AGRICULTURE AND HERITAGE

By Alan R. Drengson

In **Building a Sustainable Society**, Lester Brown tells the story of the rise and fall of one of the major centers of Mayan civilization. He sees parallels between the agricultural practices that led to the collapse of Mayan civilization and those of our culture. Brown describes a recent study of Mayan population in the lowlands of Guatemala. This study showed that from the time of Homeric Greece in 800 B.C. until 900 A.D., there was a continuous doubling of population, on the average of every 408 years. The greatest density of population reached was the same as the most populous, contemporary, agricultural societies. Then, he writes, "(a)t this agricultural, cultural, and architectural peak, the civilization suddenly collapsed. Within decades, the population fell to less than one-tenth of what it had been. An analysis of core samplings from two lake beds in the area hints at the reason for this abrupt decline. As population pressure increased, soil erosion gradually accelerated. The topsoil was being washed into the area's lakes, draining the cropland of its productivity and one of the world's early civilizations of its sustenance." (pp. 3-4)

Scientific studies show that as early as 250 A.D. the area was deforested. As pressures on the land intensified with increased cultivation, the stored resources of the soil were consumed faster than they could be replenished. The Mayans were consuming the land, and this made possible the rapid growth in population and culture. The costs to the soil were probably not perceptible to the "managerial elite or their economic advisers." (From the original article, as quoted by Brown p. 4)

Brown speculates that we might be in a similar situation, given the current practices of mechanized, North American (and also global) agriculture. The demands that we are making on the soils and lands far exceed those of earlier civilizations, which were smaller in scale and more localized in their effects.

New soil is formed in nature at a rate of from one to five tons per acre, per year, depending on the land. When erosion exceeds the natural rate of formation the soil thins. As Brown points out, all major farm land areas in North America have soil loss rates that exceed the natural rates of soil formation. In Tennessee the average loss is 14.1 tons per acre, in Missouri it is 11.4 tons, in Mississippi it is 10.9, in Iowa 9.9, in Texas it is 14.9 tons, and in Colorado it is 8.9. Canada's farm lands are suffering from the same soil loss problems and this is described in **Soil at Risk: Canada's Eroding Future.** (See book section.) In the Peace River region the per acre loss is 5 to 12 tons per year. In Ontario the loss ranges from 5.5 to 21 tons, in PEI it runs from .1 to 9 tons per acre, per year.

The effects of soil thinning on fertility have been calculated by David Pimentel of Cornell University and others. He found that, other things remaining the same, corn yields declined an average of "four bushels per acre for each inch of topsoil lost from a base of 12 inches of topsoil or less." (As quoted by Brown, p. 21) A similar calculation is presented in **Soil at Risk**: Erosion of 1 inch of top soil can reduce wheat yields by 1.5 to 3.4 bushels per acre. South West Ontario has lost 30 to 40 percent of its corn yields for these reasons. These calculations are complicated by the fact that farmers attempt to replace this loss by increasing the use of petroleum based chemicals and fertilizers. These allow a mining of the soil by artificially stimulating plant growth.

Most discussions of contemporary agriculture in the major media stress either the productivity of our agriculture, i.e. productivity in terms of labor expended, or the plight of the farmers. In more specialized periodicals and reports, we find disquieting accounts of what is happening on the farm. In part the economic plight of farmers in North America is related to the enormous capital that is invested in farm land, equipment and chemicals. This capital is borrowed at high interest rates. Measures of farm productivity and economic prosperity tend to be based on short term returns. If total costs and long term consequences are considered, a different picture emerges. Over the long term we can see that soil erosion, and soil lost to acidification, salinization, urban development, and contamination represents a large toll of our agricultural heritage. (We have not mentioned the secondary effects of many of these processes on ecosystems and health, nor have we described the effects of farm bankruptcy rates on the cultural community of farming.) When we consider all soil loss, the rates far exceed those permissible for a long-term, sustainable agriculture. But at the same time, the current economics of agriculture seem to make it less cost effective (in the short term) to undertake methods of cultivation that conserve soil. The farmers seem caught between a rock and a hard spot. If they practice cultivation of the soil to protect it, the short term costs can decrease the operation to less than marginal economic value. If they practice contemporary short term methods of maximizing yields and returns through mining the soil, the long term fertility costs will undermine the viability of farming. Moreover, as soil quality goes down, other costs must go up to replace soil fertility with chemical substitutes. Loss of soil fertility leads to compensatory use of artificial fertilizers. Monocultured hybrids, raised on petrochems are more vulnerable to insects. Insect sprays contaminate food chains through water and air born transmission. These chemicals can adversely affect animal and plant life, including humans. However, as **Soils at Risk** and Brown make clear, there are solutions to these problems, but they require a comprehensive approach and a redesign of our practices.

