# *Environmental Decline and Public Policy*

*Pattern, Trend and Prospect*

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# Contents

# Chapter II

## *Historical Aspects of Environmental Decline*

### *Is Our Predicament New?*

Current news on environmental problems frequently emphasizes the totally unprecedented nature of the ecological crises that beset us in this nation and the Western world as a whole. We are told, for example, that the summer of 1988 constituted "the hottest summer on record" in North America. Similarly we hear that Boston Harbor has never in its history been so polluted, and in European waters seal populations died of an epidemic in 1988 on a scale never before witnessed by man. By stressing this "never before" aspect of events, it is sometimes argued that the experience of the past is largely irrelevant for policy planners. Since our circumstances are new, so the argument runs, past experience leaves us with little or no instruction for the formulation of a practical public policy for the environment.

### *The Current Crisis Has Precedents*

This is not altogether true. While particular types of industrial pollution may be new and the scale of ecological devastation may be greater now than previously, recent research demonstrates that the Western world is not confronting completely unprecedented circumstances. We need only cast our gaze over a somewhat enlarged horizon to realize that numerous civilizations before our own have confronted environmental degradation. Moreover, many regions of the non-Western world are currently facing and some are coping with environmental deterioration in our own time. Historians and archaeologists have studied examples of ecological collapse in past civilizations while anthropologists are examining contemporary examples of ecological degradation in non-Western cultures.

In our urgent concern to formulate effective environmental policy in the United States, we would be wise to keep the insights of this historical and cross-cultural research clearly in mind, lest public leaders commit our society to repeating and amplifying the tragic blunders of other cultures and past civilizations. If we continue to tie our society's

infrastructure and agricultural production to a declining resource base, as ancient civilizations did with such depressing regularity, we too will suffer the fate of unavoidable collapse.

*The Ecological Decline of Ancient Civilizations*

Anthropogenic ecological degradation is, unfortunately, very ancient indeed. Since at least the advent of sedentary agriculture, humankind has acted as a powerful biological and geological agent in complex ecosystems, almost invariably without a corresponding awareness of its own impact upon the environment. For this reason, conscious statements by witnesses from the past or from other cultures in our own day have not adequately reflected the full scope of human involvement in ecological decline. Thus, written records or oral traditions are not in themselves sufficient for investigating the question of human agency in ecosystems.

Archaeologists have debated the relative importance of human agency or environmental change as the primary factor in explaining accelerated patterns of soil erosion in the circum-Mediterranean over historic time. While climate theories were favored at an early date, theories stressing anthropogenic activity are gaining ascendancy. As Kevin Greene says in *The Archaeology of the Roman Economy*:

> Recent work around the Mediterranean has tended to favour human rather than climatic factors as the cause of the dramatic accumulations of sediment which took place in so many areas.

Thus many catastrophes which have long been understood as "acts of God" or "natural disasters" were in fact largely generated or substantially aggravated by collective and cumulative human behavior.[1] The recurrent pattern of the rise and fall of ancient civilizations in the circum-Mediterranean region, Mesopotamia, Phoenecia, Palestine, Egypt, Greece, and Rome[2] is clearly revealed in the emergence and collapse of their agricultural complexes.

These urban-based civilizations had to solve the basic problem of producing food surpluses and collecting raw materials from rural areas to sustain the non-agricultural activities of populations engaged in commerce, ritual, government, and the arts. Over time the strategies that each society pursued to produce food and procure resources left their characteristic mark on the environment. Many of these strategies proved not to be sustainable in the long run. Local populations overtaxed the natural resource base of the region through depletion of water, soil, or forest reserves, and their continuous agricultural demands on the land exceeded its long-term carrying capacity. The general pattern was one

of gradual emergence, brief efflorescence, and rapid collapse of civilizations, often taking the form in the final stages of devastating military struggles for the control of arable land or a declining resource base.

Techniques of agricultural intensification—terracing, crop selection, animal husbandry, irrigation, and the like—were devised to meet repeated crises of production. Despite short-term improvements in output, however, the long-term consequences of these technologies were not foreseeable by early agricultural innovators. In subsequent decades or centuries problems of overgrazing, watershed deforestation, soil erosion, siltation, water-logging, soil salinization, and crop blight often emerged as the long-term consequences of earlier innovations, sometimes leaving whole regions permanently destroyed for agricultural use.

Written documentation of these phenomena frequently presents explanations in terms of military, political, or religious rivalry and conflict, perhaps most obviously because the elites who wrote such literature were part of military, political, or religious institutions in the societies concerned. Nevertheless, no matter how persuasive this literature may seem to be, explanations of this kind inevitably oversimplify and distort a more fundamental understanding of the dynamic of agricultural civilizations.

Current archaeological research based upon scientific analysis of soil profiles, vegetation, and landscape evolution indicates that in the rise and fall of ancient civilizations there was at the base of nearly all sustained conflict an irreducible ecological component. Patterns of rivalry in the circum-Mediterranean could express either a momentary ecological crisis or a long-standing decline of some fundamental element of ecological capital of the agricultural systems concerned. The ecological dislocations were frequently most visible in the "peripheral" areas of the great Mediterranean empires, for it was here that the imperial powers established systems of commercial agriculture and proceeded to exact levels of agricultural production that exceeded the ecological capacity of the land.[3]

## *The Ecology of European Expansion*

The sobering ecological lessons of the ancient world may well have remained clear in our collective consciousness were it not for the experience of the Western world over the last five hundred years. In no other period of history does there appear to have been as much exploration, outward migration, trade, and conquest in such a comparatively short interval of time.

This recent experience has overshadowed—indeed all but eclipsed—the lessons that we should have learned from the recurrent decline and collapse of ancient agricultural civilizations. It can be argued

that recent history has been responsible for a potentially fatal, cultural blind spot concerning the vulnerability of our current industrial system of agriculture. Because of its experiences between roughly 1450 and 1950—a period marked by seemingly unlimited expansion—the Western industrial world now finds itself conceptually ill-equipped to understand and politically impotent to cope with the problems of ecological adjustment that currently face all societies in our modern, finite world.

