The Archaeology of Global Change

The Impact of Humans on Their Environment

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A Landscape Analysis of Western Europe during the Early Middle Ages

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From the Roman conquest to the French Revolution, Burgundian history provides a rich venue for the study of political, social, and cultural change as it relates to geography and climatic variation. In this chapter we focus on the early Middle Ages because in that period long-distance trade and other mediating factors were not sufficient to buffer the region from environmental disturbances. The location of Burgundy, in the central highlands of western Europe and astride the economically important Rhône-Saône Valley, is especially sensitive to the waxing and waning of regional and supraregional power and prestige. These shifts of power are traced through archaeology and critical evaluation of Classical period and early medieval historical texts, working (inasmuch as is possible) past biases inherent in the points of view of both the contemporary writers toward their opponents and modern-era historians toward the so-called barbarians of the north. The concepts of landscape, heterarchy, and information capturing are introduced to broaden our own perspectives on cultural events of the past. From this emerges an account of the subtly varying proportions of climatic and cultural influences on Burgundian subsistence systems and cultural development during the early Middle Ages.

Strategies: The Burgundian Point of View

François Rémond wrote the end-of-year expenses for 1790 carefully, in his clear slanted hand. The accounting was destined for his new superiors: fellow citizens who, like him, were now elected officials. Just two years before, as priest in the Burgundian village of Uxeau, his superiors had been clerics, answerable only to the Pope in Rome. Now, as antimonarchical and anticlerical fervor swept France, Rémond could not help but wonder what additional changes the new year and the new government would bring to his old parish, now a *commune.* Three years later, in March 1794, the 44-year-old Rémond, by then a national representative of the new government, performed the civil ceremony himself that united him in marriage with the widow Benoîte Daviot.

The intervening event in Rémond's life, between celibate cleric and married *agent national,* was the French Revolution. It prompted Rémond to change his allegiance away from a Mediterranean, southern, ecclesiastical institution to the Parisian, northern, and secular structure of the new French nation. Rallying themes of the Revolution were liberty, equality, fraternity; its icon was the figure of Marianne,

depicted leading troops of the Revolution into battle. These themes represented a religion of politics as fervent as Mediterranean Catholicism.

By altering his allegiance, Rémond utilized one of the tactics common to Burgundians when confronting changing times. A similar political realignment was at issue in the same region nearly 17 centuries earlier, in 58 B.C. At that time a bitter dispute erupted between two brothers, Dumnorix and Diviciacus. They were members of the ruling elite of a powerful polity of Celtic France, the Aedui, who inhabited the land that is now Burgundy. Diviciacus was Julius Caesar's trusted lieutenant, traveling with the Roman general as he positioned troops to take over western European trade passing along the Rhône-Saône-Seine Rivers. Dumnorix was outraged that his brother could be disloyal to ideals of Aeduan sovereignty and Celtic independence for venal commercial and strategic reasons. These opposing attitudes toward Roman presence in Gaul led to Aeduan civil war; Diviciacus's influence failed to keep those who supported Dumnorix from voting to join a pan-Gaulish resistance to Roman colonialism, but his pact with Rome eventually prevailed. Dumnorix chose the northern Gauls and Germans, while Diviciacus sided with the southern Romans. The drama of their conflict marked a turning point, heralding over 200 years of assertive Mediterranean control of Burgundy and many of its northern neighbors.

Following the Romans, there were numerous other episodes of political and religious realignment. Changes from one orientation to another (north or south), or in some instances to a nonaligned internal leadership, transpired sometimes violently, sometimes peaceably. A rich record of these reorientations has been left us in the form of historical documents, archaeological data, and environmental information.

The tales of Rémond and of Dumnorix and Diviciacus illustrate an enduring theme of Burgundian history. Apart from the cultural integrity of the inhabitants themselves, there have been two great mediating traditional influences. These are the North Sea/English Channel powers, and the forces of the Mediterranean. Before the advent of rail transportation, these two worlds were accessible to one another for commercial purposes largely through the valleys of the Rhône-Saône-Seine corridor (RSSC). The lives of Dumnorix and Diviciacus and of Rémond bookend the premodern historical record of western Europe. The conflict between Dumnorix and Diviciacus was precipitated by Julius Caesar's effort to secure the RSSC for Roman (Mediterranean) benefit. In subsequent centuries, control of the highlands flanking the RSSC changed hands frequently, enduring at least a dozen times for a century or more. This penchant of Burgundians for looking both ways, north and south, evokes the double-faced "Janus" head, pervasive in both northern and Mediterranean iconography.

Previous efforts to identify the reasons for this restless record of power relations have concentrated on hypotheses of invasions from the Eurasian steppes triggered by climatic change (Bury 1963; Huntington 1907). While periodic incursions from the north and east (e.g., the Huns and Vikings) partly explain some of the cultural disruptions experienced by inhabitants of western Europe during the first millennium A.D., they ignore the fundamental question of how populations—whatever their ethnic and geographical origins—have come to terms with enduring characteristics of the Burgundian environment. It also ignores the contributions of northern groups to indigenous European adaptive strategies.

It has been suggested that several factors have shaped power relations over the centuries. They include the spread of civilization (i.e., urbanization), plagues, unintentional self-administered lead poisoning by elites, diminished soil capacity, and climate change. Although all of these are clearly active ingredients that have to be given equal opportunity to manifest their effects in the historical account, we concentrate primarily on the role that climate plays in this larger scheme. As has been documented elsewhere (Crumley 1993; Crumley and Marquardt 1987; Gunn and Crumley 1991), Burgundy resides at the junction of three markedly different climatic regimes: maritime, Mediterranean, and continental. Each of these regimes has a distinct seasonal pattern of moisture that greatly influences agricultural and pastoral exploitation. These climatic regimes exhibit long-term change in accordance with global warming and cooling, enforcing radically different environmental circumstances for those who rely on the land's bounty. These changes have been extensive and enduring; peoples, powers, and ideas have literally blown into Burgundy on the prevailing wind of their era.

A renewed effort is being made to identify and set aside deeply embedded biases that color much of the western intellectual tradition's view of its own history. We do this by

developing an integrated understanding of cultural, historical, biogeographical, and climatic influences that mediated culture change in western Europe. Three concepts—landscape, heterarchy, capturing—facilitate understanding of these processes, and they are illustrated with reference to events of the early Middle Ages, when many of the differences between the old Classical Europe of Dumnorix and Diviciacus and the nearly modern Europe of Rémond were formulated.

Extending Points of View

A "MODERN," NARROW POINT OF VIEW

Negative characterizations of the intervening period between Rome's Golden Age and the contemporary era began as early as 1340. Italian poet Francesco Petrarch and subsequent Renaissance scholars attempted to revitalize Roman and Greek heritage by linking classical and their own "modern" times and distinguishing both from the barbaric intervening years. During those centuries, they thought, the brilliance of Mediterranean culture was cruelly eclipsed by northern barbarian hegemonies.

Beginning with the Enlightenment and especially in the Romantic era (both periods of northern political dominance in Europe), historians and politicians turned their attention to understanding the contribution of northern Europeans to the modern heritage. This stimulated the search of ancient records for elements contributing to the cultures of modern north European peoples (Geary 1988; Gibbon [1789]1994; Hodges and Whitehouse 1983; Musset 1975; Wailes and Zoll 1993; White 1966; Whitehouse 1989; Wood 1994) and the employment of archaeological methods to bring to light features of northern culture not revealed by classical texts. For example, Napoleon III, stimulated by Caesar's account of the Gaulish Wars, patronized mid-19th-century archaeological excavations at the Burgundian Celtic capital of Bibracte and engineering studies of Alesia, where Caesar's siege brought pan-Celtic resistance to an end.

