

Explorations

Earlier in the Journal we mentioned briefly the impact that Howard Odum's report to the Royal Swedish Academy had on all of us last fall, both intellectually and emotionally. It could have been said to have had a comparable effect to a doctor's report, pinpointing the progress of a fatal disease. One knows the prognosis is going to be bad and can, of course, only get worse. But, before actually hearing the report, one's fears are still somewhat amorphous and vague, having the tenuous quality of a bad dream. With the report, the specifics take shape. One can no longer be evasive in one's responses. It was so for us with Professor Odum's report, which John Todd discusses here. No longer are the problems ominous but ill-defined. Professor Odum makes only too clear where and how we are endangered, relating this not only to the false concept of energy held by our economic system but also to the living world in which it is based but habitually chooses to ignore. We feel it is a perhaps painful but essential part of Explorations.

A careful reading of this article and that of Richard Merrill, under Land and Its Use, will reveal many parallel, even convergent, themes. It is worth noting that they were written three thousand miles apart and completely without collaboration. What sets them slightly apart from many that have discussed energy in recent months is the fact of both Rich and John's continuing awareness of the inter-relatedness of all economics, energy and agriculture to the finite planet we seem bent on exhausting.

The second article in this section by Eugene and Marya Anderson of the University of California at Riverside is one that is interesting on a variety of levels. As New Alchemy has started working in other countries, we have become all too aware of the fact that "help" in any form is ill-conceived if it is not accompanied by an exhaustive effort to understand the people to whom you would offer your knowledge or skills. While too much pondering could lead to a Hamlet-like paralysis, it is still terribly important, before rushing forward with one's good works, to understand a culture and to know, as the Andersons point out, that there are often taboos and practices which, although often incomprehensible from our frame of reference, can be a deep-rooted part of a people's thought patterns.

Another idea that emerges from the article as thought-provoking is that of the politics of food. Here there is no need to draw examples from the third world, so successfully have we managed, on this continent, to use food as a means of exploitation. Aisle after aisle of supermarket shelves stacked with highly refined, extravagantly packaged, nutritionally dubious and ever more expensive foods make shopping frustrating, at best, for the comfortable and devastating for the poor. Their exploitation takes another dimension when one considers that it is often the poorest people who find junk foods most irresistible as the only piece of the glittering affluence surrounding them that is in any way attainable.

— NJT

The Dilemma Beyond Tomorrow:

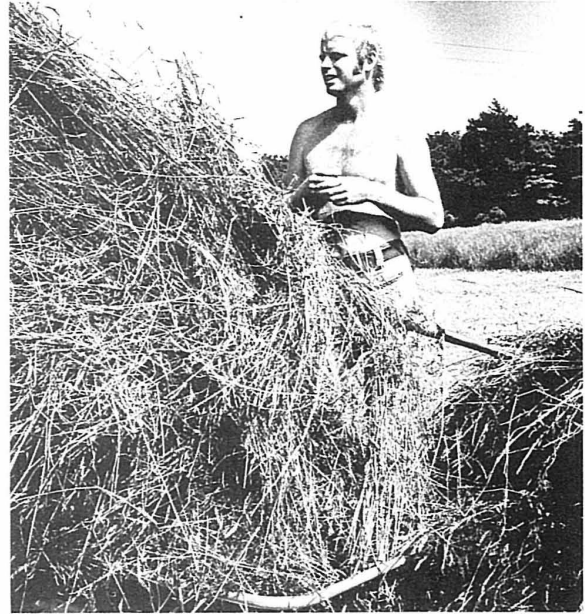


Photo by John Cressey

A Look at How the Fundamental Laws of Nature Have Been Defiled by Modern Industrial Societies Thereby Threatening the Fate of Mankind

Late last fall I attended an ecology conference at Goddard College in Vermont organized by Murray Bookchin, the well-known political ecologist. The Goddard discussions began with a look at the “energy crisis” which was just beginning to flex its muscles, inconvenience and scare people. Several of those present, savvy students of energy and its use in our society, had pretty much concluded that the whole business was a trumped-up affair to benefit the few at the expense of the many. Subsequent events have pretty much borne out their early analysis.

But underneath Oil’s dirty underwear there is something critical that needs reading and understanding. Manipulated events can be heraldic in that they provide a model for looking at economic forces in the world by which we can see a bit more clearly into the future. The pseudo-crisis has had educational value with frightening portent.

I should like, at this point, to make four statements about energy in relation to society and then discuss them a bit more fully, beginning with the last point first.

1. Energy and its use is critical to the fate of society.
2. Our knowledge of energy is primitive and lacking in wisdom.
3. Even if the present crisis is the result of manipulatory activities, the forces which enable Oil and others

to be manipulative are growing. Within our lifetimes a terrible scramble for the remaining cheap energy will take place. This almost certainly will mean war and oppression.

4. Contemporary “advanced” societies have built themselves a humpty-dumpty civilization based upon a crude understanding of nature, energetics and society. The scary thing about this is that megatinkerers, oil barons of whatever nationality, could actually collapse the whole industrial world without meaning to, merely by playing their narrow-interest power games. I shall give a brief example of what I mean, but it should not be forgotten that there are at the same time comparable events that could be, and are, occurring in many other sectors of society.

DOWN ON THE FARM, or DO WE EAT TOMORROW?

It is difficult for us to imagine stores empty of food. We have no precedent for such an event. But every time you see a gas station with an “out of gas” sign, remember that the problem is magnified down on the farm. In our mechanized society an empty tank in a tractor can quickly mean an empty shelf in a food store. The lag time can be as short as nine months. Even slight energy shortages have the potential to trigger myriad unexpected events.

As I mention in the article describing New Alchemy's Ark, food production in America, unlike agriculture in many regions of the world, is highly energy-intensive and dependent upon huge oil inputs. The disparity, in energetic terms, between U. S. agriculture and that of peoples with sensitive gardening approaches to farming is as high as 25:1 or even 40:1 in favor of the latter. This is a side of the green revolution its proponents rarely discuss. Some farmers in places like Malaysia and New Guinea are capable of producing twenty calories of food for one calorie of energy expended; we use five calories or more of energy to produce one calorie of food on the American table. We are hooked on high energy modes of food production and because this fact has been ignored, a population has been placed out on a limb.