*The Europeans' "Biological Allies"*

Ironically, it is precisely the remarkable "ecological success" of European cultures that has led to their current ecological myopia. Recent research on the historical ecology of European expansion makes this abundantly clear. Briefly put, Europeans were able to expand with such rapid success throughout great portions of the world between 1450 and 1950 largely because their microbes, viruses, weeds, pests, and plant and animal domesticates proved to be heartier than indigenous species in competition for survival in distant lands around the world. It was the success of their "biological allies" that paved the way for Europeans to dominate much of the modern world.[4]

The comparative success of the Europeans' biological allies ultimately stemmed from the evolutionary history of microbes, plants, and animals. Essentially, the antiquity of agricultural practice and urban civilization in the Old World meant that diseases, weeds, cultigens, and herbivorous domestic animals had developed highly effective mechanisms for feeding or breeding simply to remain alive in the context of close competition with other species. Hence, many of these organisms were equipped with more effective defenses, better dispersal mechanisms, or more aggressive behavior than the species occupying similar eco-niches in the newly discovered colonial territories. With the help of their "biological allies" European agriculturalists quickly exploited the natural capital of vegetation and fertile soils in regions where indigenous populations were either sparsely settled agriculturalists or foraging nomads. The ensuing biological intrusion was frequently devastating for populations of indigenous flora and fauna and often led to substantial modifications of local biotic communities, alterations of the regional hydrology, and the devastation of age-old topsoils.[5]

*Loss of Ancient Agricultural Wisdom*

European agricultural techniques were substantially transformed in the New World colonies, even as the New World itself was being physically transformed. In this process, some age-old agricultural wisdom appears to have been lost. Conservation of resources simply seemed no longer

necessary in the circumstances of comparative abundance. Whereas intensive techniques of resource husbandry had come to characterize the confined land-base of medieval European agriculture, the New World afforded rich new possibilities for agricultural expansion. In effect, since the discovery of the New World, predatory expansive agriculture and parasitic resource use came to characterize European civilization, leading some emergent cultures, including our own, to believe in a mythology of expanding "frontiers." Because historically this was a plausible mythic image, the mythology of "frontier cultures" could be sustained for centuries and verified by numerous cases of parochial experience.

It is important to realize, however, that the overall expansion of the land surface under cultivation, and not improvements in basic technology, accounted for increases in agricultural output over most of the period. While total production rose dramatically, productivity per acre and productivity per unit of energy input often declined. Nevertheless, profits from total agricultural surpluses helped to finance the emergence of urban-based industrial systems. The dynamic of industrial growth served, in turn, to sustain the mythology of "unlimited frontiers" and further transformed these formative frontier myths into a belief in perpetual economic growth. Having expanded upon the things of nature, the West came to believe that expansion was in the nature of things. Perpetual growth was considered both good and natural.

The European experience of overseas expansion and ensuing industrialization has engendered deep-seated habits of thought and images of cultural self-perception.[6] In our day, these images and metaphors leave the industrial world unable to construct a viable system of stable production in our finite circumstance. In effect, we are trying to sustain a "frontier culture" in a post-frontier world. Little wonder that our environmental policy is so embarrassingly immature.

## NOTES

1. J. Donald Hughes, *Ecology in Ancient Civilizations* (Albuquerque: U. of New Mexico Press, 1975). Kevin Greene, *The Archaeology of the Roman Economy* (Berkeley: U. of California Press, 1986), p. 85. See also: S. Judson, "Alluviation and Erosion," in E. Fentess, et al., *Excavations at Fosso della Crescenza 1962* (Rome: 1982) [Papers of the British School of Rome, No. 51], pp. 58-101; and Claudio Vita-Finzi, *Archaeological Sites in Their Setting* (London: 1978), especially, pp. 8 and 11-13.

2. H. W. Lawton and P.J. Wilke, "Ancient Agricultural Systems in Dry Regions," in A. E. Hall, G. H. Cannell, and H. W. Lawton, eds., *Agriculture in Semi-Arid Environments* (New York: Springer-Verlag, 1979), pp. 1-44. Popular, if somewhat dated, accounts include: Edward Hyams, *Soil and Civilization* (New York: Harper and Row, [1952] 1976); and Vernon Gill Carter and Tom Dale, *Topsoil and Civilization* (Norman: University of Oklahoma Press, 1976).

3. W. Groenman-van Waateringe, "The Disastrous Effect of the Roman Occupation," in: R. Brandt and J. Slofstra, eds., *Roman and Native in the Low Countries: Spheres of Interaction* (Oxford: British Archaeological Reports, s184, 1983), pp. 147-157; and Claudio Vita-Finzi, "Roman Dams in Tripolitania," *Antiquity* 35 (1961), pp. 14-20; and Z. Naveh and J. Dan, "The Human Degradation of Mediterranean Landscapes," in: F. Di Castri and H. A. Mooney, eds., *Mediterranean Type Ecosystems* (New York: Springer-Verlag, 1973), pp. 373-390.

4. Alfred W. Crosby, Jr. *The Columbian Exchange: Biological and Cultural Consequences of 1492* (Westport, CT: Greenwood Press, 1972); also his *Ecological Imperialism: The Biological Expansion of Europe, 900-1900* (New York: Cambridge University Press, 1986). For a detailed account of the ecological impact of early colonial presence of Europeans see: William Cronon, *Changes in the Land: Indians Colonists, and the Ecology of New England* (New York: Hill and Wang, 1983).

5. For an overview of the patterns of ecological interaction that characterize colonial circumstances see: Timothy C. Weiskel, "Agents of Empire: Steps Toward and Ecology of Imperialism," *Environmental Review* 11:4 (1987), pp. 275-288.

6. For a discussion of the impact of the frontier experience upon ecological consciousness in America see: Timothy C. Weiskel, "Rubbish and Racism: Problems of Boundary in an Ecosystem," *Yale Review* (Winter 1983), pp. 225-244.

## *ANNOTATED BIBLIOGRAPHY FOR CHAPTER II*

### ECOLOGICAL DECLINE OF ANCIENT CIVILIZATIONS

* 2.1 *

**Dale, Tom, and Vernon Gill Carter.** ***Topsoil and Civilization***. rev. ed. Norman: University of Oklahoma Press, 1974. LC 74-175105. ISBN 0-8061-0332-9. (The 1st edition, published in 1955, was used to prepare these notes.)

