

Environmental Degradation in Ancient Greece

*Contrary to the view that the ancients lived in harmony
with their environment, archaeological and geologic
evidence shows that they often abused the land*

by Curtis N. Runnels

The stark Greek landscape charms everyone who sees it. For thousands of years, Greeks and visitors alike have sung the praises of this small country, famous for its Bronze Age civilizations and the cultural achievements of its people in classical times. But is the countryside one sees today the result of climate acting alone, or have humans played a part by clearing forests and causing soil erosion?

Recent archaeological work is changing a long-standing view of the impact of agriculture on the land in Greece. The evidence mounts for episodes of deforestation and catastrophic soil erosion over the past 8,000 years. Many scholars believe they resulted from a long history of human land use and abuse. This new perspective on human settlement and its impact on the natural environment stands in sharp contrast to the views of the 19th-century Romantics, who saw the ancient Greeks as careful stewards of a land they held to be filled with gods.

Indeed, it remains a widely espoused opinion today that the destructive ecological practices of modern civilization are a new development. The popular press frequently carries reports of people who advocate returning to the bal-

anced and reverential regard they suppose our ancestors had for the natural world. The Garden of Eden is a primal myth of Western civilization, and it was preceded in classical antiquity by the belief in the Golden Age—a time, alas now lost, when human beings were said to have lived in innocent harmony with their natural environment.

Sir Peter B. Medawar (in *The Limits of Science*, a book of his essays published in 1984) described this kind of thinking as "Arcadian." He compared the concepts of Utopia and Arcadia and concluded that Arcadia is closer to the ideal of a Golden Age than are the Utopias of Thomas More and Francis Bacon. Their Utopias were places where science-based technology was employed for the melioration of society, whereas Arcadia "is the conception farthest removed from Utopia, for one of its principal virtues is to be pastoral, prescientific and pretechnological. In Arcadia, mankind lives in happiness, ignorance and innocence, free from the diseases and psychic disquiet that civilization brings with it—living indeed in that state of inner spiritual tranquillity which comes today only from having a substantial private income derived from trustee securities."

The effects of Arcadian thinking can be seen in the debate about the degree to which the ancient Greeks were responsible for the deforestation and erosion that have reduced much of Greece to a barren, stony—if picturesque—wasteland. To be sure, environmental degradation (if not its causes) was noted in ancient times; many references to it appear in the writings of the ancients, particularly Plato and Aristotle. They give accurate and apparently eyewitness accounts of deforestation and soil erosion in the fourth century B.C. Archaeology can now confirm that despoilment of the natural environment

took place in antiquity, but the evidence allows one also to place the responsibility for this destruction primarily on the inhabitants of that time.

A New Kind of Archaeology

Over the past two decades, the introduction of multidisciplinary and intensive regional survey techniques in Greece has revolutionized Greek archaeology. One aspect of this revolution is a shift away from the investigation of single sites to studies of the natural and cultural history of entire regions. This approach is achieved in part by using new methods of fieldwork, particularly searching large areas (typically more than 100 square kilometers) with teams of people who record every artifact, feature and site that can be detected. Another innovation is the large-scale use of remote sensing, ranging from ground-penetrating radar to satellite images, to assist the archaeologist in detecting past human activity. Further aid has come from the new discipline of geoarchaeology, which combines the techniques of geology and archaeology to improve the interpretation of the natural contexts of ancient cultures.

An example of the collaboration between archaeologists and geoarchaeologists can be seen in the study of landscape change in southern Greece. Two major projects in which I have participated since 1979 in the Argolid (the northeastern part of the Peloponnese peninsula) combined walking tours designed to identify archaeological sites with geologic surveys that attempted to reconstruct the history of the landscape during the Pleistocene and Holocene epochs of the past 50,000 years.

One of these projects targeted the Argive plain. According to Aristotle, it had undergone considerable alteration in the Bronze Age, from about 3000 to

CURTIS N. RUNNELS earned degrees in archaeology from the University of Kansas and Indiana University and has taught at Stanford University. He is associate professor of archaeology at Boston University. Runnels has worked for 20 years in Greece, specializing in the study of early prehistory and the relation between human settlement and landscape through time. His most recent book is *A Greek Countryside: The Southern Argolid from Prehistory to the Present Day*, written with Michael H. Jameson and Tjeerd H. van Andel.