Energy is used in a variety of ways in the production of food. There is the manufacture of necessary modern machinery and equipment, then transportation, storage, drying, processing and packaging, not to mention a number of other inputs including advertising, all of which require fossil fuels for their sustenance. To make things worse, our agricultural lands have been so badly treated and misunderstood in ecological terms that a whole arsenal of chemicals is required to fend off pests, kill weeds, check diseases and provide plants with nutrients. These chemicals are all ultimately dependent upon fossil fuels in their manufacture and many are petroleum derivatives. Herbicides, pesticides, fungicides and fertilizers can be purchased by farmers only if oil remains cheap and readily available. The manufacture of both nitrate and phosphate for fertilizer requires excessive amounts of energy, surpassed on a per unit output basis by few other industries, such as aluminum.

Industrialized agriculture cannot get along without these inputs, as many alternative paths have been closed behind us. We are increasingly paying the price for treating land as a commodity rather than as something alive and sacred. When the oil tinkers tinker, they could unleash events which will bring real troubles to the farms and the larders of the country.

Already there are ripples as a result of the mini-crisis. In the fall of 1973 a number of farmers were finding it difficult to get enough gas to dry their high-yield corns. The problem is at once ironic and typical; the new corns are harvested "wet", having a higher water content at harvest time than older varieties. Spoilage results if they are not artificially dried.

But the worst problems in the food production chain are in the industrial linkages. Cutbacks in availability of oil to petrochemical industries, as well as increasing prices, could put a squeeze on pesticides, herbicides and fungicides. If these products "short fall" on farm lands, there could be a serious drop in production of foods. Shifts to biological farming methods can and must take place, but they cannot be rapid, as they

usually take many years to be effected and require more intensive techniques and planting strategies, not to mention a wholly different attitude toward agriculture. One petrochemical industry spokesman predicted a sixty-five billion dollar drop in his industry and 1.6 million jobs lost in 1974. While he was no doubt exaggerating the magnitude of the problem for ends not yet clear, there is little doubt that shortages and price increases of an unprecedented nature are taking place and that these will inevitably affect farm inputs. One example will suffice to make my point. Within a period of a few weeks, the price of phosphates from Morocco, a major phosphate producer, rose from \$14 to \$42 a ton.

This whole scenario, it must be remembered, has to be seen against the backdrop of a world without substantial food reserves. Nations with faltering industrialized agricultures cannot be bailed out, short of war or blackmail on their part. If a pseudo-crisis can induce strains into a system, then a genuine reduction in fuel availability could seriously dislocate a modern society.

A real energy crunch is on the way. At this point I should like to bring forth some of the arguments of Howard Odum, one of the fathers of ecology in America. Odum's view of the future is one of the most apt, and we would do well to listen carefully to his message.

For several decades Howard and his brother, Eugene Odum, have been students of Nature, trying to comprehend the primary ecological forces that underlie biological change. They have done much to advance the science of ecology, and a landmark paper by Eugene entitled, "The Strategy of Ecosystem Development", (1) chronicled the characteristics of ecosystems and environments, their use of energy and their changes over time towards more diverse, complex and stable states. Nature changes constantly. The environmental factors and man's impact on these changes are beginning to be understood. Howard Odum, in a small volume, "Environment, Power and Society", (2) attempts to apply the mechanisms of nature and the methods of ecology to an understanding of human societies and their relationships with the living world. The book, with its charts and flow diagrams and its jargon borrowed from the language of systems, has not been widely read outside the discipline of biology, although its message was very clear to those who studied its contents. Professor Odum concludes that highly industrialized societies are so out of tune with nature that their fate will be sealed within the lifetimes of many alive today.

Recently Howard Odum presented a paper to the Royal Swedish Academy of Science entitled, "Energy,

1. E. P. Odum, 1969. *The Strategy of Ecosystem Development*. Science, Vol. 164, 262-270.
2. H. T. Odum, 1971. *Environment, Power and Society*. John Wiley. 336 pp.

Ecology and Economics" (3). Its message was directed both to the public and to world leaders and stated that through our ignorance of energy and nature we have created a world community that is precariously balanced. He predicted a one-hundred-fold drop in the world's population within five to twenty years, a drop closely paralleling a comparable reduction in the amount of energy available to industrial societies.

I should like to précis some of his arguments here, as the paper delivered to the Royal Swedish Academy has yet to appear in print. I apologize to him for any misinterpretations that might enter into my analysis of his ideas.

Odum views energy, whatever its source, be it coal, oil, nuclear fission or the sun and the wind, in terms of its value. By value he means real work after the energy has been extracted, processed and delivered — in a sense paid for. This is energy at its point of ultimate use. He also grades energy in terms of what it takes, energetically speaking, to make it work directly on our behalf. If it takes almost as much energy to mine, process and manufacture the components and substructures of power-producing systems and maintain the support organizations, as can be delivered for ultimate use, then the *net energy* is very slight. He argues convincingly that energy is not seen in this way by economists.

He has modeled inflation through his technique of seeing money as an energy-linked phenomenon in the "ecosystem" of nations. Seen this way, the relationships between energy and money begin to clarify. Inflation, in these terms, is directly related to the diminishing availability of net energy — as the amount of net energy readily available to a society decreases, so does the value of its money. The relationship appears to be a direct one. The quality of energy is also tied to this idea. If more energy is put into the energy-getting process, be it arctic oil, coal, or nuclear plant, than was necessary previously when fuels were more available, then less real work can be bought with the energy produced. At this point, money is worth less, independent of the machinations of high finance or government. To summarize, the value of money is directly tied to the net amount of energy available to the society that prints it.

The available energy reserves will have to be re-evaluated by both modern governments and most of their critics in light of Odum's line of argument. If net energy is the criterion upon which we are to base our planning for the future, then present estimates are much exaggerated as they are based on available reserves or gross energy. Howard Odum states, "Suppose for every 10 units of some quality of oil shale proposed as an energy source there were re-

quired 9 units of energy to mine, process, concentrate, transport and meet environmental requirements. Such a reserve would deliver 1/10th as much net energy and last 1/10th as long as was calculated."