In these pages, Dale and Carter seek to validate an ecological basis for the rise and decline of civilizations. In its initial stages civilization rests on a flourishing agriculture which, in turn, presupposes availability of productive topsoil. After a civilization has established itself, it can survive or even expand for a time, despite the loss or depletion of its topsoil. It can do this by military conquest, by colonization, or by economic diversification, through manufacture and trade. Ultimately, however, such strategies will fail. Civilizations that suffer a fatal loss of topsoil inevitably decline.

Some historians have tended to deny the central importance of the presence or absence of topsoil as a causative or contributing factor in the rise and decline of civilizations. Toynbee, for example, asserts that the very poverty of the soils of Attica played a critical role in the emergence of Athens as a high civilization, in accordance with his "challenge and response" theory. Thus Toynbee and many other historians, including Thucydides, have claimed that Greek soil was never fruitful, bountiful. Thucydides ascribed Attica's "freedom from faction" to the supposed poverty of Greek soil from the earliest days. Plato, who lived from 427 to 347 B.C., disagreed with all such theorists, however.

In one of his dialogues, Plato, speaking through Critias, described changes that had occurred in the land of Attica over time: ."... what now remains of the once rich land is like a skeleton of a sick man, all the fat and soft earth having wasted away, only the bare framework is left. Formerly, many of the present mountains were arable hills, the present marshes were plains full of rich soil; hills were once covered with forests, and produced boundless pasturage that now produce only food for bees. Moreover, the land was enriched by yearly rains, which were not lost, as now, by flowing from the bare land into the sea; the soil was deep, it received the water, storing it up in the retentive loamy soil; the water that soaked into the hills provided abundant springs and flowing streams in all districts. Some of the now abandoned shrines, at spots

where former fountains existed, testify that our description of the land is true."

Evidence gathered from modern soil surveys definitely supports Plato. According to the authors, "in their virgin state, most of these rolling plains [of Attica] had a black or red clay-loam soil of fair depth that was highly productive. Beneath this soil was a layer of soft limestone that weathered fairly fast and helped build up or enrich the soil above.... Today there is a layer of soil only a few inches deep over most of the Attica plains and hills, and limestone outcroppings protrude from the surface every few feet."

The Roman philosopher and poet Lucretius, writing circa 60 B.C. before the Empire was established, bemoaned the fact that the earth itself seemed to be dying. The once bountiful land, he observed, was nearing exhaustion as rivers and rain eroded it and carried its topsoil into the sea. Other thinkers and observers were able to note shrinking food supplies and diminishing populations of regions where the land was seriously eroded. Roman observers and imperial administrators could and did recognize the threatening effects of soil erosion but they did not understand soil science. They devised various carrot and stick legislative devices to compel farmers to renew cultivation of barren, eroded, and even abandoned farms. All such devices, unaccompanied by programs of soil conservation and reclamation, proved to be fatal as the impoverished lands were subjected to increasingly intense cultivation. In completing the destruction of the land, the emperors and their administrators hastened the disintegration of the empire.

Edward Gibbon attributed the fall of Rome to "barbarism and religion." In the view of Dale and Carter, far more to the point in accounting for that fall was the fact that Roman agricultural regions were being progressively depopulated because their impoverished agricultural base could no longer sustain the previous levels of population density.

* 2.2 *

**Greene, Kevin.** ***The Archaeology of the Roman Economy.*** Berkeley: University of California Press, 1986. LC 86-7024. ISBN 0-520-059158.

In his book, Greene summarizes the findings of archaeology as it—archaeology—has been applied to the Roman economy. Because agriculture was by universal agreement the most important element in that economy, it may legitimately be made our sole focus of interest.

Modern archaeological excavation of the villas and farmsteads in what was the Roman empire, when undertaken in conjunction with geomorphology, soil science, climatology, paleobotany, and pollen analysis, has made it possible to study the manner, intensity, and consequences of Roman exploitation of the land. An analysis of the layered soils shown by an excavation can contribute to an understanding of the changes that

have occurred over thousands of years, either through climatic change or through the intensification of land use—which is agriculture.

A revealing example of a soil science analysis of an excavated layer of soil is the "dark earth" found in many urban excavations in Britain in the late Roman and early medieval phases. "Dark earth" has been found to be "an accretion of rubbish, frequently disturbed by human and animal activity which could also be characteristic of a market garden soil."

Multidisciplinary studies have shown unmistakably that a dramatic decline did occur over time in both the productivity of the soil and in population levels, a decline that was caused in the first instance by erosion and sedimentation. Some theorists have argued that changes in climate were responsible for the observed decline in soil conditions. An example of climatological causation is an increase in rainfall which leads to flooding, and hence to soil erosion and sedimentation, siltation, and other problems.

Greene, however, observes: "Recent work around the Mediterranean has tended to favour human rather than climatic factors as the cause of the dramatic accumulations of sediment which took place in so many areas. By 1978, Vita-Finzi had virtually dismissed climate from the study of geomorphology." Critics of climate change as a major causative factor point out that the natural processes involved in erosion and sedimentation are extremely complex. A change toward wetter conditions could decrease erosion by increasing vegetation. Agricultural exploitation of the land can be shown to increase the rate of deposition up to 100 times.

Furthermore, many Roman documents mention floods in Rome and relate them to patterns of forest exploitation and to the number of settlement sites in central Italy. A recession in agriculture would reduce the number of sites, the amount of forest clearing that could be done, and the number and severity of floods. Thus historical evidence confirms the evidence of archaeology. Finally there is evidence that farmers in the Adige Valley of northern Italy, by adopting adequate methods of terracing, forestalled serious erosion until 600 AD.

* 2.3 *

**Groenman-van Waateringe, W. "The Disastrous Effect of the Roman Occupation."** In: *Roman and Native in the Low Countries: Spheres of Interaction*, edited by Roel Brandt and Jan Slofstra. B A R International Series 184. Oxford: British Archaeological Reports, 1983. ISBN 0-86054-237-8.

Interaction between the Roman occupation and the low countries occurred primarily in the sphere of a local economy that was made subservient to an imperial design. "In a pre-industrial society, wealth is highly dependent on the productivity of land." A serious agrarian crisis,

therefore, followed from the Roman-directed over-exploitation of the land.

That there was over-exploitation is manifest: 1) There was a move away from small-scale mixed agriculture to large-scale monoculture; 2) The overseas market was given preference to the native market; 3) Existing market and exchange patterns were dismantled in order to augment Roman control; 4) The trading network was transformed into a taxation network.