Early in the 20th century, historians drew on the techniques of social science to develop critical methods capable of penetrating some literary biases (Cantor 1991). Of particular importance was the thesis of Henri Pirenne (1939), which proposed that southern Roman values held sway in the west until Islam smashed the old order in the 8th century. A new Europe then emerged, founded on northern Europe's Carolingian dynasty. Though it provided a basis for reckoning ancient north European contributions to modern culture, Pirenne's thesis places the transition to modern times with the 8th century Saracen invasion, thereby reinforcing the influential perceptions held by the literarte elite of that earlier period, of the "dark" or early Middle Ages.

Archaeology began to make major contributions to reformulating biases following 1950 (Hodges 1992; Hodges and Whitehouse 1983; Whitehouse 1989; Young 1991, 1992). Archaeological theory provides hypotheses and models to redress the balance between literary and nonliterary sources. Today new data from archaeology generate theories that bridge the sciences and the humanities and offer new insights into medieval European society.

Developments in interdisciplinary science suggest that some of the "dark" can be removed from the Middle Ages by evoking broad contexts for understanding historical, biogeographical, and climatic influences on cultural change. By studying processes rather than focusing on transition periods and events, we seek to circumvent ethnically biased interpretations of the time following the Roman loss of dominance in western Europe. It is evident from the tales of Dumnorix and Diviciacus, Rémond, and others that Burgundians always understood that they had to deal with both north and south as complex social, political, and environmental events unfolded.

A BROADER POINT OF VIEW: LANDSCAPE, HETERARCHY, CAPTURING

While contemporary environmental issues such as ozone depletion, habitat degradation, biodiversity loss, and sea-level change can be studied at the planetary scale, only regional and interregional scales make it possible to place global environmental conditions in cultural context (Crumley 1994b, 2001; Crumley and Marquardt 1987; Gunn and Adams 1981; Gunn and Crumley 1991; Gunn et al. 1995; McIntosh et al. 2000). These near-continental scale studies provide a bird's-eye view of processes that generate various adaptive poses within regional cultures. It is regional cultures, after all, that represent the distilled human assessment of what is necessary to live in a given place on the face of the earth.

Interregional comparison is not new. Kidder (1924) realized early on in his study of the prehistory of the south-

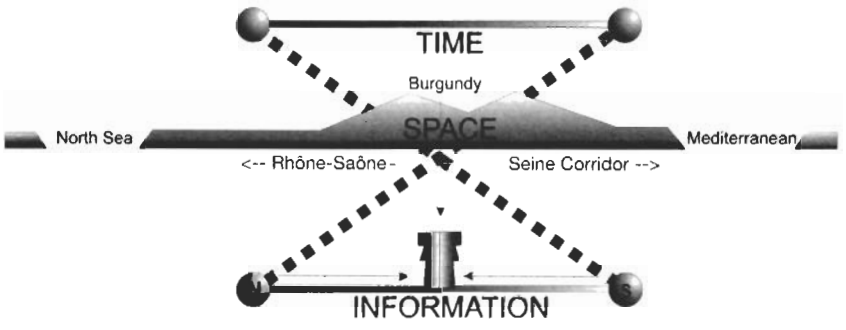

Figure 9.1. Time-space relations along the Rhône-Saône-Seine corridor.

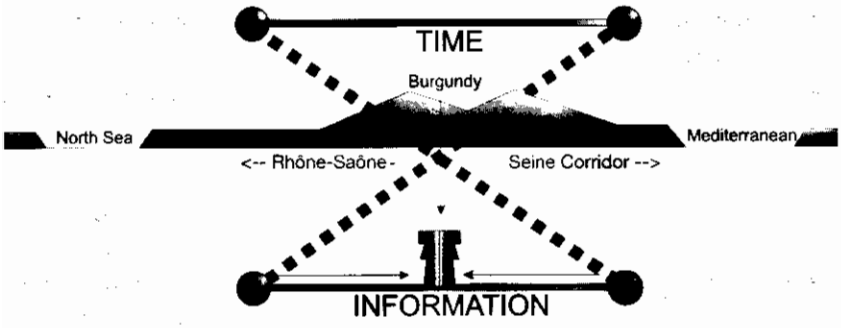

Figure 9.1. Time-space relations along the Rhône-Saône-Seine corridor.

western United States that interregional relationships had to be evaluated before regional chronologies could be understood. Steward (1955) and Antevs (1948) both saw the world as teleconnected parts that could be profitably compared to gain insight into culture and environmental change. Interregional methods remain much underutilized and theoretically underdeveloped, however. We suggest that interregional and continental-scale studies will assume greater importance as global climate is better understood, and as the concept of global ecology is linked to human survival. A tangible human-scale global ecology necessitates the long-term analysis of specific regions and their landscapes to reveal the relationship between global climate change and traditional strategies of settlement and land use.

Interregional studies of adaptation require broader concepts than intraregional studies. Perspectives on social and political structures should encompass their variability and seek to avoid biases. Similarly, the retention of information across many generations, beyond the level of conscious parent-to-child training, requires new concepts for the study of such transmission.

An explicit element of this methodology is to focus on one region while treating adjacent regions as context. The landscape of Burgundy focuses our spatial interest within a broader interregional context. In the Burgundian highlands of western Europe we see the interaction of peoples and climates over extended periods of time as being explained by a model that incorporates elements of time, space, and information (Figure 9.1). The underlying cultural dynamic is the interregional struggle for control of the lucrative avenue of trade along the Rhône-Saône River corridor. People who inhabit Burgundy either control this economic and cultural corridor, or it controls them as greater powers resident in the Mediterranean or North Sea basins alternatively assert their presence.

We are concerned with the early Middle Ages, from roughly A.D. 250 to 1000, set in the temporal context of nearly 2,000 years from Dumnorix and Diviciacus in Classical times to Rémond of the French Revolution period. Despite earlier claims for literary and economic modernity by historians, the traditional landscape survived largely intact from the development of long-distance trade routes in prehistoric times until the completion of the railroad system in the late 19th century, which changed the scale of transport.

A landscape does not just "survive"; it is maintained. The information necessary to do so, held over the long term by the inhabitants of Burgundy, has been acquired through practical experience, in informal and formal education (which predates Roman times) and as lived collectively during periods of cultural and political domination by peoples of Mediterranean or North Sea origin. Thus contemporary Burgundian economic strategies include vineyards native to the Mediterranean basin, moisture-tolerant vegetables of North Sea basin origin, and herd animals of Eurasian economies. Their economic acumen is the result of accumulated wisdom gained by coping for millennia with the flow of trade across the spine of Europe.

Burgundians, like all societies around the world, are constrained by the same basic human capacities and limitations. However, strategies, or combinations of approaches and circumstances, can be formulated within the very broad range of cultural potential, quite possibly outside the range of commonly held, modern, western values. We suggest that the principles of heterarchy and information capturing as defined below play an important role in broadening our perception of the survival and prosperity of human groups. These principles are employed also in an effort to identify and escape the biases of the western intellectual tradition. In addition, they enable us to examine human economic and

sociopolitical organization at temporal and spatial scales that offer a bridge to the work of global ecologists.