Here we are beginning to probe the essence of the quality of energy and the dilemma beyond tomorrow. Nature has her own set of rules and what we can glean from the use of energy in ecosystems seems to apply to ourselves. From this we can see that competitive and cooperative relationships between societies have different meanings at different periods in their development.

If we are to avoid the fate that has afflicted all previous major civilizations, we will have to identify and cope with shifts in energy value. A forest, meadow, village or country will best survive if it uses its energy for the most useful purposes at any given point in time. Energy requirements can and do shift dramatically.

In nature rapid growth seems to be adaptive only during periods when new and cheap resources are available. Ruthless competition exists between plants as well as animals, when a new spacial resource becomes available. For example, when a field is cleared, colonization takes place which involves rapid shifts in species domination and abrupt rising and falling in population densities. The discovery of the fossil fuels locked in the earth's crust and subsequent use of them triggered a process in human societies in some respects analogous to those in the newly exposed field or meadow example. New energy resources became available. The scramble to exploit them was imperialistic and aggressive. Those that succeeded in obtaining these resources have in effect "changed the world."

A second phase may be approaching when readily available energies basically have been tapped. In nature, those energies remaining are used for maintenance and the gradual shift to other modes of interaction. Rapid net growth specialists like the weeds in the fields are replaced by a diversity of organisms, longer-lived, and of higher quality, with more subtle, frequently synergistic relationships which maximize their energy efficiencies. The area that was a field changes into a forest that is more diverse and stable.

Odum feels that we are going to be forced to shift from a rapid growth society to a steady state society and that we will have to begin soon or the crashes that in nature are characteristic of shifts from growth to steady states may be felt by ourselves.

There is a constructive side to his message: should we shift to a steady state system, the quality of life could, in theory, be maximized. Odum speculates that only in such a society could socialistic ideals of equitable distribution be effected.

At this point, I should like to probe the concept of energy quality and its importance in understanding the significance of the present scramble for new energy

3. H. T. Odum, 1973. *Energy, Ecology and Economics*.
Paper invited by Royal Swedish Academy of Science. 26 pp.

sources. One of the most difficult and important ideas Odum introduces is the idea that higher quality energy must subsidize lower quality energy if the total energy output is to be maximized. The forest provides a good illustration: leaves at the top of trees transport fuels so that more shaded leaves which have less solar energy available to them get some additional energy. In this way the dim light that reaches the forest floor can be utilized even though it is of lower quality. Energy is maximized because the uppermost leaves provide a support base for lower ones which work less efficiently. High quality coals and oils, when they are inexpensive, keep goods and services cheap. These goods and services, in turn, provide the subsidy for marginal kinds of energy which would not yield much on their own. I shall elaborate on this concept when discussing the role of nuclear power in the field of energy as a whole.

Economists and technocrats are predicting that the marginal energy yielders might one day become economical. Odum claims this to be a fallacy on the grounds that they require the subsidy to exist at all. Present day marginal energy yielders represent lower quality energy sources.

It is at this point in the argument that the technologists like to point out that new technologies with greater efficiencies will be developed to reverse the equation and save us before readily available fossil fuels are exhausted. The story may not turn out so beneficently, as technologies with high end-point efficiencies, (for example, engines that develop considerable power with relation to fuel requirements) actually acquire their efficiency through energy-expensive manufacture, maintenance and support structures. To produce more efficient engines requires more energy in the form of extremely complex factories. The percentage of net energy yielded may actually decrease with more efficient engines.

Environmental technologies being developed in the name of pure water and pure air also reduce the amount of net energy available to society for useful work. In relatively small and balanced human communities, pure air and water are provided by a free energy subsidy from nature. Wind, water, sun and soils work together to purify wastes and human by-products. But natural purification works only when human societies are made up of relatively small units surrounded by ecosystems such as lakes, swamps and forests that have the ability to purify and restore. When urban sprawls become too large, nature's aiding capacity is overtaxed and the free subsidy vanishes. At this point we have to maintain livable environments with costly and energy-intensive technologies like sewage plants, which include tertiary treatment facilities, waste extraction, transport systems and others. The cost to society, as a result of overshooting the natural carrying capacity of nature, is great and unhappily, is ignored by almost all.

Societies must be designed using nature as a recycling partner if they are to survive the period when high energy purification technologies can no longer draw on cheap energy sources to sustain them.

There is much discussion of new sources of energy, especially solar energy, these days. The New Alchemists and others are trying to use these energies on a small scale in more delicate and sophisticated ways. Trapping the sun's heat to provide livable climates in greenhouses and housing structures takes advantage of an energy source normally quickly lost to the atmosphere. But to see large-scale utilization of solar energy as a replacement for oils and other fuels may well prove to be an ill-founded fantasy, and to expect solar power to permit our civilization to continue on its present course is nonsense.

Solar scientists see our salvation in the large-scale manufacture of solar cells that translate the sun's energy into electricity. These cells will be mounted on vast solar collectors, some of them in space. But the solar energy striking a given unit of collecting area is very low, some 10^{-16} kilocalories per cubic centimeter. This means a tremendous amount of energy in the form of subsidies from oil and coal economies will be needed to manufacture a very large number of cells and installations for concentrating the energy and transforming it into electricity for its ultimate use. The net energy available to society may not be nearly as high as solar exponents believe.

However, plants which have an incalculable amount of surface area exposed to the sun will remain the best utilizers of the sun's energy. Their end products, food, building materials and wood fuels, represent the most effective use of the sun's energy. Plants have tiny semiconductor photo receptors based upon the same principles as have been adapted for use in solar cells. Unlike manufactured solar cells, they constitute another of nature's subsidies.

It follows, if the above notions are correct, that the whole concept of environmental technology needs re-evaluation and that those technological processes which duplicate nature's work must be seen as economic and energetic handicaps. The contemporary dilemma has been created by the establishment of high technology industrial and urban regions which have long overshot nature's healing capacity. Our attempts at correction and purification of these ecologically unsound areas will actually run down available high quality fuels at a more rapid rate. If we stick with our present system we are trapped, because we will need to use a disproportionate amount of energy to sustain a livable environment which in turn will leave less energy available for primary work. For future societies to thrive, growth limits should be set by ecosystems rather than by economic dictates which span only a few years. It is unlikely that new forms of energy, even nuclear

energy, will be able to bail us out if we don't restructure the human landscape of this country.