GOLDEN AGE of Greece is represented in Claude Lorraine's painting *The Judgment of Paris* (1646), in which the goddess of strife throws down a golden apple inscribed "to the fairest" and says that Paris must award it to one of three god-

esses. The persistent view of the ancient Greeks as careful stewards of a land that they saw as guided by gods and goddesses is belied by recent archaeological evidence of soil erosion caused by human land abuse.

1000 B.C. To investigate ancient land use, I joined archaeologist Berit Wells, director of the Swedish Institute in Athens, and Eberhard A. W. Zangger, a geoarchaeologist now at the University of Heidelberg. Our goal was to survey two valleys, Berbati and Limnes, which lie on the northern edge of the Argive plain and have a combined area of 60 square kilometers.

This project, sponsored by the Swedish Institute and headed by Wells, had two parts. One was a geoarchaeological study of the two valleys by Zangger, who had done a similar study of the Argive plain while working on his doctoral dissertation at Stanford University. The other was an intensive archaeological survey.

The survey brought to light evidence of human activity from the Middle Paleolithic period, some 50,000 years ago, and showed that agriculturists entered the area about 7,000 years ago, settling

on the edges of the Berbati Valley near the best soils and supplies of water. After this initial colonization, the size of the original Neolithic settlements began to grow, and new ones were founded. By the Late Neolithic period (between 4000 and 3000 B.C.), more than 20 settlements and smaller sites were scattered over the region. This expansion continued for the first few centuries of the third millennium—the Early Bronze Age in cultural terms.

Ancient Land Use

From the larger settlements came evidence of agriculture and many artifacts such as pottery, querns for grinding grain and simple stone tools of flint and obsidian. Some of the smaller sites doubtless served special purposes (as huts for shepherds and storehouses for tools, for example) and were not necessarily inhabited permanently. Neverthe-

less, they demonstrate the more intensive use of the landscape at this time because they are located on steep slopes, at high elevations and in areas where only soils of marginal productivity ever existed.

In addition to sites where past human activity left concentrations of artifacts, our searching technique revealed tens of thousands of individual Neolithic items scattered over the countryside. These thin scatters of artifacts are found in areas now uninhabited and in some cases uninhabitable because they are devoid of soil and vegetation.

The pattern of settlements and artifacts reveals the structure of what archaeologists call fossil cultural landscapes. Particularly interesting are the numerous finds of ground and polished hard-stone axes and flint blades, which have edges coated with silica deposited when the blades were used to cut grasses and other plants. These common agri-

cultural tools belong to the Neolithic period and the Early Bronze Age and mark regions where agricultural fields once existed. We believe grazing and farming were the principal activities on the slopes of the Berbati and Limnes valleys from 4000 to 3000 B.C. and that they resulted in one or more episodes of catastrophic soil erosion, which left alluvial fans in the valley bottoms and deep layers of sediments to mantle the Argive plain.

One episode occurred at the end of the Neolithic period, well after the expansion of settlement in the Berbati and Limnes valleys. This erosion buried at least one Neolithic site in the Argive plain, which was found in one of Zangger's cores that was drilled through the thick alluvium. What appears to have been a second similar event came in the third millennium, at the end of the Early Bronze Age. The erosional deposits of this period spread across the Argive plain to make up most of its present

surface. Nor were these the last events to be recorded. Flooding eclipsed parts of the town of Tiryns at the end of the Late Bronze Age (around 1200 B.C.). After this natural disaster, the slopes of Berbati were abandoned and for the most part never inhabited again.