EXTENDED MIDLEVEL CONCEPTS

Understanding the nature of the interaction between global and regional physiography, climate, and culture requires a broader theoretical context than is generally presumed. It encompasses not only landscape forms and meanings (e.g., Ashmore and Knapp 1999), but also alternative elements of social organization (e.g., heterarchical), along with information acquisition, storage, and transmission, as illustrated by the concept of capturing. Together, these concepts broaden our comprehension of the cultural range, or phase space, over which groups search for adaptive adjustments to combinations of social and environmental circumstances.

Landscape. The study of landscapes has been broadly recognized in recent years as a conceptual device that facilitates integration of diverse data from geology, soils, and biological communities to cognition. Of major concern is that all of these influences on regional ecology be considered as a holistic unit, influenced by global conditions and manifest in local climate (Crumley and Marquardt 1990; Marquardt and Crumley 1987). In this perspective, the most enduring characteristics of the physical setting (geology) act as a stage, while cultural phases are the sets. This stage provides an interactive interdisciplinary context, or mixing eddy, for the various elements of the model.

Heterarchy. The study of complex systems, especially those in which humans play an important role, benefits from assuming broad organizational options; in this way, the importance of various elements in the system can be seen to vary with time and circumstance. The term "heterarchy" refers to relations among elements, which may be unranked in relation to one another (e.g., species in the category "birds") or may be flexibly ranked given the circumstances (scarce hawks/plentiful ducks, spring/fall, endangered/not endangered, etc.) (Crumley 1987a; McCulloch 1945). In the terminology of programming languages, heterarchical organization means that a subroutine can call on other subroutines to perform a special task and thus temporarily assume a superequal relationship to other elements (Minsky and Papert 1972). Thus hierarchy is a subset, a special case, of heterarchy.

The concept is particularly useful for describing the dynamics of power relations in human groups. Since power has multiple sources and valences, and because conditions change, the recognition of heterarchical relations among powerful entities (in addition to the more familiar hierarchies) extends the scope of both description and explanation of sociopolitical structures. It is possible, given the setting of certain traditional methods of enforcing law and inheriting power, for social heterarchies to become hierarchies and vice versa (Crumley 1987a, 1987b, 2001, 2003a, 2003b; Ehrenreich et al. 1995; Jones 1992; Schiele and Freidel 1990; Small 1995).

Heterarchy is an especially useful concept for the study of long-term cultural change because it allows fluidity of function among elements and thus provides numerous options for explaining precipitous changes in social structure or in the whole of the complex system of human-environment relations. An exclusively hierarchical model forces one to assume that all social change consists of "rise" or "fall," since it focuses on the evolution and collapse of the elite component of a society. By employing a heterarchical model, the loss of power by a particular elite body need not automatically be seen as the collapse of the society as a whole, but rather as a reorganization in which various elements assume transformed roles. A hierarchy is characteristically a "brittle" heterarchy since it is cemented by vested interests. It may, therefore, be prone to collapselike phenomena.

Heterarchies should, in theory, be completely fluid during adaptive transformations unless a situation arises for which there are no customary actors with a solution. In that circumstance, an innovative solution and the information supporting the new solution will be socially manifest; a cultural hero will be incorporated into the culture's operational pantheon (Dove 1993; Gunn 1994a) or power relations among members of the existing pantheon rearranged (Schiele and Freidel 1990).

Capturing. Long-term studies of cultural change, at the scale of traditions enduring for hundreds or thousands of years, require a long-term concept of cultural information management rather than shorter-term intergenerational information transfer, which is adaptive and implies that transferred knowledge is largely of immediate utility, being subject, much like genes, to a sort of natural selection. It leaves

the generally observed phenomenon of "useless" knowledge unexplained or invites convoluted syntheses to overcome gaps in utility. If cultures are to mature in the regions in which they locate themselves, however, they should have to accumulate adaptive knowledge during a given set of conditions and retain it across periods when other conditions prevail and that knowledge is not useful. A culture must be able to utilize stored knowledge when the conditions reoccur. We call this husbanding of not immediately useful knowledge "capturing." The current best candidate for a cultural structure to transfer and tend multigenerational knowledge appears to be pantheons, which, taken in a broad sense, encode behavior over the long term (Gunn 1994a). Each figure in the pantheon keys a set of knowledge developed to meet a circumstance that has occurred in the past and may reoccur. If it reoccurs, its return reinforces its utility for the regional society. There are indications in the anthropological literature that cultures may retain packages of captured knowledge for up to 2,000 years through a set of pantheon-creating processes (Roberts et al. 1975).

While the landscape, heterarchy, and capturing concepts shed some light on long-term culture change, they do not all have equal emphasis in this study; subsequent work will further integrate them. In the following sections we discuss the landscape of Burgundy, the physiographic substrate, the regional climatology, and the observed political transformation of the RSSC. Then we attempt to comprehend the processes that integrate these biocultural and physiographic aspects of the Burgundian landscape.

Physiography and Cultural Geography

Culture-climate influences are not always direct or linear. Our purpose is to determine the pattern of such influences over the long term, especially repeated methods of coping that are rooted in cultural continuity. Patterns emerge as a result of interaction of physiographic conditions with historically transmitted values. Because it is used repeatedly, the strategy of changing allegiance demonstrated by Dumnorix and Diviciacus and by Rémond suggests a cultural pattern. This flexibility probably developed from ancient efforts to capitalize on a critical location astride an important riverine trade route and contrasts with the more inflexible loyalties of more isolated mountain populations. If these and other processes exist and can be identified, it should be possible not only to understand their impact but also to formulate therefrom a sound regional basis for anticipating future global change problems.

Our landscape analysis focuses on the physiography of the terrain between the North and Mediterranean Seas. The dissected highlands of west-central Europe create physical and cultural barriers to communication and transfer of goods between the cultures of the flanking ocean basins. As a result, cultures on the intervening ridge are able to develop in relative isolation and to control and profit from trade and cultural exchanges between the ocean basins.

The mountainous backbone of the study area reaches its highest elevation in the Alps on the French-Swiss border. Farther to the west are the Morvan Mountains of southern Burgundy and the mountains of the Massif Central, highlands that are a dissected mix of Precambrian granites and Mesozoic sea sediments. In the Morvan and Massif Central mountains, elevations rise to between 1,000 and 2,000 meters, but much of the terrain stands at about 300 meters. Elevations taper to the Aquitanian Lowland near the Atlantic Ocean. Particularly important since prehistoric times have been the Rhône and Saône River valleys between the Alps and the Central Massif. Trade between the North Sea and Mediterranean Sea employed this corridor after 600 B.C., thus intensifying its function as an artery of cultural mixing and a site under contention (Braudel 1979; Wells 1980, 1984). The Rhône-Saône-Seine route connected Marseilles on the Mediterranean Sea with the English Channel and North Sea ports such as Bologne (Barraclough 1989:58; Hodges 1984; Lebecq 1983).

To the north of the Massif Central highlands, the North Sea Basin includes the Paris Basin and the Flanderian Lowlands. Because of its proximity and access to water transport, the North Sea region has been an important center of economic interaction since at least Classical times. During the Celtic era, Northwest Europe had a profoundly nonurbanized population distribution. Even in Ireland, the center of both Druidic learning and Christian monasticism, it was the Vikings who built the first towns (Dublin, Wicklow, Cork) in the ninth century A.D. Nevertheless, this countryside covered with hamlets, gardens, and pastures supported dense populations (Hodges 1984).