Nuclear energy is considered by many high technology advocates to be their trump card, but this is a myth the perpetuation of which is in part responsible for continuing on our ill-fated course. Professor Odum, in discussing the energetics of nuclear energy, does not feel the need to go into the dangers inherent within the use of the atom in order to make us rethink what we are presently doing in promoting a large nuclear industry. On the other hand, I think the safety factors, nuclear waste storage and the slow but steady build-up of radioactive materials in the environment are justification enough not to develop nuclear energy as the panacea to all our energy problems. Odum's argument rests on the fact that the net energy from nuclear power plants is low, being presently subsidized by coal and gas economies.

In his talk to the Royal Swedish Academy, he states, "High costs of mining, processing fuels, developing costly plants, storing wastes, operating complex safety systems and operating government agencies make nuclear energy one of the marginal sources which add some energy now, while they are subsidized by a rich economy. A self-contained, isolated nuclear energy does not now exist. Since the present nuclear energy is marginal while it uses the cream of rich fuels accumulated during times of rich fossil fuel excess, and because the present rich reserves of nuclear fuel will last no longer than fossil fuels, there may not be major long-range effect of present nuclear technology on economic survival. High energy cost of nuclear construction may be a factor accelerating the exhaustion of the richer fuels."

The use of breeder reactors is the next link in the efficiency chain. They use less fuel in the production of electricity. However, their net yielding ability is not yet known, in part because of the huge research and development costs involved. Further, contemporary nuclear plants may consume the fuels needed by the breeders before breeder technology comes of age, so we may never know whether or not they could be net yielders, independent of fossil fuel subsidies.

Nuclear enthusiasts are often quick to point out that the ultimate solution to energy in society lies in creating fusion plants; the fusion phenomenon being akin to fabricating small "suns" here on earth. But workable pilot plants have yet to be developed, and there is no concrete knowledge either as to potential net energy or as to how large an energy subsidy will be required. Societies may not be able to afford to shift to the fusion process from their oil and coal bases, even if the concept of fusion should, one day, prove workable.

If the above concepts have a basis in fact, as I believe they do, it is possible to look with fresher eyes

into the dynamic of our present society. The picture that emerges is one of instability and unhappy changes unless we begin to create anew human communities within the limits placed upon us by the living world upon which we depend.

Countries and regions within countries operating upon their own energy resources require less money to function and are in a fortunate position when they export goods and services. Perhaps a corollary of this point is that regional development should be tied more closely to indigenous energies when the future in the long term is seen as being more important than short term wealth and instability. Certainly such an approach would tend to enhance diversity and stability within a region. It might be argued, and quite rightly, that disparities between regions would arise and that the inhabitants of less favorably endowed areas would be poorer. This is partly what I mean by the term, "the limits of nature." Present disparities between regions are sometimes equalized only because of an abundance of cheap energies. This cannot be sustained for long. I have seen communities within a few miles of each other in Haiti, where non-human energy is very expensive and scarce, that are totally different. The root of the differences lies in the local ecosystems themselves. It is when the less fortunate are inextricably dependent on the more fortunate for survival that oppression and injustice reaches its peak.

I would like to suggest that there might be compensations, even though disparities will be generally seen in a negative light. If it were somehow possible to adjust the size of a given community or population to the ability of the surrounding landscape to sustain it, then viable societies might evolve. In these cases, the social goals of equality would have to be worked out within the framework of a region's productive capacity. It may be that sophisticated political theory will one day tell us that an optimal social/political course within a rich and fertile river valley will be different than one for residents of high mountain valleys with inhospitable climates, even given the same goal of maximizing the human experience. In designing adaptive societies, ecological realities need to be placed within the political sphere.

Countries that have high amounts of energy to sell are, in Odum's view, in a strange predicament. If they sell oil (a rich energy source) and don't use it for useful work at home, they too become subordinate nations requiring technical goods and services. Many Arab nations are becoming increasingly aware of this and are shifting more of their energy to manufacturing within their own boundaries. Should they do this on a wide scale they could topple energy-poor manufacturing nations like Japan. Japan's future could provide a barometer of the eventual fate of modern industrial nations.

Those countries or regions that will have the best chance of shifting from their present course closer to

steady-state, lower-energy societies will be those that use primarily internal energy sources and relatively high degrees of indigenous technologies in redirecting their path to safer grounds. Those with the richest internal energy sources will, I suspect, retain more of the characteristics found in high growth, cheap energy economies of today.

It is necessary for us to admit to ourselves that there will continue to be differences in relative wealth between regions in the future as there are today, but this fact should not negate the need for political consciousness to strive for social structures which maximize equality within a region. It may be that well-fed, healthy peoples with small amounts of energy available to them will redirect their lives towards stewardship and artistic and philosophic goals. Wealth as understood by materialists may be an enemy rather than an ally. I don't know this..... but I do feel that when we subtly incorporate the living world into our social consciousness, we have a better chance of surviving, and extending the human condition. An enlightened state will depend on a far greater appreciation of the underlying forces of nature.

There have been systems in nature known to have shifted from fast-growing to steady states through a gradual substitution of components from the former state to those of the latter. I suspect that, in these instances, there still existed a fair amount of reserve energy to effect the substitution. But when readily available energy is exhausted, removed, or tied up within a few species, then dramatic crashes can and do take place. Odum's point here is apt when speaking about shifts in human societies:

"Because energies and monies for research, development and thinking are abundant only during growth and not during energy levelling and decline, there is a great danger that means for developing a steady-state will not be ready when they are needed, which may be no more than 5 years away, but more probably more like 20 years."

The urgency induced by this re-evaluation of our present state is amplified by the humanitarian gestures on the part of some wealthy nations in providing food and medical aid to countries suffering from famine and disease. In Odum's opinion, this practice does not stabilize the world as we have been led to believe, but instead depletes existing reserves, ensuring that the world community will suffer en masse, instead of piecemeal. If he is right, we will find ourselves confronted with an agonizing moral crisis. The only consolation may be that, if it were known that a widespread drop in the human population were inevitable under the present modus operandi, perhaps a powerful impetus would be created to develop alternatives. Many of the techniques described in the "Journal of The New Alchemists" are designed as substitutes, utilizing what presently exists within a

given region. Indigenous courses of action, to be widely effective, will require significant changes in social and political consciousness and a tremendous amount of hard work and commitment to a future that must be very different from the present.