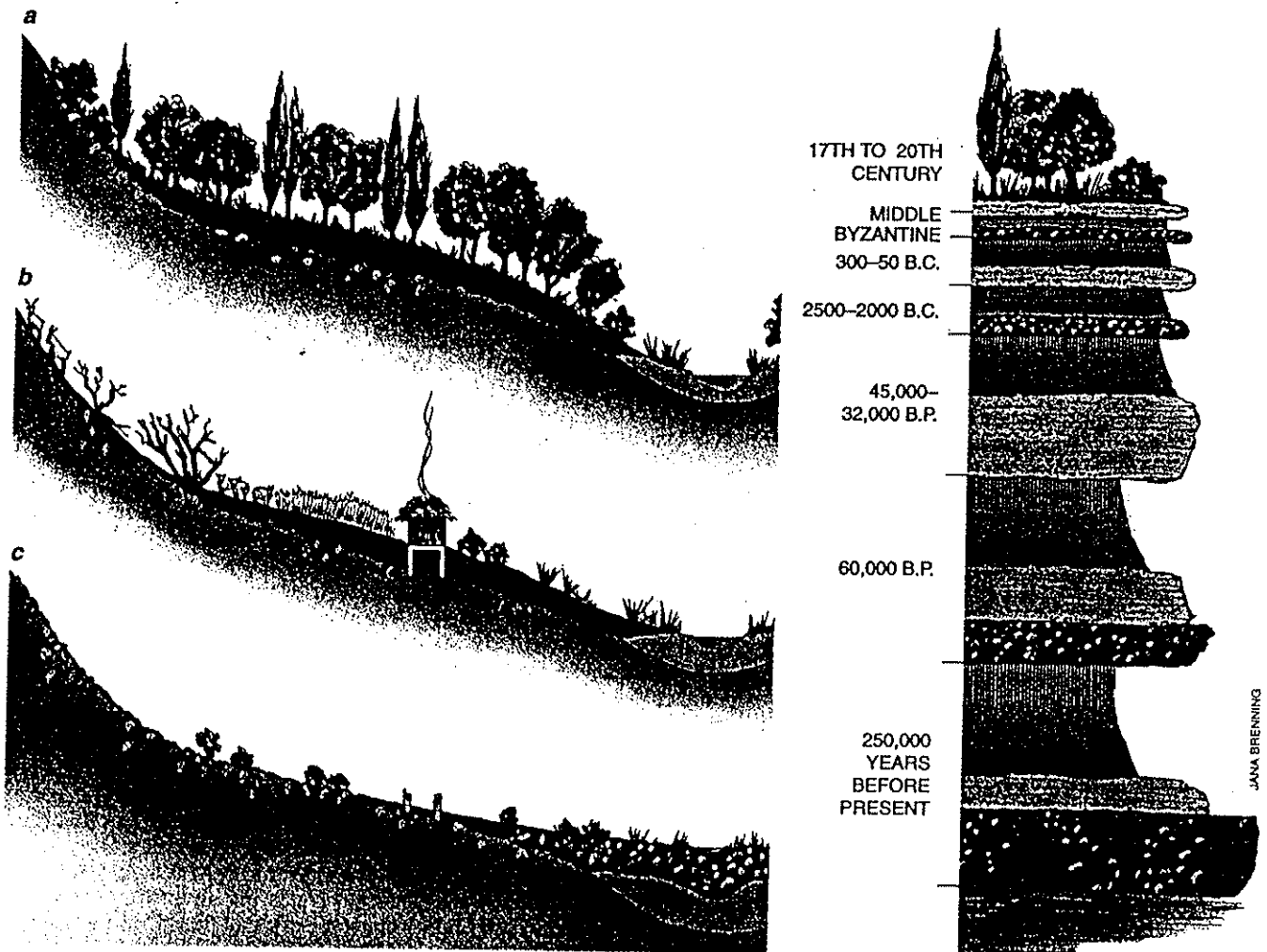
Confirmation of the picture offered by the archaeological record comes from pollen taken from a seven-meter core obtained from the now vanished Lake Lerna in the Argive plain and analyzed by Susanne Jahns of the University of Göttingen. It shows that deciduous oak trees were common in the Argolid in the Holocene epoch. By the middle of the fourth millennium B.C., however, the oak pollen had dropped off sharply and was replaced by pollen of hornbeam, pine, scrub oak and heather. These plants are endemic to cleared and disturbed land. Today the slopes surrounding the Argive plain consist of bare, rocky land covered with a thin scrub vegetation of low bushes and

herbaceous plants, with only isolated pockets of trees—chiefly pines.

Other projects in Greece have found signs of soil erosion. The episodes do not correlate in time with the periods of erosion in the Argolid. If climate were the sole cause, most of Greece would have simultaneously been affected. The variation in timing therefore points to a human role. Clearing natural vegetation from the slopes, which was necessary to bring them under cultivation and to open them for grazing by sheep and goats, made the soil unstable and thereby triggered extensive and permanent erosion.