To the south, the narrow coasts of the Mediterranean Basin provided an avenue of commerce to western Europe from the Near East from the Neolithic until the late first mil-

lennium B.C., a route along which empires developed (Oaks 1987:306). High mountains flank the coasts except at Marseilles, where the lower Rhône Valley offers access to the European hinterland. The Rhône Valley was penetrated by the Mediterranean cultural complex well before the Roman conquest of Gaul in 58 B.C. During the sixth century B.C., first Greek and later Roman cities dotted the countryside. Trade was so intensive during the first millennium B.C. that fields of wine jar fragments from that time are still being found. Thus the lower Rhône Valley, culturally a part of Cisalpine Gaul, is within the Greco-Roman Mediterranean sphere.

Climate

The premodern and modern climate of Europe, along with that of eastern North America, is the most extensively studied in the world. Only in the last decade have broadened perspectives on global paleoclimate revealed the North Atlantic Basin to be a somewhat peculiar place when compared with the rest of the world. An example of how this provincial perspective has influenced scientific opinion can be observed in the date 8000 B.C. that officially marks the end of the Pleistocene Epoch. While this is generally correct for the North Atlantic Basin, the date has proved to be something of a misnomer for the world at large. Research (Broecker and Denton 1990) has shown that global oceanic circulation at the surface follows a course from the Pacific to the North Atlantic through the Indian Ocean. Under some global climatic conditions, this extensive circulation pattern brings unusual warmth to the high latitudes of western Europe. At other times, the northward reach of this circulation is attenuated, leaving western Europe under the influence of cold continental air masses from Eurasia and North America. For example, circulation into the north Atlantic was stopped abruptly at around 9500 B.C. by meltwater runoff from North America as the St. Lawrence River was opened by retreating glaciers. The resulting desalinization of the North Atlantic left both western Europe and eastern North America with an Ice Age–like climate for a millennium. In the world at large, however, most areas remained generally warm after 11,000 B.C. An example close to Europe is North Africa, where sediments at Haua Fteah Cave show Holocene conditions after 13,000 B.C. (McBurney 1967). Thus the so-called latest Pleistocene was in reality the first of the Holocene Little Ice Ages rather than the last of the Pleistocene glacial advances.

Studies such as Broecker's have shed considerable light on the mechanisms that change century-to-century climate in western Europe. Evidence that the northward reach of ocean circulation has been attenuated during the Holocene by colder world conditions comes from ships' records since the 1500s that refer to trees being carried by currents in the Atlantic (having been transported to the Atlantic by North American rivers) (Bryson and Murray 1977:82). The trees follow the Gulf Stream, which traces the northern limit of global ocean circulation. During the globally cold years following the 1500s, the Little Ice Age in Europe, the trajectories of these trees were much further south than during globally warm times, with a one- to two-century lag.

It is now widely believed that global temperatures have risen and fallen substantially during the last 3,000 years, and the details of these shifts, especially before about 1860 when instrumental observation came into use, are a subject of much research (Gunn 1994c; Houghton et al. 1990). With historical records at their disposal, students of historic climate have been able to work out these details to a half century or less. Particularly interesting is a sea-level curve from Denmark (Tanner 1993) (Figure 9.2). Since global temperature controls the amount of water locked in glaciers around the world, the sea-level curve is not only an indication of depth of water at the shore, but also a measure of the general state of world temperature. Data on Northern Hemisphere high-latitude glaciers (Denton and Karlen 1973) provide a valuable cross-check on the status of the world temperature-hydrological system.

Global average temperature provides some insight into local climate changes, which after all are the direct result of global changes. As we have demonstrated elsewhere (Gunn and Crumley 1991), every year during the last four decades of intensive instrumental observation (1958–present, Gunn 1991), the amount and distribution of precipitation across the seasons change with global temperatures. The effects of oceanic circulation on European climate offers an explanation of this relationship. Because the earth is a thermodynamic system (Budyko 1977; Gunn 1994a, 1994b), global temperature is the unifying measure of the status of the atmospheric and oceanic circulation system, and of its effects on local environments.

The behavior of the air masses lying between oceans and their landward manifestations are also a function of global temperature. The three air masses of preeminent importance

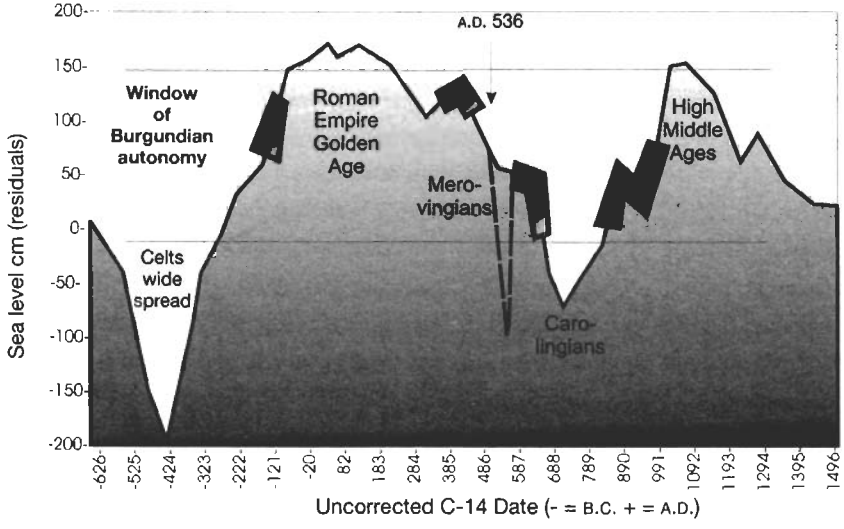

Figure 9.2. Sea-level curve 1000 B.C. to A.D 1500 and glacial curve.

to the West European massifs are the Mediterranean, maritime, and continental masses (Table 9.1) (Crumley and Green 1987; Gunn and Crumley 1991; Trewartha 1961). The appearance of the Mediterranean air mass, the northern edge of the subtropical high or Azores High, brings distinctly warm dry summer weather. The maritime air mass emanating from the North Atlantic Icelandic Low brings year-round moist conditions. The continental air mass, or Siberian High, contributes dry air along with extreme summer and winter temperatures. The annual average location of the air masses depends on global average temperature and ocean circulation; hence these air masses can move north or south at any time of the year. During the globally cold Pleistocene and Little Ice Ages, for example, cold global temperatures brought Siberian air and year-round drought. An unusual phenomenon associated with cold global climate in the modern era occurred in 1976, the globally coldest year in the last three decades. The winter was cold and dry, as would be expected, but the summer was hot and dry, because dry Siberian air permitted direct solar radiation to generate high temperatures in western Europe. This condition has an adverse effect on plants adapted to the Mediterranean climate (grapes, grains, olives), which require mild wet winters followed by dry summers for the crops to sprout, mature, and be properly harvested and stored. Maritime conditions appear with medium global temperatures bringing years of cool moist summers and warm moist winters. If the global temperature is hot, the subtropical high balloons over the area year-round, resulting in hot temperatures and extended drought.