Initially Roman administration, with its centralized economic control and its greater ability to rectify local food shortages, resulted in large increases in population. Thereafter, "a vicious cycle develops." Improved markets for local producers providing food for expanding populations led to increased food production. Not only did food producers have to feed the local populace but also the Roman military and civilian occupation force as well as the people of the towns that came into being in the wake of the Roman occupation. With farming methods, for all we know, remaining unchanged, increased production "must have exacted a heavy toll from the entire ecosystem." On the poorer soils of the low countries, that is, those that are not "on the fertile ridges of sandy loam of the northwest European littoral and in the terp-region of Friesland, Groningen and Ostfriesland," there was overgrazing, soil erosion, and acidification, in consequence of which came epidemic disease and sharp declines in both food production and population.

Groenman-van Waateringe argues that this vicious cycle was ultimately caused by the fragility of the complex Roman economic/ecological system. Complex systems have finely tuned regulating mechanisms. When these malfunction, the entire system is jeopardized. The native low country system, on the other hand, was simple, poorly developed, and consequently robust.

* 2.4 *

**Hughes, J. Donald.** ***Ecology in Ancient Civilizations***. Albuquerque: University of New Mexico Press, 1975. LC 74-27446. ISBN 0-8263-0367-6.

"A human community determines its relationship to the natural environment in many ways. Among the most important are its members' attitudes toward nature, the knowledge of nature and the understanding of its balance and structure which they attain, the technology they are able to use, and the social control the community can exert over its members to direct their actions which affect the environment. The ancient world shows us the roots of our present problems in each of these areas." (p. 147)

Primitive attitudes of humans toward nature can be characterized as animism according to which nature and humankind are made of the same

essential stuff, thus eliminating the human-nature dichotomy. Animism is an ecologically more discerning natural philosophy than the dominance or indifference views that succeeded it. All the great ancient civilizations—Egyptian, Mesopatomian, Israeli, Greek, and Roman—accepted the view that nature existed to serve the needs and whims of humans. The Jewish and the Christian world views added to the notion of dominance the further view that the visible world was unimportant in comparison with the unseen, spiritual world of god. The Romans were most blatant in their assertion of dominance over nature. They treated all of nature under their sway as though it were one of their conquered provinces.

In the sphere of knowledge, in Greece, as we might expect, there was evidence that a few of their more empirically-inclined thinkers were beginning to approach an ecological science. The Romans, by contrast, had no ecological science at all. In technology and in technologically-driven devastation of the environment, however, the Romans surpassed everyone. The technologically superb network of Roman aqueducts was linked, in many direct and indirect ways, to the degradation of the environment and to the deaths of innumerable Romans. The highly efficient aqueducts brought into Rome debilitating industrial poisons in large quantities. Finally, all the ancient civilizations were aware, in varying degrees, of the dire consequences of such forms of anthropogenic devastation as deforestation and soil erosion. Each civilization enacted some prohibitive environmental laws to constrain the most flagrant offenders.

Hughes ably documents his central thesis that the roots of our environmental difficulties lie in our cultural past. Furthermore he demonstrates that what can be called the ecological consciousness of our own day is made up of the components he specifies: a philosophy of nature, ecological science, technology, and prohibitive environmental legislation.

* 2.5 *

**Hyams, Edward Solomon.** ***Soil and Civilization.*** London and New York: Thames and Hudson, 1952. Re-print. New York: Harper and Row, 1976. LC 75-43490. The Harper and Row edition contains a new preface by Hyams; otherwise, the 1952 text remains unaltered.

Hyams assigns precise meanings to a few frequently repeated concepts as follows:

*"Farming—scientific, industrial, ecological"*:

> Speech commonly perverts the word "scientific" when it uses such phrases as "scientific farming." In fact, as that phrase is conventionally used, it means only "profitable"

farming—profitable, that is, for a brief time, either for the farmer or his banker. Such farming is better called "industrial farming" for it entails the application of chemistry and mechanics to the soil in order to maximize production, and consequently profits, in the shortest possible time and in the belief that agriculture is capable of indefinite expansion. Truly scientific farming is that farming which is controlled by an ecological understanding. Ecological farming has come into existence only since circa 1930.

*"Artificial soil community"*:

An agricultural region, large or small, but in either case integral, in which the natural balance of a wild countryside, which sustains and enhances soil fertility, has been successfully replaced, as a rule over a long period of time, by an artificial balance of cultivated instead of wild plant, domestic instead of wild animals. Such a community must, of course, include men as members, men living not off the soil as capital, but off the increment of fertility which they themselves are engaged in producing. The community is self-sustained and self-supporting in essentials.

These and other concepts are necessary to the development of Hyams' thesis that topsoil and subsoil have played a central role in the rise, continuation, and decline of civilizations. As Hyams concedes in his preface, he does run the risk of distortion in stressing, to the exclusion of all others, the influence "of men on soil and soil on men." Nonetheless, many of his specific documentations of the effects of soil degradation are persuasive.

*1) Deforestation and the soils of Rome*

"Other things being equal, the aridity of a soil climate is proportional to the numbers of trees present. As the early Italians cut trees to clear soil, they were unwittingly engaged in changing the climate of their country in an unfavorable sense." Hyams quotes Varro (116-28 B.C.) to the effect that in Latium wheat was harvested in July. Today Italians must harvest wheat in June to save it from the withering drought. Hyams speculates that, probably several hundred years before Varro, it may have been harvested in August, just as it now is in southeastern England. The soil of Campagna, the region of about 800 square miles surrounding Rome, was thin and fertile at the beginning of intensive agriculture, circa 500 B.C. Hyams enumerates the sequential steps in the downward spiral of degradation.

> The water-cycle was disturbed. Torrential run-off of the decreasing rainfall carried away the hillside soils, silting up streams and rivers, causing flooding and creating malaria-infested marshes; the most mortal symptom of soil disease, gully-erosion, appeared on the hillsides.

*2) The exploitation of subsoil in Attica*

> When a people finds itself upon a thin and stony soil, the product of natural erosion, or of the tactless mauling of the natural soil community by the people's predecessors, it may, in certain climatic and economic conditions, save itself by the ingenious exploitation of its subsoil. Such a people may, even in the absence of a fertile top-soil, create a balanced soil community, but one which will be of a peculiarly artificial and precarious kind. For one of its "members" must be a foreign market.