The Soil Tells a Story

Our second project produced further evidence of regional land abuse. This study was carried out in the southern Argolid, a remote part of the Peloponnese peninsula. With historian Michael H. Jameson of Stanford and geo-



LAND ABUSE by ancient Greeks followed a consistent pattern (left). At first (a), a mixed forest held the soil in place on a slope. When the forest was cleared for farming (b), the soil stayed in place for a time, but eventually erosion carried it off the slope, depositing alluvium in the valley bottom (c). As a

result, a typical geologic profile (right) from the southern Argolid region of Greece shows a sequence of erosional deposits and intervening soils (with their approximate ages). In each period the soil that gradually forms above the deposits is thinner and less developed and is less able to support vegetation.

archaeologist Tjeerd H. van Andel of the University of Cambridge, I conducted an archaeological reconnaissance of some 250 square kilometers. The survey identified more than 350 sites of human activity spanning a period of some 50,000 years.

An interesting pattern of settlement emerged when we plotted the numbers of sites by archaeological period. It turned out that the sites are not distributed evenly through time but instead exhibit a series of abrupt peaks and valleys, suggesting that periods of expansion of sites over the land were followed by periods of abandonment. Somewhat to our surprise, we found that this unexpected pattern of settlement could be correlated with the geologic history of the region.


This correlation resulted from an analysis of the erosional history of the area made by van Andel and Kevin O. Pope, also at Stanford. An innovative feature of their work was the study of soils. Soils can be distinguished from the deposits of erosion because they form on the deposits as a result of the chemical weathering and transformation of underlying sediments—a process that can take thousands of years in the semiarid parts of Greece. Van Andel and Pope identified at least seven cycles of soil erosion that were followed by times of stability when thick profiles of soil had the opportunity to accumulate. The age-related features of soil profiles make it possible to correlate the different erosional deposits and soil profiles with archaeological findings.

Three of the erosional events that left marks in the geologic record took place during the last ice age—at about 272,000, 52,000 and 33,000 years ago. They can be attributed to global climate changes. But four episodes belong to the past 5,000 years. Each episode—at about 2500 B.C., 350 to 50 B.C., A.D. 950 to 1450 and in recent times—was followed by a period of stability when substantial soil profiles formed. Although small-scale climate changes may partly explain this pattern, we place the chief blame on the activities of the local inhabitants. Our evidence for this claim is twofold: the correlation between the periods of erosion and the periods of intense human settlement, and the formation of soil during the periods when the human impact was minimal.

Our dating technique began with a search for archaeological sites and artifacts that are covered by alluvium, buried in it or sitting on it. By combining archaeological and geologic data, we were able to date the times of erosion closely. An important element in this work was the recognition that lay-

Paradise Lost

"In the time of the Trojan wars the Argive land was marshy and could only support a small population, whereas the land of Mycenae was in good condition (and for this reason Mycenae was the superior). But now the opposite is the case... the land of Mycenae has become... dry and barren, while the Argive land that was formerly barren owing to the water has now become fruitful. Now the same process that has taken place in this small district must be supposed to be going on over whole countries and on a large scale."
—Aristotle, from *Meteorologica*, Book 1, Chapter 14



A typical landscape in the Argolid region of Greece today

ers of soils could be used to determine periods of surface stability that contrasted with the erosional periods.

From these data we concluded that the clearing of land during times of intensive human settlement gave rise to soil erosion, which in turn caused the people to abandon their settlements or at least to scale back their activities. And the reduced human activity permitted erosional deposits to stabilize and soils to form.

Soil erosion on a similar scale has been reported from other parts of Greece—the northern provinces of Macedonia and Thessaly and the islands of Euboea in the center of the country and of Crete in the south. The episodes date from as early as the sixth millennium B.C. and continue through virtually every historical era to the present day.

The archaeological study of ancient environmental catastrophes has only just begun, and it is perhaps too early to say that such analyses can always distinguish the effects of human habitation from those of climate. Nevertheless, it is clear from the variety and different timing of these events in neighboring regions that a climatic explanation is unlikely to account for all the data. We have learned enough to maintain that the changes in the natural landscape in

antiquity are at least partly the result of shortsighted human activity. The lesson to be drawn from our work is that people have a long history of misusing the land: environmental catastrophes are not an innovation of the modern world.

FURTHER READING

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