Weather records from the 20th century indicate that the southeastern Mediterranean has experienced true Mediterranean climate (hot dry summer and cool moist winter) only during the years 1900–1960 (Trewartha 1961). As global average temperature increased during the period, Maritime climate dominated northwest Europe with progressively greater frequency. Thus the Mediterranean-Maritime boundary along a northeast-southwest line through Burgundy moves in response to the global average temperatures, and the intersection of the air masses renders Burgundy the ecologically effective boundary or ecotone (Crumley 1993). This explains the correlation between

Table 9.1
Precipitation conditions in Burgundy resulting from air mass dominance

	Air mass		
Condition	**Continental**	**Maritime**	**Mediterranean**
Dry summer	X		X
Wet summer		X	
Dry winter	X		
Wet winter		X	X

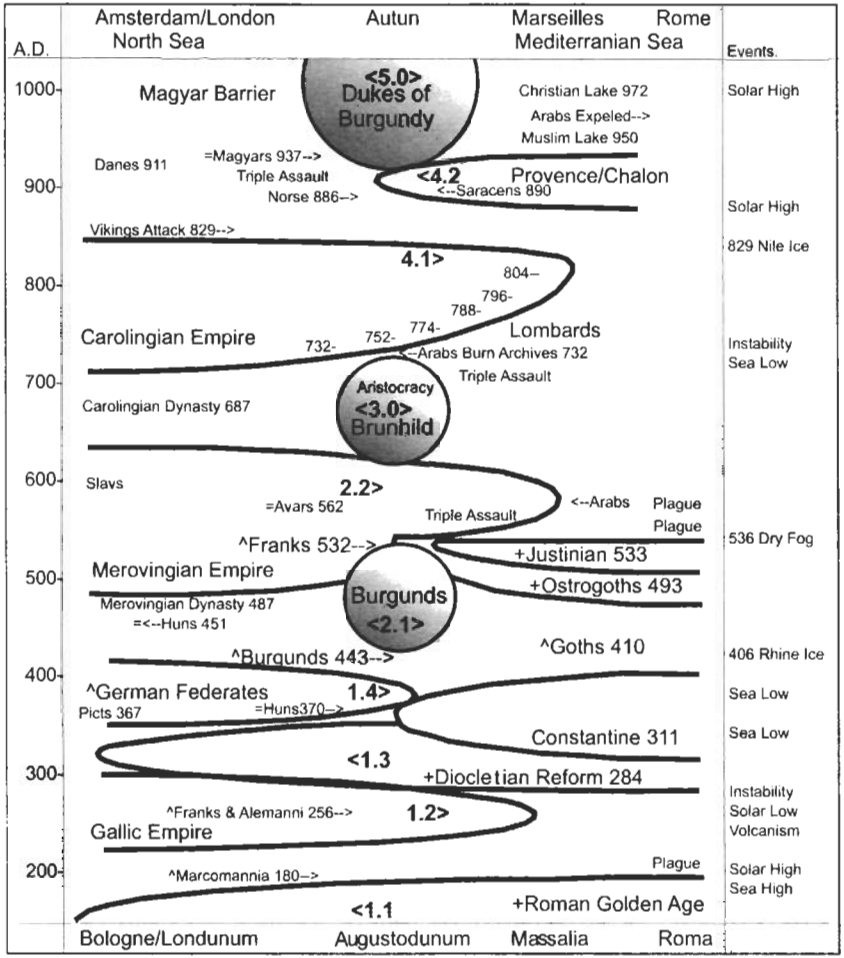

Figure 9.3. Climate-culture relations during the early Middle Ages.

global temperatures and annual stream discharge in the study area (Gunn and Crumley 1991).

The astronomical and geophysical variables that control the global climate (Gunn 1991) and that are traceable in some form for the period of study are solar emissions (Landscheidt 1987, 1988) and volcanism (Bryson and Goodman 1980). Sea level (Tanner 1993) and Arctic ice mass (Denton and Karlen 1973) can be used to check on the effects. It should be kept in mind that sea level and ice volume will lag behind changes in the atmosphere by some years, and will average out or smooth lesser variations (annual, decadal).

Figure 9.3 shows climate plotted alongside cultures of the early Medieval period. The various assertions of northern, southern, and local power have been assigned decimal numbers from 1.0 to 5.0. This type of exercise (see Gunn 1994b) makes it possible to identify coherent episodes of climate and culture for study. The climate episode encompassing the early Medieval period has been termed "Vandal" (Bryson 1994). The Vandals were a Germanic group characteristic of the so-called Volkerwanderung, the era of wanderings of peoples. As such they provide something of an origin myth for modern western culture; their movements are probably in some cases related to the climate during the period. The climate of the early Middle Ages appears to be a coherent but complex episode. The preceding Roman Optimum (200 B.C. to A.D. 200) and the subsequent Medieval Maximum (A.D. 900 to 1250) were periods of warm and relatively unvarying climate that lasted hundreds of years. In strong contrast, the Vandal episode appears to have been comparable to the Little Ice Age, or Ages (A.D. 1250–1920), in which subepisodes of global cold and warm climate of less than 100 years' duration alternated through a number of cycles.

This instability is very important and can be quantified through tree rings (see Baillie 1993 for discussion of available data). Given the generally unfavorable effects of this climate on European civilization, "unstable" can probably be

defined as climate intervals of less than 100 years. At least in Europe, it seems to take about a century of stability for polities, generally city states, to acquire the trappings of empire. Thus in the European cultural milieu, climate interacts with society to generate hierarchies by providing a stable platform of sufficient duration for the evolution of the social forms necessary to sustain a hierarchy.

While the utility of these quantified variations in global climate are valuable in setting the long-term stage, it is more often short-term disturbances, punctuating forces, that significantly affect human life. These highly observable events provide worldwide culture-climate horizon markers (e.g., Gunn 2000). During the early Middle Ages several clearly documented climatic events occured in association with major atmospheric disturbances and extended periods of global cooling (see right column of Figure 9.3).

The first of these events (Figures 9.3, Subepisode 1.2) occurred after A.D. 200, when German warriors moved across the Rhine and the Danube into the Mediterranean sphere. This period of disturbance may have resulted from the largest episode of volcanism in the last 10,000 years (Bryson and Goodman 1980). Another event occurred in A.D. 406 when the Rhine River froze and mobile Germanic societies were able to cross the northern frontier by horse and on foot and follow Roman military roads to warmer climes.

An important climatic disturbance after A.D. 536 (2.2) slowed tree growth for about 15 years. Volcanoes have been suggested as a cause (Stothers 1984). However, studies of Greenland ice cores do not support this thesis (Baillie 1994). Climatologists are now suggesting that the event may have been caused by a meteor or meteor showers striking the earth (Baillie 1994). A sudden drop in sea level occurred at this time (Figure 9.2; Tanner 1993). Pestilence and famine swept not only Europe but the entire world, apparently the result of a major atmospheric event. The effects were observed as a "dry fog" that blocked the sun's light for over a year. Various diarists reported that people could not see their shadows at noon. This event was followed by another round of large-scale population movement in Europe (notably by the Avars and the Anglo-Saxons).

Yet another unusual event (4.2) occurred in A.D. 829 when the Nile River froze (Crumley 1987c:240; Lamb 1977). The presumed cause was a rapid global cooling, although no explanation of the cooling has been put forth. In any case, it triggered the collapse of the Carolingian trading sphere on the North Sea (Hodges 1984); simultaneously the Vikings swept southward en masse, raiding into the Mediterranean along the rivers of western Europe.

To seek a causal account (Salmon 1982) of the effects of geology, climate, culture, and individual initiatives on the trajectory of culture change, we assume an apportioning perspective in which all of the relevant elements play a role but that the quantity and quality of their contributions vary over time (Gunn 1994a). An interesting example of a probable error in assigning cause can be seen in Geoffrey Barraclough's (1989:32) account of the early first millennium A.D. German states of western Europe. He reports that "Justinian's wars and the havoc they wrought" brought about the collapse of the western empire and the Ostrogoth German state in the Mediterranean. From a broader perspective, it has been known for some time that a catastrophic event (as outlined earlier) occurred in A.D. 536. Famine, pestilence, and death were prevalent that year and in the next 15 years all over the world, not just in the Mediterranean. The population of Justinian's capital Constantinople dropped from a half million people to nearly half that number. A reasonable apportioning of causes for the A.D. 536 catastrophe points in large part to sudden environmental change, and suggests that Justinian should take an active but secondary role. In creating the following landscape history of the early Middle Ages, we follow this apportioning perspective as far as the data allow.