We have said little so far about the nature of topsoil itself. Topsoil is not just an innert mixture of chemicals, but a biological community of incredible complexity, that is part of an interconnected cycle of decay and restoration. Any philosophy for a sustainable agriculture has to start with an understanding of the soil and its living characteristics. Alternative approaches to agriculture that include a vision of sustainable practices also involve some understanding of the culture of agriculture, for the most successful, long-term, sustainable agriculture (often called permaculture), actually increases soil fertility, and is traditionally surrounded with a culture of rich festivals and rituals which help to insure the continuance of sound practices of cultivation. In festival and ritual Mother Earth is celebrated; respect and worship of her is cultivated. Sound agricultural practices make this respect and worship concrete and her nurturance is earned. Farming and cultivation are such a culture's basic organic metaphors for understanding the nature of human life and the way to live wisely on the Earth.

The metaphors of soil and cultivation go deep. Consider: As we treat the soil, so we treat ourselves. As we nurture ourselves, as we feed our bodies, so shall our health be. Our minds can be cultivated, nourished on proper, wholesome nutrition, or fed a diet of junk. (A lot of popular entertainment is mental junk food.) The emotional life cannot be overlooked, for here too is "fertile ground" for the cultivation of human nature. As farm land can be abused and turned into a sterile desert, so too our emotional lives can be turned into deserts, when we repress our sensitivities and deprive our sensibilities of sustaining cultivation. As we sew, so shall we reap. The future of our culture can be read in its agriculture. The character of our society can be seen in its methods of cultivation. Its methods of cultivation can be seen as all forms of planting and care. How do we cultivate the plants and animals that sustain us? How do we cultivate character and values in our communities and selves? In referance to growing character, we know that the quality of the total diet of food, love, and learning, along with our genetic and cultural heritage, is related to what we can become. There are many forms of nutritional disease which begin in the soil of our lives. These literally carry through to the earth under our feet.

The etymology of "agriculture" reminds us of the earth under our feet. "Agri" comes from the Latin "ager" which means a field and is the source of the word "acre". (Which originally meant the size of field one could plow in a day.) "Culture" is derived from "cultura" which means cultivation. To cultivate is to till, or to prepare the soil for some end. The word "cultivate" contains the word "cult" which comes from the Latin "cultus," which means care and cultivation. Note that the source of "cultus" is the Latin "colere," which means to till and is akin to the Old Norse "hwel" and also the Anglo-Saxon "kweol," which is the source of "wheel" (to turn). "Colere" also means to be engaged in. Putting all of this together, then, the agriculturalist is one who is engaged in the cultivation and care of the soil or land. He/she tills the soil and cultivates a crop. The older agricultural societies saw nature in terms of a recurring cycle (wheel) of birth, growth, maturity, death and decay. For it, there was a time for everything: A time to plow and a time to sew, a time to reap and a time to lie fallow. In some religions this grand cycle is called the "Wheel of Life". What is living is superseded by death, but out of decay in the soil comes new life, a reincarnation of matter in the living. Life and death are just two different parts of the same wheel that turns round and round. (From this comes the idea of the wheel of fate and fortune.)

Aristotle once called earthworms the intestines of the soil, and, we might add, to the good farmer the soil is the intestine of the Earth. For in the soil all matter is digested and made available for larger plants and animals. Without its part in the cycle, the pyrimid of life on Earth would vanish. The discipline of caring for the soil is itself part of growing character. A mature ecosophy involves a transcendence of willfulness, impatience and greed. It involves the tempering of desire with love for the good Earth. We journey to the Moon and see the Earth from afar; we realize that the Earth does not belong to us, but that we belong to it. As with Candide our journeys end, and we realize that we have to cultivate our own gardens, for by our fruits the art of our stewardship is shown. This applies not only to spinach, but also to culture and character. Agriculture is both science and art and so is the cultivation of character and culture. What sustains all three is the same type of discipline, the same practice, attention and care.