Fig trees, olive trees, and the vine will grow in subsoil after the topsoil has been eroded. Although Athens was able to cultivate these plants on the austere soils it inherited from its improvident predecessors, it had to export its wines and olives abroad in ceramic containers. This necessity became the stimulus to the Athenian ceramics industry.

*3) Industrial farming*

Industrial farming that seeks to maximize production and profits using all available sciences is as old as human efforts to go beyond subsistence agriculture. The industrial approach is evident in the parasitism on alluvium in the Tigris-Euphrates valley; in the growth of the deserts around Carthage; throughout the Roman Empire; and in a starkly dramatic form in Oklahoma.

*4) Artificial soil communities*

In only two parts of the world does Hyams find evidence of what he calls artificial soil communities in which human beings as members of that community have intelligently augmented soil fertility. These soil communities are those of the former Inca Empire in the Western Andes and existing Atlantic Europe.

* 2.6 *

**Jacobsen, Thorkild, and Robert M. Adams. "Salt and Silt in Ancient Mesopotamian Agriculture."** *Science* 128 (21 November 1958): 1,251-1,258.

"The semiarid climate and generally low permeability of the soils of central and southern Iraq expose the soils to dangerous accumulations of

salt and exchangeable sodium, which are harmful to crops and soil texture and which can eventually force the farmer from the land." An examination of ancient records establishes that destructive levels of salinity have occurred at least three times. The earliest period, occurring between 2400 and 1700 B.C., is important historically in as much as it coincided with the northward movement of political power from southern to central Iraq. Several parallel lines of historical and archaeological evidence allow the increasing salinization to be followed quantitatively: 1) The presence of patches of saline ground is noted in the reports of surveyors in the reign of Entemenak; 2) Crops to be planted were chosen in part on the basis of which were most salt-tolerant. Wheat has low salt tolerance, whereas barley has more. Counts of grain impressions in excavated pottery show that, from 3500 to 1700 B.C., the proportion of wheat to barley steadily diminished. By 1700 wheat had been abandoned as a crop; 3) Records also show that fertility, measured in liters per hectare, also declined markedly.

> As the rate of sedimentation is affected by the extent of irrigation, so also were the processes of sedimentation—and their importance as agricultural problems—closely related to the prevailing patterns of settlement, land-use, and even sociopolitical control. The character of this ecological interaction can be shown most clearly at present from archaeological surveys in the lower Diyala basin....

Two successive phases of settlement and irrigation, "each operating in a different ecological background and each facing problems of sedimentation of a different character and magnitude," can be distinguished. The earlier phase, lasting from about 4000 B.C. and ending in the final centuries of the pre-Christian era, was one in which there was a fluctuating pattern of settlement and abandonment. Water seems not to have been drawn great distances from the main watercourses. "Under these circumstances, silt accumulation would not have been the serious problem to the agriculturalist that it later became. The short branch canals upon which irrigation depended could have been cleaned easily or even replaced without the intervention of a powerful, centralized authority."

The second phase of settlement was characterized by a much greater exploitation of available land and water resources. The population expanded; the area of cultivated land was enlarged, as was the irrigation system. It became necessary "to crisscross formerly unused desert and depression areas with a complex—and entirely artificial—brachiating system of branch canals." The length and complexity of the irrigation canals led to their filling up with silt more rapidly than before under

conditions of a simpler design. With increasing siltation came the need to expend more time and energy on maintenance. "With the converging effects of mounting maintenance requirements on the one hand, and declining capacity for more than rudimentary maintenance tasks on the other, the virtual desertion of the lower Diyala that followed assumes in retrospect a kind of historical inevitability."

* 2.7 *

**Judson, Sheldon. "Alluviation and Erosion."** In: *Excavations at Fosso della Crescenza, 1962*, edited by E. Fentess et al. Papers of the British School at Rome, no. 51. London: R. Clay and Sons, 1983. OCLC 1537364.

"Alluviation begins when a stream is no longer able to remove all of the sediments brought to it from its drainage basins. Possible causes are several, but we need here to consider only three: climate, land use and normal stream dynamics." Judson provisionally rejects the evidence from climatic change. Stream dynamics have not been found to offer a sufficient basis for observed alluviation and erosion in Italian streams. The author concludes: "It seems reasonable to us that the cause of increased alluviation along sediment-clogged streamways has been due to land use on the slopes."

* 2.8 *

**Judson, Sheldon. "Erosion Rates Near Rome, Italy."** *Science* 160 (28 June 1968): 1,444-1,446.

"Near the beginning of the Christian era, small stream valleys in the Mediterranean region began to silt up, and various works of man were buried." Judson reports on the rates of the production of sedimentation in west-central Italian streams, past and present.

For the early period before human beings intensively used the land, lake cores provide estimates of the rates of erosion. "The basin of Boccano, astride Via Cassia about thirty km north of Rome, is a volcanic crater; the lake originally filling it was drained by the Romans in about the second century before Christ. Bonatti, in a pollen analysis of cores from the old lake deposits, reports a single carbon-14 age of 8429 + or - 180 years. This date enables one to estimate the rate of sedimentation, which can be converted to rate of erosion of watershed. The resultant estimate is about 3 cm/1,000 years between 6600 B.C. and drainage of the lake. This rate of erosion compares closely with the low rate of erosion around Lago di Monterosi before the days of agriculture."

To determine the rates of production of sedimentation for the period since the second century before Christ, Judson averaged the modern rates of erosion over entire drainage basins, as shown by stream records. "In addition archeological sites provide rates over periods ranging up to 2500

years." The erosion rates for the drainage basins ranged from 9 to 73 cm/1,000 years. The rates of erosion of the archeological sites were comparable, though higher. They commonly ranged between 20 and 40 cm/1,000 years.

"With intensive occupation by man the rates have increased by an order of magnitude."

* 2.9 *

**Lawton, H. W., and P.J. Wilke. "Ancient Agricultural Systems in Dry Regions."** In: *Agriculture in Semi-Arid Environments*, edited by A.E. Hall, G. H. Cannell, and H. W. Lawton. New York: Springer-Verlag, 1979. LC 79-13995. ISBN 0-387-09414-8.