Landscape History of Climate and Culture Relations

The 800 years from about A.D. 200 to 1000 provide a clear example of power relations between regions. It was a time when the fundamental religious and political character of a broad European culture was being annealed from smaller, heterogeneous populations. It is, for such a diverse population, a relatively well-documented and well-studied period. It is also one near enough to our own time to be fairly well understood climatologically. For example, tree-ring chronologies (Baillie 1993) and ice cores (Thompson et al. 1994) commonly span this period with year-by-year accounts of climate. All of this information makes the holistic study of the early Middle Ages an important step toward understanding climate and its impacts on culture in the Burgundian region before various buffers were developed in later periods.

The early Middle Ages are laden with tales of the struggle for power among Mediterranean and North Sea polities along the RSSC through conquest, migration, and cultural infiltration (Figure 9.3; see Barraclough 1989; Berry 1987; Hodges and Whitehouse 1983; Hoyt and Chodorow 1976; McEvedy 1967; Whitehouse 1989; Young 1979). Our opening scenarios are drawn from the lives of Rémond, the cleric turned civil official, and the Gaulish brothers Dumnorix and Diviciacus, who aligned with power bases north and south of the Morvan Mountains in hopes of controlling critical trade routes, to reveal personal ramifications of these shifts of power. The motivations for these patterned shifts of power bases during intervening centuries raise questions about the process involved. That these exchanges of political power and population somehow involved environmental variables is already established (Gies and Gies 1994: 42–43). It is time to understand the process through which western European cultures traditionally interact with each other, and with the European terrain and climate. Key elements of this interaction are the subsistence interfaces of the cultures discussed below.

Figure 9.3 outlines the exchanges of power, culture, and politics along the RSSC and maps the two countervailing elements of the western European landscape. The vertical dimension is time and the horizontal dimension is space. The North Sea element (^ in Figure 9.3) is asserted through predominantly Celto-Germanic institutions and modes of political action; the Mediterranean culture (+) appears through Roman institutions, either ecclesiastical or military. In this context it is important to recognize that temporally limited institutions such as the Roman Empire or the Roman Catholic Church represent the Mediterranean power base. Similarly, Celtic and German polities, Charlemagne's Carolingian Dynasty, the Ottoman Holy Roman Empire, and the Irish Church represent the northern power base. Earlier historians ignored the power relations emanating from the north. More attention was given to eastern continental peoples such as Huns, Avars, and Magyars. They appeared and brought technological innovations and cultural practices with them, but as is typical of migrating peoples, they were absorbed into the existing cultural substrate. In contrast with the "pulse of Asia" model emphasized in previous works (Bury 1963; Huntington 1907), which sees Eurasian steppe climate as a central cause of changes in Western Europe, we view steppe population movements as adaptive responses to changes in the environment of the steppe area but do not consider this an explanation for adaptation in Burgundy.

The right side of Figure 9.3 shows global conditions and known regional climate events, which provide the environmental context of each of the early Middle Ages/Vandal subepisodes. We define the initial series of subepisodes on the basis of known global climate events discussed earlier in the climate section and periods of cultural continuity, which can be considered archaeological cultural phases. The time and space ellipses circumscribing the duration and spatial extent of the polities appearing along the RSSC are based on historical research cited in the previous sections.

An extended verbal description of subepisodes is presented in the appendix to this chapter; the cultural chronology there adds social detail to the climatic patterns observed in the discussion of sea level and global temperature and affords a more thorough analysis of the allied cultural and environmental factors.

In broad perspective, there are three major environmental horizon markers along the time line: the volcanism of the third century, the dry fog of the sixth century, and the Nile freeze of the ninth century. These events, timed approximately 300 years apart, frame the environmental context of the period. The time between each of the environmental marker events afforded a century of home rule for Burgundy.

During the marker events, there were assertions of power along the RSSC. In the first two cases, either the Gallic Empire, Merovingian Franks, or German Federates moved south or obtained control along the corridor. After the sixth century, the pattern changes. The Carolingians had asserted their presence southward along the corridor before the ninth-century Nile freeze, presumably during a warmer period, and then, rather than gaining area during a cold event, as the Merovingians did, they lost it. This loss of control of the RSSC reflects a change in a nothern power's response to a colder climate. Since the Carolingian period marked the first genuine synthesis of northern and southern customs, the question of culture and climate interaction merits further research in this time period.

A Wider Subsistence Interface

Underlying political and social relations, subsistence technologies mediate physiographic and climatic environment and nutritional needs. This is especially so in prerailroad

economies where issues of subsistence are preeminent. In parts of Europe not served by water or rail, famine was a common cause of death until the middle of the last century. Following the year 1708 in Uxeau, a sequence of inauspicious weather events precipitated a famine in which scores fell dead along roads. The cleric Jacob, Rémond's antecedent, wrote in June 1710 that he was giving up recording deaths because there were so many to bury and many of the deceased were not known locally. Plague often accompanied unfortunate turns in subsistence, preying on weakened populations. Infanticide and abandonment were practiced to hedge against famine. In the 20th century, during inclement periods that coincided with interruptions in rail service during the world wars, famine once again appeared (Pfister 1988, 1990).

Plants are a key element of the subsistence interface since they cannot move in response to seasonal variation in the environment. In much of the existing literature, the European subsistence interface is envisioned in terms of the interaction between climate and grains, grapes, and olives. This complex consists of Mediterranean field crops, however. These interactions have been well documented through scholarly efforts, especially those of the Annales School (e.g., Clavel-Levêque 1989; Duby 1974; Hodges 1984; Le Roy Ladurie 1971; Pfister 1984, 1990; and those summarized in Bryson and Murray 1977). The primary feature of this subsistence system is the interdependent use of grape, grain, and olive harvests that flourish during episodes of Mediterranean-dominated climate and decline during maritime- or continental-dominated climate. As producers have discovered, grapes fail during the shortened growing season of continental climate and olives fail during periods of cold weather under a maritime-dominated climate. However, a variety of subsistence strategies have emerged across the RSSC. In western Europe, gardens feature both summer moisture-tolerant and winter cold-tolerant domesticated plants derived from cabbages, onions, and mustards, providing more reliable subsistence. Pastoralism thrives on the Eurasian steppes. These were the principal maritime and continental adaptations, and are, even today, important to western European lifeways. The local produce of all three systems can be seen mingled in the open-air markets of Burgundy (Crumley 2000).

To achieve a broader understanding of European subsistence technology, it is essential to give equal consideration to northern and eastern European customs that are better adapted to the maritime and continental climates than the Mediterranean grain complex. These technologies are based on varying combinations of gardening and pastoralism (Crumley 1995, 2000). In the case of Burgundy, retaining captured information on all three strains of subsistence probably ensures survival during the most troubled times. It would be useful to understand the conditions under which captured knowledge is lost, regained, suspended, and reinvigorated. In at least one instance, politics and military intervention evidently suspended implementation of captured knowledge, but it was revived as conditions demanded. During the sixth century, for example, Benedictines revived the Roman art of grafting trees (Gies and Gies 1994:48). The making of cheese and the practice of manuring appear also to have been lost and regained or reinvented.

