CONCLUSION

In 1891, W.O. Atwater published an article in The Century magazine entitled "The Food Supply of the Future." This article exemplifies the scientific optimism of the times, and quite accurately predicts the large increases in productivity as well as the rise of artificial food production through chemical synthesis that occurred during the first half of this century. He even anticipates science tapping the sun as a source of power in the 20th century. However, his opinion "that the capacity of the earth for yielding food for man is almost unlimited,"[1] and that soil fertility is "in such abundance that the cropping of ages would not begin to exhaust them"[2] (chemical elements necessary to plant growth), is being reassessed in the 1970's.

Atwater states:

> "It may seem paradoxical to say that the dense population which the older economy told us was to be the precursor of starvation will be actually the antecedent condition of a cheap and abundant food-supply; but is this anything more than the reassertion of a principle which has proved itself true in the manufacture of cloth in the factory, of machinery in the machine-shop, and in countless other ways?"[3]

And that:

> "We may hope that the science of the future will provide the power. The amount of vegetable growth that is possible within a given area is entirely outside our ordinary calculations. The old way of estimating possible food-production by land-area and soil-fertility is wrong. We have only to assume that as the population of the earth increases there will be a corresponding improvement in the use of plant-food and energy, of which the supply is practically inexhaustible, and the problem is solved."[4]

This optimism and belief in science and technology did not foresee the grave global problems of decline in soil fertility, pollution, and limits to biological control. It did not foresee the shortages of natural resources, which have already begun to affect us before substitutes can be created. The optimism of the late 19th century may have made sense to those people given the reality of the times, but such optimism today is blindness to the reality of 1976. Optimism need not be forsaken and scientific advancements will continue to help, but the underlying assumptions must change.

Estimates of the World Bank, the United Nations, and the USDA do not predict any increase in world food reserves--despite U.S. bumper crops this past year. Implications for increasing amounts of available per capita food over the next ten years are very poor. World population has already passed four billion. Assuming good climatic and economic conditions there remains real doubt as to the possibility of maintaining the present per capita level of food supply. Future trends

of climate and available resources are unclear, but extrapolation of many present trends indicates severe dislocation and shortages of food. Without question, changes will occur. The nature of those changes and their effect, will in part depend upon the ways in which all of us act over the next few decades. Due to its vulnerable geographic and economic position, Vermont will feel the effects of change as much (or more than), any other area in the United States.

Economic indicators point to increasing diversification of production all over the world, rather than greater centralization into multi-national corporations. In all likelihood the repositories of modern ideas will also change. Those groups and nations most able to adapt will find themselves in ascendant positions, as J. Bronowski has prophetically pointed out in his Ascent of Man. As De Tocqueville noted, local government has been the school of democracy. There is nothing in the American tradition or our basic concepts of democracy that prevents a movement towards decentralizing some major aspects of our political/economic system. In fact, to the contrary. We need only redefine efficiency. Perhaps, with new ecological awareness, we will come to better understand what can not be centralized without creating disequilibrium and system unresponsiveness (or, an inappropriate response) to environmental information in its broadest context.

We have a wealth of information from the past and from all over the surface of the globe, as well as the tremendous scientific and technological capability of the present projected into the future. If we are to create balanced food production systems which function in an integrated ecological fashion, we must draw on these resources and on our immense reservoirs of creative energy. This is no small task.

Natural biomes or biogeographical regions exist and transcend state and national political boundaries. The assessment of "needs," the assessment of production potential, the determination of real and total costs, the consequences of the production-consumption system in terms of interpersonal realtionships, personal and societal health, and long-term environmental balance are areas of vital concern in critiquing the present food system and developing new, more humanistic bioregional systems. These are specific areas for discussion and diligent research, to be approached in an objective and holistic fashion with the fullest focusing of human and natural resources. This does not mean that the "cold barren facts" are the only material to be assessed. We need to learn to "think with the heart, feel with the head" in attacking this problem, to subject all of our values to thoroughgoing scrutiny--but not to make the work "value-free." The quality-of-life aspects of bioregionality are its greatest values.

The transitional stages to a more self-sufficient system are in some ways harder to imagine than the finished product. It is clear, for example, that the present economic system for food production and distribution works largely because all of the real costs, the total environmental and societal costs which it takes to make the system work, are not figured into the price of a head of lettuce or a pound of tomatoes. Present economics charge only some of those costs (usually only the most direct ones) to the price of a tomato, while

the other costs of the system as a whole are assessed through the "commons" as Garrett Hardin has called it. It is not clear when these dues will be paid, but they will not go unpaid indefinitely.