"There can be little question that agriculture did and does increase the food supply. Nevertheless, agriculture has also had many deleterious effects, including environmental degradation, astronomical increases in human population, nucleation of population into large permanent settlements, greater susceptibility to social and medical adversities, dietary deficiencies, and widespread famine. Thus agriculture has resulted in an over-all loss of man's ecological flexibility."

Ancient irrigation systems, widely used in the dry regions of the Near East, curtailed ecological flexibility still further. In Mesopotamia, the ancient land lying between the Tigris and Euphrates Rivers, irrigation systems as they evolved over time tended to fall into three configurations of increasing complexity. The third and last configuration was a large-scale system, planned and controlled by the central government. "The Sassanian period saw massive irrigation projects, such as the construction of the gigantic Nahrwan canal, which took water from the Tigris River." The authors claim that the canals "probably" had inadequate slopes "which led to greater and more rapid silt accumulation." These systems required continual maintenance in order to remain operational, and in times of military crisis, an adequate maintenance force was not available. "Such large-scale systems could not survive the pressures placed upon them."

In one instance, a Near Eastern irrigation project "appears" to have been ecologically sound. The Nabatean systems of water harvesting used in the Negev desert of Israel is one example of an "early farming technology that made use of their environments with a minimum of disruption." Lawton and Wilke continue: "Study of the ancient farms on the Negev, including data gathered from reconstruction of two farms, showed that they had two essential features: (1) several cultivated terraced fields located in the deep valley soils, and (2) a cleared upland watershed area averaging about 10-50 ha [hectare] on the surrounding slopes." After describing the subdivisions of watershed areas, the authors add: "The division of the overall catchment into smaller subcatchments,

each with diversion channels leading to specific parts of a farm, prevented destructive peak flows and made it easier for the farmer to exercise control over the flood."

Siltation of irrigation canals, salinization, and depletion of soil fertility were problems that plagued the farmers of the ancient Near East. They still exist to plague the farmers of today.

* 2.10 *

**Naveh, Z., and J. Dan. "The Human Degradation of Mediterranean Landscapes in Israel."** In: *Mediterranean Type Ecosystems—Origins and Structure*, edited by Francesco di Castri and Harold A. Money. New York, Heidelberg, Berlin: Springer-Verlag, 1973. LC 72-95688. ISBN 0-387-06106-1 (New York).

Relying on pedological and geomorphological evidence, Naveh and Dan analyze anthropogenic landscape degradation in Israel as a function of the soil-vegetation system. While granting that quantification of the interactions between mode, duration, and intensity of human interference, among other factors, is still extremely difficult, the authors believe that several generalizations are warranted.

"The harsher and more fragile the environment, the more far-reaching and irreversible will be the man-induced changes in state variables and the slower and more difficult will be the process of recovery." The destruction of the vegetable canopy in Israel's semi-arid zone at an early date exposed the soil to the direct influence of the harsh climate and to unimpeded rainfall. In this way there arose conditions similar to those of more arid regions with a sparse plant cover, flashfloods, and extremes of climate.

On the upland arable slopes, several cycles of degradation and regeneration have occurred. Early clearance of forest and woodlands caused the first erosion cycle. Later there was an aggradation cycle of terracing. Still later neglect of the terraces generated catastrophic erosion.

> As illustrated in examples from Judean hills and Western Galilee, this has been followed by a regeneration cycle, leading to maquis, garrigue, batha and derived grasslands. But recently [with] increasing human and livestock pressure the erosive degradation cycle has been renewed....
>
> The soil recovery process has been slowest on shallow soils covering hard rocks, and faster on soft rock....The dynamics of recovery are apparently determined by the recent "bio-function" and especially by soil depth, by slope exposure and by the "initial floristic composition" of the abandoned site.

During the long phase of agricultural decay and population decline in the mountainous region of Israel, a new equilibrium was established on the uncultivated upland ecosystems. This new equilibrium is now endangered by population explosion, by increasing traditional land use with its accompanying erosion, by urban sprawl, and by neo-technological despoliation.

* 2.11 *

**Vita-Finzi, Claudio. "Roman Dams in Tripolitania."** *Antiquity* 35 (1961): 14-20.

The Roman wadi dams of Tripolitania were effective in both conserving and creating cultivable soil in the difficult area of northern Libya. *Wadi* is an Arabic word for a gully, valley, or river bed that remains dry for much of the year but flows during rare winter floods. The Roman soil and water retention dams, while they continued in good repair, caused the flow of silt-laden water through the wadis to be fairly well distributed. When the dams and their concomitant works fell into disrepair, trees on the slopes of wadis decreased and erosion became severe. Vita-Finzi concludes his report:

> The wadi floods of today are both more violent and more short-lived than they were two thousand years ago.

## ECOLOGY OF EUROPEAN EXPANSION

* 2.12 *

**Cronon, William.** ***Changes in the Land: Indians, Colonists, and the Ecology of New England.*** New York: Hill and Wang, 1983. LC 83-7899. ISBN 0-8090-3405-0.

Cronon concludes his argument with two summarizing passages: "By integrating New England ecosystems into an ultimately global capitalist economy, colonists and Indians together began an unstable process of ecological change which had in no way ended in 1800. We live with their legacy today." After quoting Carl Sauer to the effect that Americans had "not yet learned the difference between yield and loot," Cronon says "Ecological abundance and economic prodigality went hand in hand: the people of plenty were a people of waste." The English colonists of New England believed in the Biblical injunction to "subdue" and to "improve" the land and to use it for the augmentation of wealth. Because of the apparent abundance of land, they came to believe that the supply of the commodity was limitless. They assumed that ecological abundance would be convertible into economic abundance indefinitely.

The colonists believed that improvements of the land were the true mark of ownership. The English conception of land ownership entailed boundaries, enclosures, fencing, restricted access to others, laws of trespass, permanent occupancy, a fixed abode, and intensive agricultural practices such as plowing with an animal team. Indians had a quite different conception of ownership. Strictly speaking, what they possessed was not ownership but usufruct, the right to use land so long as the property was not damaged or altered. Because Indian customs enshrined the idea of usufruct as distinguished from the legal concept of ownership, the colonists declined to recognize that the Indians owned any land at all, not agricultural fields, ponds, lakes, river banks or forests, however the Indians may have used these resources in accordance with their seasonally modulated migratory way of life. Ultimately the land came under almost complete English ownership. Cronon states the consequences of the colonial land grab:

> Strictly speaking in terms of precolonial New England, Indian conceptions of property were central to Indian uses of the land, and Indians could not live as Indians had lived unless the land was owned as Indians had owned it. Conversely, the land could not long remain unchanged if it were owned in a different way. The sweeping alterations of the colonial landscape which Dwight himself so shrewdly described were testimony that a people who loved property little had been overwhelmed by a people who loved it much.

