total controlled input energy, above which efficiency declines.

28. In family learning of creativity, the energy allocated to subsidy in communication-and-care increases total learning output, from zero application to twenty percent of the total controlled input energy, above which output declines.

29. In classroom learning of planning ability, the energy allocated to subsidy in communication-and-care increases total learning output, from zero application to thirty percent of the total controlled input energy, above which output declines.

30. In classroom learning of creativity, the energy allocated to subsidy in communication-and-care increases learning efficiency, from zero application to fifty percent of the total controlled input energy, above which efficiency declines.

31. In classroom learning of democratic relations, the energy allocated to subsidy in communication-and-care increases total learning output, from zero application to forty percent of the total controlled input energy, above which output declines.

32. In tutorial learning of technical tasks, the energy allocated to subsidy in communication-and-care increases learning efficiency, from zero application to ten percent of the total controlled input energy, above which efficiency declines.

33. In family learning of healthy habits, the energy allocated to subsidy in communication-and-care increases total learning output, from zero application to twenty

percent of the total controlled input energy, above which output declines.

34. In tutorial learning of creativity, the energy allocated to subsidy in communication-and-care increases total learning output, from zero application to thirty percent of the total controlled input energy, above which output declines.

35. In tutorial learning of democratic relations, the energy allocated to subsidy in communication-and-care increases learning efficiency, from zero application to thirty percent of the total controlled input energy, above which efficiency declines.

36. For learning scientific planning skills:

a. mass media systems are most energy-efficient, but result in the least amount of learning;

b. apprenticeships or "on-the-job" training are less energy-efficient but of more consequence;

c. extension agent-demonstrators are even less efficient but result in even more learning;

d. and schooling is least efficient but the most learning occurs.

37. Cultural creativity in rural life depends on having more access to solar energy than required for essential needs, or access to technology which conserves more than enough energy for essential needs.

38. There is an optimum amount of access to solar energy which supports tendencies toward democratic relations.

With more than the optimum amount, anarchy is encouraged as people do not perceive the need for mutual interdependence. With less than the optimum amount, competition, factionalism and violence are encouraged.

39. a. Cultivating democratic relations is more costly in energy than maintaining patrimonial or feudal relations in rural cultures.

b. But with democratic relations prevalent, achieving social welfare or community-wide well-being requires less energy than it does where patrimonial or feudal relations are prevalent.

40. To the extent that institutions of the larger society, such as schooling, political parties, the media and industrial technology, reflect non-democratic processes and attitudes, rural life development is hindered, the task of educators is made more difficult, and alternative energy resources are needed to improve rural life.

41. a. Subsequent development of scientific planning ability or creativity depends on the number and extent of early encounters with contrasting environments, different individual adults and information media sources.

b. But more than ten hour-long exposures or new experiences each week inhibit subsequent development of scientific planning ability and creativity.

42. Maintaining physical health and emotional, moral and social health requires considerably greater access to energy resources than only maintaining physical health does.

43. a. Repeated and consistent behavior by significant others has more consequence for an observer learning and accepting rural life development values than either subsidies in communication-and-care or amounts of kilogram-calories in diets;

b. but behavior planned for observation is demonstration, a form of communication-and-care;

c. or, behavior not planned for observation has non-learning outcomes, which may complicate or confound energy-for-learning analysis;

d. and to determine what is consistent and repetitious demonstrated behavior requires many observations.

44. a. Personal demonstration is the most energy-efficient learning system for promoting rural life development overall.

b. Individual or small-group tutorial learning produces the most learning conducive to promoting rural life development overall.

c. School and classroom learning systems are least energy-efficient and result in the least amount of learning relevant to promoting rural life development overall.

45. Anyone with experience in hard labor or secondary school learning has the information to understand energy and learning relationships and rural life development values when they are demonstrated.

46. Urban academics and professionals command the energy resources to promote rural life development.

47. In government-organized development projects, there is seldom enough energy allocated to promote rural life development values and behavior among participants or intended beneficiaries.

48. Efficiency and net product in promoting rural life development depend on:

a. the extent to which educators demonstrate good health, scientific planning ability, cultural creativity and democratic relations;

b. and, the extent of contact between educators and the rural poor.

Rural educators. Several conclusions about potential rural educator-energy analysts were indicated by the findings and bear repetition. One may notice that little is stated about local leaders. More culturally-specific data are needed before likely hypotheses should be advanced about them. But variation in the quality of rural leadership may be so great that generalizations will never seem realistic.

49. Anyone with experience in hard labor or secondary school learning has the information to understand energy constructs when the latter are hypothesized or explained.

50. Local leaders and village teachers have enough extra energy resources to obtain and evaluate information which can contribute to rural life development.

51. Village teachers do not control enough energy resources

to orient formal learning systems to promotion of rural life development.

52. Village teachers normally do not direct their energies to become educators for rural life development.

53. Urban scientists, engineers, academics, priests, doctors, lawyers, merchants, bureaucrats and soldiers control the energy with which to become educators for rural life development.

<u>Energy and the rural poor</u>. Rural revivals will not succeed unless projects and demonstrations reflect realistic understanding of the plight of the masses. The general situation indicated by the following hypotheses may vary, for better or worse, among individual communities or households.

54. Most farmers already follow energy-efficient methods of food production and processing and of learning the methods. The rural poor need access to methods which will result in greater food output, a variety of means to learn and more motivation to learn.

55. Any farmer has the information to respond to suggestions about acquiring more or new energy resources or means to conserve energy.

56. The rural poor do not have enough energy to secure minimum amounts of proteins for normal cognitive, creative, moral, emotional and physical development.

57. The rural poor lack energy in information to know why

and how to improve diets.

58. The rural poor often do not have the energy in information or from demonstration to change culturally-restricted bad diets.

59. Many of the rural poor do not have surplus energy to attend meetings, schools, or even religious services.

60. With some perceived surplus energy, the poor allocate it to acquiring leisure pleasures for immediate gratification, such as tobacco and alcoholic products, which require little energy in consumption.

61. Addiction to drug-centered leisure pleasures results in the rural poor diverting energy from maintaining family nutrition, and health deteriorates.

62. The rural poor do not have the energy to maintain, and seldom participate in, classroom learning systems. Tutorial learning systems would be less costly in energy for the poor.

63. Relatively passive observation learning systems prevail among the rural poor because more active systems cost too much energy to maintain.

64. The rural poor do not have enough surplus energy for controlled interaction with children three hours per day.

65. Because of entropy in information, technologies to conserve information are needed by the rural poor.

66. The rural poor often do not have access to the energy in information and communication-and-care of village teachers or local leaders.

67. The rural poor often do not have access to the energy to represent their own interests against absentee landlords, market moneylenders, police, bureaucrats and land speculators.

A final note. The problems indicated by the statements above may seem so overwhelming that no feasible projects or inspiring demonstrations suggest themselves. There are hundreds of millions of people ensnared by the problems and many perceive no possibility for improvement. No one, including government agents, seems to be willing or able to help the poor help themselves.

But perhaps solutions are not evident because concerned agents and educators have not asked the right questions. It is hoped that the questions raised by the interests and arguments of the present study offer a new and fruitful approach to the problems of the rural poor. At the very least, it is expected that the findings and hypotheses inspire or lead rural educators to formulate new questions of their own, and of relevance to the particular rural people that particular educators wish to help. If that occurs, then this work will have made a small contribution to rural life development.

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