The place of medicine within the framework of energy reductions is not well understood, but disease as the leveller of populations will again resume its primary role in the fate of humanity. Odum, seeing medicine in energetic terms, concludes that our "medical miracles" are also high energy miracles and that the energy for total medical care is a function of the total energies of a country. As the energies per person fall, energy for medicine declines and chronic disease will again become a population regulator.

Epidemics will also become more prevalent. Epidemic diseases operate under a different principle than chronic diseases. Chronic diseases test the vitality of individuals within a given population, whereas epidemics sweep through a high percentage of a population and the effects are more dramatic and widespread. Nature's systems normally use the principle of diversity to minimize epidemics. The other side of the coin is that an epidemic is a biological mechanism whereby inherently unstable monocultures are eliminated. Man's societies may represent, biologically, a kind of monoculture. Certainly his agriculture is characteristic of unstable systems. We have avoided crashes solely through methods that can exist only as long as there is cheap and universally available fuel. Odum's case is succinct:

"Man is presently allowed the special high yields of various monocultures including his own high density populations, his paper pine trees, and his miracle rice only so long as he has special energies to protect these artificial ways and substitute them for the disease which would restore the high diversity, ultimately the more stable flow of energy."

What is our future going to be like if we continue? Professor Odum's view of tomorrow is an unhappy one:

"The terrible possibility that is before us is that there will be the continued existence on growth with our last energies by the economic advisors that don't understand so that there are no reserves to make change with, to hold order, and to cushion a period when populations must drop a hundred-fold. Disease reduction of man and of his plant production systems could be planetary and sudden if the ratio of population to food and medical systems is pushed to the maximum at a time of falling net energy."

We are, whether we like it or not, confronted with the awesome and unprecedented task of reconstructing human societies so that they come into line with the laws of nature. Hopefully we can do it in a way that extends rather than constricts the human experience. In short, to change the world we are going to have to change ourselves. The beginnings are tangible and concrete, and there are guides including ecological concepts.

We find that there are resources, often in the strangest places, as we become less concerned with high energy and more concerned with diverse wholes. If we are willing to change the way we live, then we can begin to restore and reconstruct. By passing through the portals of nature, we can begin to work with or through her so that the scars begin to heal. The path will involve the three strands of practicality, science on a small and human scale, and a wisdom that is philosophical, even mystical. Separately change cannot come about, but perhaps..... and this is only perhaps, together the world will begin to sing.

It is easy to begin. The Ark and the Backyard Fish Farms reflect wholistic and small-scale thinking, and although they are early explorations into man in nature, they will help give confidence and directions.

Time is not on our side. Hence the urgency and tone of the "Journal." To some, like Odum, our survival is at stake; should they be proved wrong, we still stand to gain. If they are right, there can be virtually no alternative that is not hell, until the living order of the earth's mantle is restored.

— John Todd

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This Ant

*It stormed all night, thunderous, raining
wind-syncopated on leaves which thrashed
against the sky or, torn away, struggled*

*on the air like bats until beaten down
and plastered to sidewalks and roads.
Now light, and a calmer wind. The rain's*

*pounding lessens to a second-thought
tap on a drumhead. A long grass stem
dips as a black ant climbs the green stalk*

*past boulders of water to stand finally
at the tip, feet braced against the sway,
and wave antennae at the sun.*

— Don Esty

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On the Need for Studies of Food Consumption Ideas

1. The Problem

For some years we have focused our research on fishing communities. Fishing is, of course, a distinctive mode of food production. It is the last stronghold of hunting, as opposed to agricultural and factory production, in the modern world, and as such an anachronism — one which the New Alchemists are trying to eliminate, by developing fish farming. Study of fishing societies led us to a general interest in the change and modernization of food production, and

this in turn has taken us on to problems of food consumption.

In the social sciences, as elsewhere, there is little attention paid to the origin and change of food habits. As everyone concerned with the world food problem knows, every culture has an enormously complex and intricate pattern of beliefs, practices, attitudes, taboos, principles and strategies relating to the preparation and consumption of food; and these beliefs are often a major hindrance to the introduction of new, nutritionally desirable foods. Moreover, even with the best of nutritional education, such changes as do occur are often in the wrong direction. Thus in spite of the best nutrition research and education in the world, the United States as a whole has been changing its collective dietary patterns for the worse; more fat and sugar is consumed, fewer fruits and vegetables, and the sugar is increasingly sucrose, which feeds tooth decay bacteria and is suspect of other sins, instead of the less dangerous sugars in fruit, honey, etc. (U. S. Dept. of Agriculture, 1969). Similar deterioration occurs elsewhere; thus in Chile, mothers decided that nursing was old-fashioned, and greatly shortened the nursing period, with disastrous effect (György and Kline, 1970). In our recent research in Malaysia, we found a shift from fruit and vegetables to fat and sucrose, similar to the changes taking place in America.

Nutritionists, agricultural developers and other concerned parties have repeatedly noted such changes, but rarely try to explain them. Rejection of new foods is laid to "tradition" or "superstition", while deteriorative changes in diet are passed off as "ignorance" or, with somewhat more sophistication, explained as prestige-seeking imitation of the west. These are obviously inadequate. Who are the Americans imitating? Their inadequacy is often cloaked behind a body of incorrect beliefs about food habits, some of which beliefs are even stranger than any taboos of the developing societies. Thus the ancient Jews are credited with a fantastic prescience about the vectoring of trichinosis, and their ban on pork thus explained. It is obvious from the taboos listed in Deuteronomy that 1) ideas of sanitation and disease vectoring were exceedingly rudimentary in those days; 2) the pork taboo is part of a long list of taboos, which cover organisms as diverse as vultures and oysters, none of them particularly noted as disease vectors; 3) these taboos fall in a pattern — they all involve animals that are strange, unusual, or anomalous, e. g., in cleaving the hoof yet not chewing the cud. Clearly pork was banned for reasons other than its possible role as a trichinosis vector. Similarly, the Hindu rule against eating beef is explained simply in terms of religion, but is actually a more involved problem (Harris, 1966). The cow is protected because it is more useful alive — for traction, milk and manure. The beef is eaten, by lower-caste and some upper-

caste individuals. Perhaps the taboo is explained in part by a need to make sure that these individuals get some protein. But, more generally, it is clear that one gets far more protein per acre by saving cows for milk, and having bullocks for plowing the fields for lentils and beans and chickpeas, than by ranching beef. Religion has thus apparently served in great measure as a sanction for hardheaded, practical economic behavior. (On these subjects, cf. Simoons, 1961, for expansion and further viewpoints.)