One particular example of the sweeping alterations will be mentioned here. Because Indian occupancy of agricultural fields was shifting and temporary, abandoned sections of land would revert to forest and become "edge habitats" which were especially good for many species of wildlife. When lands ceased to be owned in the Indian fashion, these edge habitats also ceased and with them many species became endangered.

The devastating epidemics that struck the Indians of southern New England during the years from 1616 through the 1630s were reliably reported to have caused unbelievable levels of mortality. Death rates of 90 to 95 percent were common. In some instances, entire villages were wiped out. This was the most brutal manifestation of ecological imperialism. The Indian population of New England in 1600 is estimated to have been 73,000. By 1700, that population had dwindled to about 12,000. Radical depopulation of this order disrupted the normal patterns of Indian economic life. Because they had to find a substitute for their former reliance on hunting and subsistence agriculture, they became the partners of the colonists in the fur trade. They exchanged animal pelts for brass and iron ware and woven fabrics of European and colonial

manufacture; they also received a form of monetary payment, wampum. Far more efficient as trappers of fur-bearing animals than the English, they soon hunted the animals to the point of exhaustion of supply. Prior to this period, the Indians had not taken animals beyond the level of their immediate need. As a consequence of the widespread extinction of species, the Indians were driven back into the poverty of what later came to be called reservations.

Most of the ecological and legal conflict between the colonists and the Indians turned on what constitutes a "resource." As Cronon points out, a "resource" exists only to the extent that a culture at a certain point in its evolution defines it as such. "By drawing the boundaries within which their exchange and production occur, human communities label certain subsets of their surrounding ecosystems as resources, and so locate the meeting places between economics and ecology."

* 2.13 *

**Crosby, Alfred W., Jr.** ***Ecological Imperialism: The Biological Expansion of Europe, 900-1900.*** New York: Cambridge University Press, 1986. LC 86-6106. ISBN 0-521-32009-7.

In *The Voyage of the Beagle*, Charles Darwin declared: "Wherever the European had trod, death seems to pursue the aboriginal. We may look to the wide extent of the Americas, Polynesia, the Cape of Good Hope, and Australia, and we find the same result." In their ecological conquests of the "New Europes," Europeans received vigorous support from their "biological allies," the plants, animals, and pathogens of Europe. What Crosby calls the "New Europes" are those lands which resemble Europe climatically and yet are separated from it by vast stretches of ocean, lands that lie across the "seams of Pangaea," to use Crosby's geological metaphor. They are the precise lands that Darwin specifies. The significance of lying across Pangaea's seams is that, because of their long-term trans-oceanic isolation, the New Europes possessed no natural competitors or predators with which to oppose Europe's plants and animals, and the aborigines of the New Europes were sustained by no immunities with which to resist Europe's pathogens. The result was that Europe's plants and animals flourished in the Americas and in Australia and New Zealand beyond anyone's wildest expectations. English plants did far better in Australia than they had ever done in England. European sheep prospered in New Zealand just as European cattle did in Texas. The case of the European rabbit in Australia is an extreme one that proves the point. The rabbit multiplied menacingly in Australia because in the entire continental island it had not one natural predator to hold its fecundity in check.

The plants that flourished most vigorously in the New Europes were weeds, a term Crosby defines as opportunistic or aggressive plants that

spread rapidly and out-compete other plants on disturbed soil. When Europe's weeds, the best forage grasses, were introduced into New Europe, they quickly and invariably ousted the native grasses wherever the soil was disturbed. European grazing quadrupeds—horses, cattle, sheep—are notorious for disturbing the soil. Hence a symbiotic relationship between the imported weeds and animals soon developed, to the incalculable economic advantage of the New Europeans.

Because their agriculture flourished in New Europe, the immigrant Europeans themselves thrived and multiplied. Their numbers increased in an unprecedented geometric progression. As their numbers increased, the numbers of aborigines declined sharply. Diseases among aborigines caused by Europe's pathogens engendered virtual genocide in many instances. William Bradford of Plymouth Plantation said of an epidemic of smallpox among the Algonkins of Massachusetts in the early 1630s: "Whole towns of them were swept away, in some not so much as one soul escaping Destruction." Crosby continues his account by alleging: "Smallpox whipsawed back and forth across New York and surrounding areas in the 1630s and 1640s, reducing the Huron and Iroquois federations by an estimated fifty percent."

In his account of the expansion of European civilization, Crosby has skillfully gathered and integrated the various skeins of ecological evidence. Although much of his story is not new—the consequences of the lack of immunity to European diseases among aboriginal peoples have been known for some time—Crosby has contributed a clarifying frame of reference that interrelates European history and the ecology of exotic plants and animals with Wegener's theory of continental drift. That body of theory is central to his account as he makes clear by his repeated allusions to Wegener in the phrase "the seams of Pangaea." Pangaea is Wegener's hypothesized unitary landmass which over millions of years broke up to form the continents as we know them today.

* 2.14 *

**Crosby, Alfred W., Jr.** ***The Columbian Exchange: Biological And Cultural Consequences of 1492.*** Westport, CT: Greenwood Press, 1972. LC 73-140916. ISBN 0-8371-5821-4.

To a degree, Crosby's 1972 book can be regarded as a preliminary and less well developed version of his 1986 book. As he was to demonstrate conclusively in his later book, Old World plants, animals, and pathogens devastated the ecological balance of the New World. A point he makes uniquely in the present book, however, furnishes the significance of his title. The destructive biotic traffic that Columbus let loose was a two-way traffic. There was an exchange. Some of the New World's plants and pathogens retorted on Europe to benefit and to plague it.

Although Crosby acknowledges that there is still substantial disagreement on the American origin of syphilis, he is provisionally committed to the view that the disease was inflicted on Europe in the first instance by one of Columbus' returning sailors in 1493. The evidence for the Columbian exchange is substantial. First of all, there are no unambiguous pre-Columbian references to syphilis in European literature. More importantly, archaeology provides no pre-Columbian bones showing characteristically syphilitic disfigurement. Euphemisms bestowed on the disease by European nations exhibited European xenophobia at its most intense. The English called it the "French" disease. The French either returned the courtesy or called it the "Spanish" disease. Under whatever name, its effects were always disfiguring; its course was frequently fatal; and physicians' purported "cures" were quackery at its most ludicrous.