Cultural Change in the RSSC

A SIMPLE THESIS-CLIMATIC DETERMINISM

What are the processes that shape the interaction of major environmental and cultural manifestations? In the past we have concerned ourselves with methodologically circumventing the biases of environmental determinism, so as to avoid presuming that cultural outcomes are wholly predictable from environmental conditions. This landscape analysis demonstrates from the outset that the Burgundian cultural trajectory is far from a simple case of environmental cause and cultural effect, where the Celto-Germanic culture would have dominated the central uplands in times of temperate climate, to be replaced by Mediterranean cultures during periods of warmer Mediterranean climate. This was indeed the case during the earlier phases of the 2,500-year historical record. The period of the Roman Golden Age was a globally warm, relatively stable period. True to the simple thesis, Mediterranean culture—especially farming methods, the villa system, and irrigation aqueducts—spread northward encompassing Burgundy and beyond. The next globally warm episode of significant duration was the High Middle Ages (A.D. 900–1250), during which the opposite cultural influence dominated. That time period witnessed a strong resurgence of Celto-Germanic values, which dominated western Europe and penetrated the Mediterranean basin as far as the Near East during the Crusades. As is clear

from the data presented in this chapter, the roots of Northern European domination of the central uplands has its origins deep in the early Middle Ages. Northern European powers, even though they purported to be related to the Roman Empire, clearly had their power bases in the North Sea regions. These polities often controlled the central highlands during episodes of non-Mediterranean climate. A growing body of opinion avers that accomplishments of this culture have been largely overlooked because of western scholarly bias toward urban, hierarchical, agrarian-based, Mediterranean culture (Crumley 1995, 2001).

A COMPLEX THESIS

Emerging from the formative early Middle Ages, the High Middle Ages were probably the single most explosive event in European history. Well-fed and energetic people employing essentially northern Celto-Germanic religious, artistic, and architectural forms built a spiritual environment of cathedrals, monasteries, parish churches, and private chapels of imposing design and size. The greatest edifice of all, the monastery church at Cluny in Burgundy, was exemplary of these vast structures. More rock was quarried in France during the 300 years of the High Middle Ages than during the entire history of Egypt (Gimpel 1961). Roman slavery was replaced by Medieval serfdom, a highly efficient method of producing food that provided peasants with their own plots of land apart from noble holdings (White 1962). The largely nonvegetable Roman diet was replaced with the largely vegetable diet of the North Sea community.

The coincidence of global-scale climate events with shifts of political and demographic momentum during the early Middle Ages suggests that climatic change played a significant role in transforming the landscape. The presumption of cause and effect can be supported in some cases by the logical relation between seasonal precipitation patterns that would have been the result of changes in global temperature and their impact on subsistence. The subtropical-temperate ecotone that divides northern Europe from Mediterranean Europe initially divided two distinct orientations toward agriculture: one was large-field agriculture, employing only a few grain species; the other was more diverse, oriented toward several hardy grains and garden vegetables. Eventually these were amalgamated to produce a hybrid, broadly adapted suite of crops in the Burgundian highlands.

Four underlying processes appear to facilitate adaptation by Burgundians:

1. The restricted-species grain complex moves north with warmer global climate. This happens because warming global temperatures move the Mediterranean dry summer–wet winter pattern further north.
2. Agropastoralism moves south with a cooling global climate. Its methods are attuned to the moist summers, or dry steppe conditions, or can be combined to hedge against unpredictable onsets of either condition, as in Burgundy. Such shifts are an integrated element of the agropastoral lifeway. This response constitutes a fissioning, not a collapse. It requires a reorganization of people and materials to respond to resource availability, whatever its source. Burgundians, residing in the overlapping areas between the Mediterranean and North Sea domains, pieced together a broad adaptive strategy attuned to all three climate regimes of the region.
3. The Celto-Germanic and Gaulish subsistence systems in Burgundy appear to have been massively disrupted during the Roman Golden Age and the early Middle Ages. First the area was reorganized and exploited by the Roman "bread basket" approach to certain regions of the empire. Then it was overrun by mobile societies during the early Middle Ages. The problem reached a critical point in the years following A.D. 536, when population slumped and chaos reigned. In the following two centuries the adaptive core moved toward a synthesis of the Mediterranean and North Sea systems. This new complex featured vegetables, herding, grain production, and viticulture; all may be observed in Burgundy today, where domestic vegetable gardens, herding (now Charolais cattle and sheep), grain, and wine are of enduring importance.
4. In social organization, Gallo-Roman elites fostered in Burgundy an adaptation of Mediterranean principles of government to northern lifeways. In a sense, then, these cultural ingredients were combined with traditional northern lifeways in the Celto-Germanic cultural milieu, but subsequently they resumed the struggle between north and south as viable challengers to Mediterranean control. These challenges were powerful enough for some groups to gain occasional control of Mediterranean lands during the early Middle Ages, as

Charlemagne did, and to almost fully encompass the old empire during the High Middle Ages.

Following the High Middle Ages, important additions, and in some cases reinventions, added to the stability of the pan-European platform. These included international trade by armed ships, field manuring, and cheese making. These techniques brought further stability to the already broad, adaptive potential of the gardening, agropastoral, and grape-grain amalgamation. The basic formulation of the early Middle Ages continues even to the present. In fact, in yet another age of global warmth, French farmers have today begun defending agricultural diversity in the face of threats that the European Union will impose another episode of Roman-style breadbasketing for the global marketplace at the expense of small heterogeneous farming enterprises.

In summary, over the centuries Burgundians built on previous generations' experience to enrich Europe's primary ecological and social ecotone. They explored various combinations of political, ecclesiastical, and ethnic power with subsistence traditions, climate, and terrain.

CULTURAL OCCLUSION

In what could be viewed as a bridging analogy between the atmospheric and cultural sciences, an explanation that avoids cultural determinism can be constructed using an atmospheric phenomenon called frontal occlusion as a metaphor. Frontal occlusion develops when a southern warm front penetrates far into a cold northern air mass. Occasionally, overextended warm fronts are cut off as the colder air closes behind them. This leaves a small, isolated warm air mass spinning in a sea of cold air. As it mixes with the northern air at its edges, it slowly takes on the cooler character of the northern air mass but still spins as an independent air mass.

In a similar fashion, Roman cultural designs penetrated far north into the non-Mediterranean cultural sphere. The Romans brought with them urban demands for monocropping and a Mediterranean farming method that was viable only as long as a favorable climate regime sustained it. They had a powerful military organization and a taste for luxury goods that linked them to the far corners of the Old World.

Roman culture was eventually enveloped by the greater mass of northern European culture, as the pre-Roman Gaulish culture was reasserted. Nevertheless, Roman culture imparted certain aspects of its character to local populations. When favorable conditions for this cultural environment failed, northern groups quickly replaced the Roman subsistence with their own, albeit tempered by their taste for urbanism and imported luxury goods. The northern cultures contributed a broader dietary selection that included vegetables and large animal husbandry. They also brought with them a system of balanced power and authority. This heterarchical system was very flexible, developed new organs of social action quickly (e.g., crusades), and abandoned them when their usefulness was past.

This slightly warmed northern European culture began to emerge during the Carolingian dynasty. It showed its strength by repelling Avars and Saracens, and by seizing lands along the RSSC and into the Mediterranean, thus bringing forth a new world power. As the need for unity diminished or unsettled conditions interrupted it (e.g., climatic deterioration, Viking invasions), the Carolingian Empire fragmented and then amalgamated again, rising during the High Middle Ages to bring full expression to the combined potential of the Mediterranean and North Sea cultures.