Anthropology has devoted some attention to these things; not surprisingly, the French are well ahead in this field (Levi-Strauss, 1964- ; Verdier, 1969, with comment by Anderson, 1970^a). Partly in response to French activity, the British have begun work on the subject, e. g., Leach, who writes mostly on taboo rather than food per se (1964). Yet even the best recent popular books on food contain numerous errors and misinterpretations, and the amount of concrete analysis of food consumption remains exceedingly small. Sociology and psychology, in spite of their interest in man's other physical needs, pay essentially no attention to the subject.

2. Some Actual Cases

Herewith we will briefly note three cases that point up certain facets of the situation.

The Cantonese Cuisine. We have elsewhere analyzed Cantonese cooking, which we studied in Hong Kong, in some detail (Anderson and Anderson, 1969; Anderson, 1970^b; Anderson and Anderson, ms). This is a highly traditional cuisine, the rules of which are definite and long-established. As Cantonese cooking has reached a high degree of efficiency in resource use, it provides an interesting case.

The cuisine can be analyzed as a minimax game: minimizing such factor inputs as fuel, time, effort and cooking ware, while maximizing nutrition, taste quality and the production of food; minimizing fertilizer and biocides while maximizing the yield of nutrients per acre. A few examples of the process: rice, the staple, produces more calories per acre than any other grain or indeed any other starch crop in the Cantonese climate. It is also rather high in protein and B vitamins as starch crops go, especially if it is not milled overmuch. Eaten with the rice are soy-bean products, the highest protein-per-acre yield of any crop in the traditional world, and a fairly complete protein at that, i. e., supplying reasonable amounts of all the amino - acids that humans cannot synthesize. Also consumed are large amounts of cabbage-related greens (high in vitamin C and other vitamins in the otherwise vitamin-poor cold season), chili peppers (high C and A), carrots and orange sweet potatoes (very high vitamin A), and fish (cheap, easily available protein). The animals raised — pigs, chickens and ducks — produce maximal protein on minimal feed. They have high conversion ratios and can be fed on scraps, or turned loose to eat the pests and weeds

from the fields, saving money and time on control. The cooking process typically consists of stir-frying or steaming for brief periods on very high heat, making efficient use of time and fuel while not destroying heat-labile nutrients. Even salt is used with maximal efficiency, to pickle or preserve foods, which are added to the meal to season it to taste – salt is almost never applied separately.

Thus we find a traditional regime in equilibrium with the environment, making about the most efficient use of resources that a traditional, unmechanized peasant society can achieve.

Penang Hokkien Diet. During somewhat over seven months of research in Penang Island, Malaysia, we studied the dietary beliefs and attitudes of the Hokkien-speaking Chinese who form the largest single group in the island's population. Here we observed, among other things, the deteriorative modernization so commonly remarked on by writers elsewhere. This was most marked in child diets, but was found throughout the system. Nursing of children, formerly carried on for some years, was being limited to a year or so, depending on how "modern" the family was. The children were weaned onto rice gruel, soft sweets and sweetened condensed milk or other milk products. This diet was exceedingly high in starch and sugar, and very low in all other nutrients – even the commercial milk products being highly diluted, in practice, with sugar and water. Formerly the pattern had been to nurse the children for a longer period, gradually introducing rice gruel and other foods. Commercial, sucrose-rich sweets had not been available and fruit had been the snack food of choice. The result of this dietary change was a spectacularly high incidence of tooth decay, especially of the front teeth (incisors, spreading to canines). Such decay is rare in the U. S., where soft foods and sweets are less prevalent in the child diet, at least after the child is old enough to eat solid food. We did not observe clinical malnutrition – partly because we were studying fishing settlements, where even the youngest child gets at least some fish – but the growth rate of the children was lower than that of American or modern Japanese children. The adults in the modern Hokkien population consumed large amounts of fat, as cooking involved much deep-frying in lard. A family of six would use one-half to one pound of lard a day, and sugar, commercial sweets being very popular. A standard snack was flour-and-water noodles in soup, the soup involving much lard or very fat bacon. While not causing malnutrition, as a lot of meat and vegetables were eaten, this diet led to gross overweight and to continued tooth decay. This diet is in part traditional, the noodles especially being a famous Hokkien dish for hundreds or thousands of years, but has been changed for the worse by a combination of factors. Increased wealth of the community and increased production of meat and sugar has allowed the purchase of much more lard

and sweets than could have been bought in traditional days. Why was the extra money not spent on lean meat, fruits and the like? The result is a complex social-structural problem. Lack of nutritional education is part of it, but the main part is the felt need of the community to rise in status by westernizing. This need is created by certain tensions and problems affecting the Penang Hokkien community. Long-established in Malaysia and with weakened ties to traditional Chinese culture, this group is still subject to anti-Chinese sanctions by the Malaysian government, which has in recent years been trying to raise the economic level of the Malays which form about half the population of Malaysia to that of the Chinese which constitute approximately one-third. The remaining one-sixth consists of Indians, aboriginals and Europeans. The economic and political measures taken by the government – in effect, positive discrimination toward Malays in education, government jobs, etc. – has affected the poorer segment of the Chinese community. The Hokkien of Penang have been also hard hit, by the decline of Penang as a port area. Most of the poor Chinese of Penang are members of the old, long-established, somewhat de-Sinicized Hokkien community, and most of these Hokkien are poor where other groups, notably the Cantonese, have been more successful and have remained closer to Chinese culture. The Hokkien see their position as worsening. Left with increasingly vague ties with China, no possibility of being accepted as Malays, and a sense of hopelessness over the economic situation, they have developed feelings of alienation. These have often caused, among other things, a shift in the direction of westernization – other doors to a stable cultural pattern being seen as closed. And the leading edge of westernization in the third world has been white flour, white sugar, soft drinks, candy, cookies and fat. These foods are easy to manufacture; the largest number of factories in any one industry in Malaysia is involved in food-processing, most of them in the production of these foods. In addition there is a large home industry of sweet and noodle-making. These foods are easy to store and to sell in the tiny shops so characteristic of Malayan towns and villages. On the other hand, the excellent, varied, cheap and nutritionally superior fruits that Malaysia produces are seen as both "backward", as they are produced by the more traditional rural districts, and identified with the Malays. Meanwhile, fat has been accepted as a sign of health, indeed of security; a very fat man is thought to be healthy and well-to-do, even psychologically well-off; fat children are desired. This is a considerable exaggeration of a pattern well established in Chinese culture; in old China, some flesh was desired, but not gross overweight. We feel this exaggeration of the traditional pattern is a sign of increased, even perhaps "exaggerated", need for security and reassurance.