Many European pathogens, but particularly smallpox, ravaged the Indians of Mexico, a fact that illuminates the otherwise inexplicable Spanish conquest of the Aztecs. Having no immunities to smallpox, they died in incalculable numbers. Crosby's text is filled with quotations relating to Indian mortality rates. Toribio Motolinia said they died "in heaps, like bedbugs." After having been driven out of the Aztec capital on their *noche triste* of 30 June 1520, the small Spanish force under Cortés returned to the city which they then besieged. Crosby explains the circumstances of the final defeat of the Aztecs:

> The triumphant Aztecs had not expected the Spaniards to return after their expulsion from Tenochtitlán. The sixty days during which the epidemic lasted in the city, however, gave Cortés and his troops a desperately needed respite to re-organize and prepare a counter-attack. When the epidemic subsided, the siege of the Aztec capital began. Had there been no epidemic, the Aztecs, their war-making potential unimpaired and their warriors fired with victory, could have pursued the Spaniards, and Cortés might have ended his life spread-eagled beneath the obsidian blade of a priest of Huitzilopochtli. Clearly the epidemic sapped the endurance of Tenochtitlán. As it was the siege went on for seventy-five days, until the deaths within the city from combat, starvation, and disease—probably not smallpox now—numbered many thousands. When the city fell "the streets, squares, houses, and courts were filled with bodies, so that it was almost impossible to pass. Even Cortés was sick from the stench in his nostrils."

To call smallpox the Spaniards' "biological ally" is more than a clever metaphor. To the extent that accounts of the Spanish conquest of

Hispanic America have neglected the devastating effects of exotic diseases on peoples lacking protective antibodies, those accounts are manifestly inadequate.

In his first chapter, Crosby reviews the evidence relating to the predominant "O" blood type of the American Indian, which contrasts sharply with the diverse blood types found in the indigenous peoples of Europe, Asia, and Africa. He does not develop the implications of blood type for differential susceptibility to disease. See Diamond on blood type A and susceptibility to smallpox.

* 2.15 *

**Diamond, Jared. "A Pox upon Our Genes: Smallpox Vanished Twelve Years Ago, but Its Legacy May Still Linger within Us."** *Natural History* (February 1990): 26-30.

Diamond reviews the evidence for a causal relationship between blood type and susceptibility to smallpox, relying on a comparative study of survivors and victims of an epidemic in India in the 1960s. "They (investigators Vogel and Chakravartti) found a total of 415 unvaccinated smallpox patients. For all but eight of these patients, they were able to find a healthy brother or sister to consider as a 'control subject'—that is, someone as similar as possible genetically to the patient and living in the same house, but differing in not having contracted smallpox despite close exposure." 261 of the patients carried blood group A; 154 lacked it. "Among the 407 healthy subjects, only eighty carried group A." These data strongly suggest that the As were susceptible and the non-As resistant to infection. "The ratio of A to non-A among the patients (261:154), divided by the ratio of A to non-A among the controls (80:327), was 7—meaning that a person with group A had a seven times greater risk of contracting smallpox than someone without group A."

Diamond also considers statistical studies that compare the frequencies of blood group A in different sections of India and Africa with reported epidemics of smallpox in those same sections." Areas with high frequencies of smallpox proved to have low frequencies of group A, suggesting that smallpox had killed off people with group A." These correlations for India and Africa are close to those for the Americas. See Crosby's 1972 book for statistical data on the very low incidence of blood group A among the indigenous peoples of the Western hemisphere.

* 2.16 *

**Mourant, A. E. "Associations Between Hereditary Blood Factors and Diseases."** *World Health Organization. Bulletin* 49:1 (1973): 93-101.

Mourant carefully considers all the evidence relating to the relationship between blood groups and susceptibility to disease in the course of which he identifies the work of the scientists on whom Diamond relies.

That study has the following citation: Vogel, F. and M. R. Chakravartti. *Humangenetik* 3 (1966): 166+. Mourant also refers to the same body of work that Diamond discusses on the possibility that modern distributions of blood groups are consistent with people having group A being particularly susceptible to smallpox.

Mourant had to acknowledge that some investigators have failed to confirm the correlations that Vogel and Chakravartti found in their studies of smallpox epidemics in India. Mourant therefore considers that the question is still unresolved.

* 2.17 *

**Ponting, Clive.** ***A Green History of the World.*** London: Sinclair-Stevenson, Ltd., 1991. ISBN 1-85619-050-1. GB 91-3508. Publisher's address: 7/8 Kendrick Mews; London SW7 3HG, England. Price (pounds sterling) 17.95.

Environmental issues are not only those that pertain strictly to the state of the natural world. They ramify out into all domains of culture and society, most importantly in the use of resources and energy, the distribution of wealth—and consequently of poverty, the way people treat people, and the way people think about the world they inhabit. Ponting's book is a "green" history of the world in the sense that it places in the foreground the force of the environment in shaping and limiting the events of human history. Ponting grants that his book is not based on original research. He has assimilated the research of others and presented it in a succinct narrative.

Ponting begins with a reconstruction of the prehistory of Easter Island where a technologically advanced Polynesian culture had once flourished. The evidence for a high culture having once existed there consisted of the presence of about 600 huge stone statues of gods or tribal chiefs that lay scattered about the island in varying states of completion and repair. The people who occupied the island in 1722 lived in a condition of barbarism and squalor, their only interest being incessant internecine warfare. When Europeans first saw the island in 1722, it was devoid of trees, but pollen analyses show that, at the time of its settlement by Polynesians, it was heavily forested. Moreover trees, or rather logs, were essential to the transport of the huge statues, each averaging about twenty feet in height, from the quarry to their final disposition. Deforestation undermined the possibility that Easter Island's specialized culture might continue.

Human attitudes and presuppositions about the natural world are of the utmost importance in determining how we interact with the environment. Unfortunately for ecological understanding, the Greek philosophers gave no support to the idea that nature is to be respected. The Jewish scriptures were emphatic that God enjoined man to exercise dominion