Rising energy prices will affect costs of food production,[5] processing, and distribution. The effect will be even more profound if energy is given a higher monetary value that is more in accordance with long term resource considerations. For example, let us examine the energy costs of bringing fresh lettuce and peppers from California to Boston. These products are carried by rail car and by truck from coast to coast, approximately 3023 miles. At 170 kcal/ton mile of running costs, a rail car uses 513910 kcal for the trip (carries 1000 cases at 43 lbs. a case), or 11.9 kcal per pound of lettuce. Due to difference in bulk, peppers are 16.4 kcal per pound. It is also necessary to account for the manufacture and maintenance of the rail car, which after amortization, is 51995 kcal for the trip, or 1.2 kcal per pound for lettuce and 1.6 kcal per pound for peppers.

At 706 kcal/ton mile of running costs, a "semi" truck uses 2134238 kcal for the trip (carries 750 cases at 43 lbs. a case), or 66 kcal per pound of lettuce. Again, due to bulk difference energy utilization for peppers is 89 kcal per pound. The maintenance energy costs for truck transport is much higher than for rail, and after amortization comes to 42 kcal/lb. for lettuce and 57 kcal/lb. for peppers. Energy costs of human labor and machinery for handling have not been included. A comparison is as follows:

Amounts of energy utilized in transport from California to Boston

	Truck	Rail
lettuce	108 kcal/lb.	13 kcal/lb.
peppers	146 kcal/lb.	18 kcal/lb.

In recent years the major carrier has been rail, with trucks carrying between 25 and 40 percent. Often, trucks and rail cars return empty to California. This has the effect of doubling the transport energy costs. Lettuce, for example, instead of being 108 kcal/lb. by truck would by 216 kcal/lb. It requires approximately 280 kcal/lb to produce lettuce. The energy required for transport compared to the energy required for production shows the large percentage that could be either saved, or used for local production, with no net energy loss by producing locally rather than in California and transporting. The above comparison is incomplete as it is not a total accounting, but it does exemplify the type of question and examination we need to undertake if we are to understand more fully the real costs to society of producing and distributing food as we now do.

A continued growth of agribusiness and specialization on a national and global basis would unquestionably be the complete end of both the family farm and a vibrant, healthy, rural society. This would mean the end of rural Vermont even as it is today. A number of studies, the most recent by Stanford University, indicate that the

family farm is more efficient than large scale agriculture. Growing awareness of this on the national level may well lead to new legislation that would help Vermont maintain the family farm. George McGovern has recently proposed such legislation in Congress. It is certain that without small scale or family farms agricultural diversity in Vermont will be impossible. Hopefully, the three previous chapters have shown that the natural resources necessary to support Vermont's population are available. The decision to utilize them in a self-sufficient fashion is both economic and a question of life style.

There is an increasing amount of economic[6] and ecological theory to support steady-state bio-economic systems and therein a more diversified agricultural system. For example:

> "There are two important parameters that measure development of ecosystems which are derived from information theory; they are for the measurement of community diversity and community organization . . ." that ". . . the total effect of a mature system with its increased efficiency in the use of energy, resources, and space and its increased community diversity and organization is to create a higher degree of environmental control (that is, the flows of energy and matter are closely directed by biotic factors within the system). This control is achieved on three levels--resource availability, climatic buffering, and system stability.
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> An immature system is dependent on a relatively large and continuous supply of resources which are external to the biotic system and so it is very open to environmental variation in the availability of resources. The lack of control leads to inefficiencies, wastage and, in time, depletion of resources if it remains in an immature state. By contrast, a mature system has a much greater biotic control over its resources through the detritus food chain and other mechanisms which are a means of regulating the availability of resources. The threat of resource depletion is much less in a mature system."[7]

If we are looking for long term ecological balance, we should examine well the implications of greater food self-sufficiency for Vermont. The search for efficiency and acceptable life style in our future may well lead to smaller scale production units. Questions on life style and how we will address the upcoming changes in our economic life, remain to be answered.

Footnotes

1. W.O. Atwater, "The Food Supply of the Future," The Century Magazine (November 1891 - April 1892) Vol. XLIII, p. 101.

2. Atwater, p. 107.

3. Atwater, p. 111.

4. Ibid.

5. For a full energy accounting in Vermont agricultural production see, Energy Utilization in Vermont Agriculture. Two volumes (Center for Studies in Food Self-Sufficiency, 1976).

6. See, for example, Herman E. Daly, Ed., Toward a Steady-State Economy (W.H. Freeman and Co., San Francisco) 1973, and E.F. Schumacher, Small is Beautiful (Harper and Row, New York) 1973.

7. Peter W.G. Newman, "An Ecological Model for City Structure and Development," Ekistics (October, 1975) pp. 260-261.