The Health Food Syndrome in the United States. With a student, Janet Farley (ms. and pers. comm.) we have done some very preliminary investigating of the rapid shift to health foods and organic foods in the United States. These foods are exceedingly well-established in certain U. S. communities, notably the Seventh-Day Adventists, and have become essentially a part of the traditional folkways of these communities. They have recently been discovered by the young, and are now — as *Time* magazine well puts it — “the Kosher of the counter-culture.” This we see as part of a pattern. Along with astrology, magic and so on, the health-food movement is a counter-science; a pseudo-scientific movement, traditional and well elaborated, with its own “authorities” and body of data, and a long heritage, much of it one of identification with the underdog or at least with the dissenter. Disillusioned with the science that has given us the nuclear bomb, the jet plane, biochemical warfare and the Nazi gas oven, the young seek an alternative science. This is in itself interesting; obviously the demons of war are not produced by science per se, but by politicians’ use of it. However, American youth has been brought up to think that “Science” has given us these blessings, along with others such as cars and factories, and the idea that technology is an independent force, rather than a tool that can be used or misused, has become firmly rooted. Thus, logically, rejection of war and materialism means rejection of the science that produced it. Specifically, in regard to food, such things as store-bought bread and white sugar, tasteless and overused as they are, are identified with orthodox food science, and thus good food must be sought in the alternative stream. The tasteless, textureless character of much modern food has greatly helped, since whole grain homemade bread, for example, is clearly more interesting to taste as well as theoretically more nourishing. But considerations of aesthetic quality are at best secondary.

Further work on this matter is needed, specifically to correlate involvement in the organic food movement with degree of rejection of orthodox science and other aspects of life that are felt to be in opposition to the counter-culture. (Cf. Deutsch, 1967, for the history of the organic movement and its identification with protest; Deutsch is very unfairly biased against organic foods and the book is far from the objective appraisal needed, but it is the nearest thing we have. All the literature on the subject, as far as we can ascertain, is partisan on one side or the other).

3. Directions for Future Research

Our concern is to relate food habits and patterns to other social concerns, and to explain both, or at least to understand them enough to allow us to make verifiable or disprovable statements about them — in short, to predict changes in food habits as related to other patterns of behavior. This involves understanding of the ecology of agriculture and diet, to prevent the gross mistakes of some developers who have tried to

modernize agriculture by making peasants give up food they needed for balanced diets, or introduced changes that upset traditional production of such necessities. It also involves some understanding of the history of the society in question, specifically its economic organization and the distribution of political power within it and between neighbors and contacts.

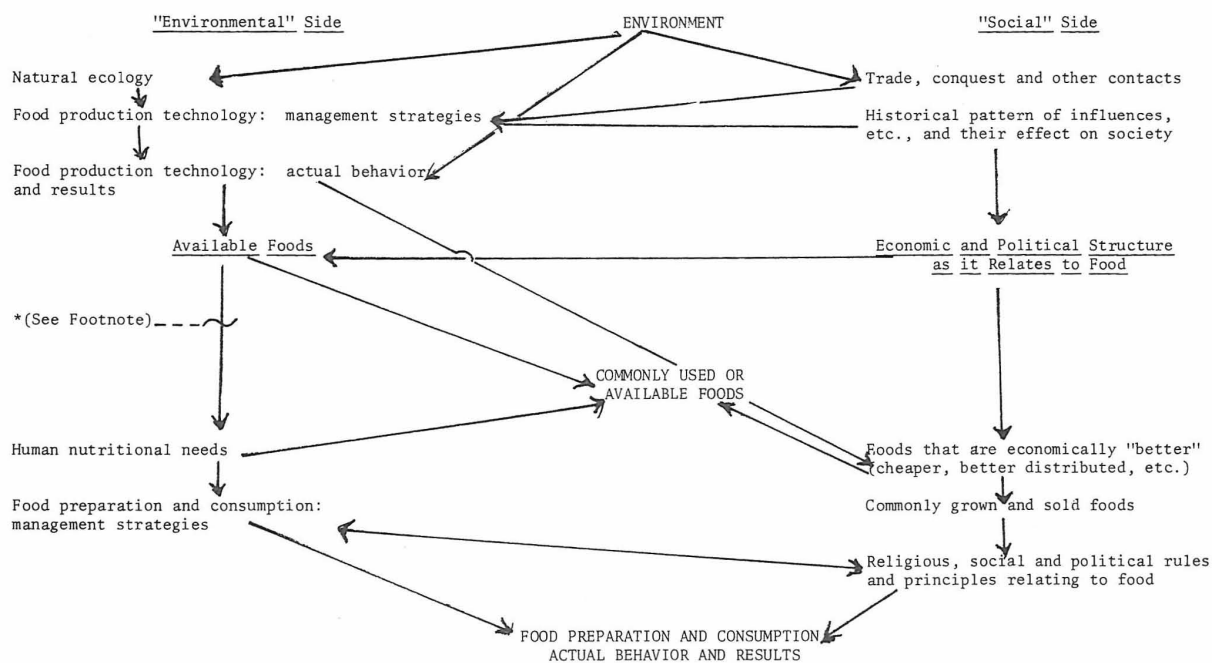
We hope, further, that nutritionists will devote more effort to establishing dietary needs and the effects of various foods and food chemicals. The current acrimonious argument over the merits of vitamin C as a cold-preventer (cf., notably, Pauling, 1970) indicates that even this long-studied and well-known chemical is poorly investigated. To us, as relatively unbiased observers, it seems that both sides are far more dogmatic than the evidence permits; statistically-significantly large samples and adequately controlled experiments are not overly abundant in the reported literature. Similar controversies, less well-publicized but none the less important, are being waged over the minimum calorie requirements of the human organism; requirements for trace minerals; toxicity of a whole range of additives and food chemicals, including naturally-occurring ones like oxalic acid; and many other things. The ratio of dogmatic statements to hard, well-controlled experimental evidence is consistently too high, and the social scientist is somewhat at a loss in evaluating needs. We are also not helped by the lack of field studies of the nutritional status and food consumption patterns of both traditional and non-traditional societies. It seems that the nutritional requirements of the rat and other laboratory rodents are far better known than those of *Homo sapiens*.