In this issue of **The Trumpeter** we explore the roots of our civilization as these interpenetrate the soil that supports us. The discussion of farming will be continued in Vol. II, no. 2, since there is more material than can be accomodated in one issue. Wilderness will be the subject of nos. 3 & 4.

This issue of **The Trumpeter** contains three articles on agriculture, two of which are published here for the first time. Michael Crofoot explores the nature of the living topsoil in "Plant Symbiosis". Stuart B. Hill describes the psychological and social dimensions of wants and needs and how these place certain demands on ecosystems and agriculture. He provides a diagram showing the contrast between a shallow and a deep approach to coping with agricultural pests. The article by Wes Jackson was originally published in **Not Man Apart**, but I have decided to reprint it here since it is one of the best, short articles on the need for, and the prospects of, a sustainable agriculture.

PLANT SYMBIOSIS: A DEEPER ECOLOGY

By Michael Crofoot

Recent discoveries in soil microbiology are developing a body of knowledge which complements and, in fact, closely parallels the emerging dialectic of a deeper ecology. These observations of the interdependent association of plants, soil and microorganisms are so revolutionary and indisputable, they are sending shockwaves through the forestry and agriculture policy making communities, redefining our concepts of how evolution, succession and ecological interconnectedness proceeds. Quite generally, mutualistic symbiosis (two or more organisms living together in benefit to all partners) between plants and certain microorganisms now appears to be the rule rather than the exception on a worldwide scale.

Although many diverse beings play a role in this unfolding drama, the principal actors are fairly well known: the symbiotic nitrogen fixing organisms and the mycorrhizal fungi. Many kinds of organisms take nitrogen out of the air and exchange it with their mother plants for photosynthetically derived products. The best known and most widespread classes are the bacterial rhizobia, symbiotic with the legumes, and the actinomycetal frankia symbiotic with a range of plants from alders to ceanothus to the eleagus clan, which are now termed actinorhizal plants. About 3000 species of legumes are known to form these nitrogen fixing nodules on their roots, while the most current list of nodulated actinorhizal plants now numbers 200 species. Many more species are expected to be reported. Such symbiotic nitrogen fixation can supply most to all of the nitrogen needs of the plant. On a global scale, a great deal more nitrogen (generally the plant world's most limiting element) is supplied to the environment via these symbioses than through the application of industrial fertilizers.

Mycorrhiza literally means fungus root. A symbiotic association is formed between feeder roots of plants and certain fungi; the association acting to much extend the plant roots in their search for nutrients and water, often protecting the roots from disease and pests in the process of infection. There are many kinds of these symbiotic associations ranging from the ectomycorrhizal puffballs and truffles, growing on many trees such as pines, birch and poplars, to the microscopic associations in the endomycorrhizal fungi of most herbaceous plants. It is now agreed that nearly all plants on earth can form mycorrhizal associations, and that in nature almost all plants do.

The scientific literature on these symbioses is voluminous and is exponentially increasing, while researchers devoted to this work number in the thousands. I cannot adequately convey the depth of this work in a short article. However, an outline of some major ecological insights derived from the larger body of literature on these symbioses should illustrate some of the material correspondences in plant ecology to the philosophy of a deeper ecology.

The deeper ecologic tenet of unity in process, or dynamic oneness, runs as a common connective thread through the symbiosis research. Plants are now seen, not as discrete competing entities, but as coevolving manifestations of seed, symbiotic microorganisms, soil, climate and time, The hyphae (or roots) of mycorrhizal fungi symbiotic with different plant species apparently interconnect and form an interpenetrating network through which nutrients and water can flow multidirectionally from tree to herb to shrub. Almost all nitrogen fixing plants are strongly mycorrhizal, suggesting that nitrogen may be directly transferred from, say, a legume to a pine tree by way of shared mycorrhizal hyphae. The sharing of an ectomycorrhizal fungi by an herbaceous spiderwort