4. Very Crude Steps toward a Model

The following schematic diagram has been developed as an extremely rough beginning of a model for guiding research. It is based on a number of models (e. g., those found in the cited works by Levi-Strauss, Harris, et al.) combined and modified in light of our research. We are currently trying to refine it.

And the model concludes with the actual nutritional status of the population as well as its food habits.

It should be noted that change introduced at any point changes everything in the model. However, for convenience we have not drawn in the reverse arrows, for, for example, introducing a new crop often changes everything else as, most spectacularly, when New World food crops like maize and chili peppers were introduced to Asia. Population rose very rapidly, in part through these dietary changes, putting a strain on traditional political systems which had trouble turning out administrative personnel fast enough to govern the population. Ecosystems were stressed, for example, by the shifting-cultivation system, overloaded by increased pressure brought about by population growth. And, of course, food preparation and production were stretched.



*Many investigators believe that adaptation to available foods changes nutritional needs.

Refinement of the model is needed, especially on the "social" side, which is at present hard to quantify and in places debatable. We think we are right in relegating ideology and religion to a very minor position, but this may not be so; other workers disagree. We have also left any "instinctive" or "inborn" factors out, but they may just possibly be relevant.

5. Exhortation

This whole field of concern has grown in our minds because our research has made us more and more aware that food consumption patterns and beliefs must be understood if the world is to be fed. While food production technology is more important, and raising the incomes of the poor is certainly more important, in giving the human race an adequate diet, food consumption cannot be ignored. Some Asian countries, for example, have concentrated on rice production increase because of the belief among both public and leaders that rice is the perfect food. Since protein and certain vitamins and minerals are more generally inadequate than starch and B vita-

mins in the Asian diet, though starch and the B's are far from sufficient either, this has had a dubious effect — especially when growing more rice means growing less protein, as when insecticides on the rice kill stream fish, or when mechanizing rice agriculture means growing few buffaloes in an area dependent on retired plow-buffaloes for meat. Another unexpected problem was found in analysis of fishing development; we found that many tropical fishermen make their real profits from sales of high-priced "luxury" fish, and thus fishing development is hindered, through lack of capital, in areas where meat is the prestige food. We assume, contrariwise, that the livestock industry has more potential in these areas than it does where a feast means gorging on high-price seafood. Such things can affect the entire economy and are more complicated and, therefore, more interesting even than such changes in taste as the worldwide Sucrose Revolution with its legacy of carious teeth.

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UPDATE ON JOURNAL TWO

"A Water Pumping Windmill That Works." pp. 21-27.

The design has undergone a number of changes since original publication. For example, we have found that while the automobile crankshaft is the least expensive strategy for translating rotary to reciprocal action, it is not as durable as we had hoped. We now are using staying, higher quality bearings and a "flywheel" reciprocating rod attachment to increase the mill's ruggedness. If you intend to build this mill, consult update in JOURNAL THREE or contact us.

"New Alchemy's Ark." pp. 35-43.

This design has been changed considerably. JOURNAL THREE contains a current brief, but accurate, description. JOURNAL FOUR will give a detailed account of design and construction. If a drawing of the Cape Cod Ark would be useful to you, send us a stamped self-addressed envelope with your request.

"Towards a Self-Sustaining Agriculture." pp. 44-61.

This article is from Radical Agriculture by Richard Merrill to be published by Harper & Row, August 1976.

"Walton Two: A Compleat Guide to Backyard Fish Farming." pp. 79-117.

p. 88: Dome covering materials: We are now using a greenhouse fiberglass material (two layers separated by 3/4" batons) manufactured by Kalwall Corporation.

p. 90: Life Support Systems is out of business, as far as we know.

p. 101, column 2, paragraph 4: We have found that some filamentous algae, at least, are eaten by our tilapia. They might be suitable for introduction directly into the system, but only after testing to see whether your fish will eat them.

Update on Fish Suppliers Listed on Page 103.

p. 103, paragraphs 1-3: Both Cal Hollis and Ray Fuller have had difficulty filling orders for tilapia. The only sources we can currently recommend are:

Tilapia: Lake Annette Fish Hatchery and Farms
P.O. Box 5665
Greenville, Mississippi 38701

Israeli Carp: Perry Minnow Farm
R.F.D. #1, Box 1015
Windsor, Virginia 23487

We may still be able to supply a few fish, as described on this page, but New Alchemy-West definitely cannot.

p. 103 (cont.): Predators: Large mouth bass (4"-5" in length) were effective predators in one pond in 1974, withstanding high pond temperatures.

p. 104, paragraph 1: We also recommend Delta Net and Twine Co., P.O. Box 356, Greenville, Mississippi 38701.

p. 108: Postscript to feeding instructions: If you cannot obtain supplemental feeds readily, a small amount of commercial floating trout or catfish chow will enhance fish growth. Be sure to use floating pellets so that consumption by the fish can be watched. Do not feed more than they can ingest in a few minutes. Purina and other feed dealers handle fish feeds.

p. 111, Reference no. 5: McLarney, Henderson and Sherman is no longer in press, but has been published. The full citation is: McLarney, W. O., S. Henderson and M. M. Sherman. 1974. A new method for culturing Chironomus tentans Fabricius larvae using burlap substrate in fertilized pools. Aquaculture 4(1974): 267-276.

p. 119, Reference no. 4: Same as above.