Appendix: Culture and Climate Chronology for the Early Middle Ages

The following discussion of the early Middle Ages episodes defined for this study are synthesized from a limited number of climatological and historical sources. While the survey of available sources provides a first approximation of climate and culture relations, it should be understood as a point of departure for further study rather than a final product. Thus the assertions are hypotheses requiring extensive refinement. The episodes are numbered using a flexible decimal system into which new subepisodes can easily be inserted without disturbing the overall structure (see Gunn [1994b] for methods of defining and testing subepisodes).

SUBEPISODE 1.1

The Roman Golden Age (27 B.C. to A.D. 180) was a period of relatively high solar emissions (Denton and Karlen 1973; Eddy 1977) and, as would be anticipated from this, high sea level (Tanner 1993). This set of conditions provided a cli-

matic platform on which the Romans and their allies could build a multicentury *pax Romana*. The expansion of this social-economic form from the Mediterranean into Burgundy and well beyond was facilitated by the extension of the Mediterranean climate northward. That extension enabled the population of mainland Europe to cultivate traditional Mediterranean crops (predominantly grains) using irrigation techniques practiced in the Mediterranean Basin and Near East. Indeed, Roman settlers occupied the Rhône Valley long before Julius Caesar's military intervention.

The precise character of the Roman Optimum climate is an important research topic. It has been thought for some time that the world was warmer during the Optimum than at present, especially in view of evidence that the glaciers in Northern Europe and northern North America receded during the Optimum (Denton and Karlen 1973), and that sea level reached a high stand between 200 B.C. and A.D. 200. A warm global climate appears to have had favorable effects on midlatitude agriculture.

It has also been found that midrange cool-warm global temperatures are governed by a complex relationship between the influences on global climate (Gunn 1991; Gunn and Grzymala-Busse 1994). Under this system, global temperatures remain stable as long as the four or five influencial factors cancel each other and prevent excessive heat or cold throughout the system's cycles. The precipitation pattern in the temperate zone differs from trends evident during hot and cold global temperatures. Primarily, the mean location of the storm tracks under the midlatitude jet streams becomes broader, allowing precipitation to reach a broader area in the higher subtropical latitudes and temperate zone agricultural belt, and thus increasing the overall productivity of that climatic zone. While much remains to be learned about the conditions of the Roman Optimum, this general outline suffices as an operating definition.

SUBEPISODE 1.2

Evidence of climatic disturbances in western Europe beginning in the late second century A.D. is supported by a fall in sea level. Volcanism was extremely high during this period (Bryson 1994; Bryson and Goodman 1980), probably supplying the cause. According to Reid Bryson and Brian Goodman's volcanism index, this event marked the greatest infusion of debris into the atmosphere since the latest Pleistocene around 11,000 years ago. Historians refer to the period as the Third Century Crisis (Berry 1987:458). Several destructive interactions between provincials, Roman government, renegade Roman legions, and others effectively ended the *pax Romana* in western Europe. During the 260s, elements of Gaul, Spain, and Britain joined in a secessionist movement, forming perhaps a government in the Celtic sense referred to as the Gallic Empire, a name sometimes applied to the subepisode. The source of unrest that generated the sundry rebellions and problems was apparently famine (Dyson 1985). During and following the Third Century Crisis, the Roman mystique that undergirded the Golden Age lost its allure, and Roman will was enforced by bureaucracy and a mobile army. Following a siege of Augustodunum (modern Autun), which had remained loyal to the legitimate emperor, Claudius II, renegade elements of the Roman legions uprooted the agricultural establishment in the countryside.

SUBEPISODE 1.3

There is no clear indication of climate trends favorable to Roman needs following the Diocletian reforms (A.D. 284–370). Low solar emissions and low sea level, in fact, would argue against an appropriate climate for Mediterranean agriculture and suggest that the renewed Roman Empire maintained order with no special assistance from climate. Such events are common once a society has formulated its economic infrastructure. Various researchers (Berry 1987) have found interest in "Romanness" confined to the elites following the Gallic Empire episode. Such an elite fascination would have provided the social path for continued Mediterranean influence without implying accompanying adaptive practices. Technically, it would appear that this episode marks the social onset of the early Middle Ages. Burgundy shifted from Roman slave labor on farms to the more northern management mode of tenant farming (Berry 1987). Augustodunum lost much of its power as an administrative center and its glory as a university town. Its administrative functions were transferred further north as the frontier became a greater problem. In fact, administration of the western empire became very difficult, requiring the Romans to invest in an expensive mobile army.

Late in the 300s, Romans resorted to alliances with Ger-

man groups, the German Federates, to maintain order and external defense. Although it looked expansive, the empire was actually fighting a rearguard action. Rebellions, again beginning in Burgundy, led to the dislocation of Roman power.

SUBEPISODE 2.1

Events around A.D. 406–408 suggest cool global conditions compared with those of the Golden Age. During the Golden Age, the Rhine River was a barrier helping the Romans control the German frontier. The barrier fell to winter's cold in A.D. 406, and German groups rode their horses across the ice into the Roman Empire, ushering in a period of substantial southward movement of populations. In Burgundy, the German group that gave the region its name established a kingdom and ruled without the help of powers from either sea for about a century. The beginnings of an urban-based Christian ascetic monasticism, under hierarchical ecclesiastical control from Rome, appeared in the Burgundian kingdom south of the Rhône-Saône junction. Its numbers expanded until the middle of the sixth century and continued into the seventh century (Wood 1981:10–11). Monasticism provides a measure of social conditions and cultural orientation among the population at large and serves as an index of public sentiment in relation to the north-south power relations discussed in this chapter.

By A.D. 500, social conditions had clearly improved in the two sea basins. The Frankish kingdom was pushing against the Burgundian kingdom's northern borders. Support from the Ostrogoths, now in control of the Adriatic and Tyrrhenian seas, canceled Frankish ambitions. The Ostrogoths, however, came under the scrutiny of what remained of the empire, now centered in Constantinople. In A.D. 533 Justinian initiated his efforts to reunite the eastern and western areas of the empire. As we noted in the climate section, he met with great difficulties, and the European population fell to its lowest level during the historic period.

SUBEPISODE 2.2

Following the Dry Fog calamity of A.D. 536, Constantinople collapsed, and the Ostrogoths similarly failed in Italy. Bubonic plague appeared in Europe, perhaps for the first time. The Franks, now into the Merovingian dynasty, flourished during these cooler global conditions. They pressed their ambitions to the Mediterranean shore. During the following decades, the Avars entered western Europe (Young 1979). All of this seems to indicate an increased and more southerly presence of cultures adapted to northern climate regimes. This is supported by a northward shift of population density from the Mediterranean around A.D. 536–600 (Gies and Gies 1994:42–43). In Europe, the church split into southern urban hierarchical and ecclesiastically based monasticism versus northern rural heterarchical monasticism under Irish influence. Ian Wood (1981:13) suggests that in the north the subsistence pattern could support isolated rural institutions while the southern adaptation would not.

SUBEPISODE 3.0

Through the 600s sea level fell, reaching a nadir by A.D. 700 that suggests general long-term cooling. Epidemiology and demography seem to reflect either political or nutritional deterioration, perhaps propelled by climate. Plagues followed famine and malnutrition and then did not return to Europe until the 14th century (Gimpel 1976:56). Population reached a low of 27 million ca. A.D. 700 (Gimpel 1976, 57). In this case, careful study needs to be given to causal relations between climate, politics, and disease; Europeans were going through the devastating experience of encountering urban diseases much as the native populations of the Americas (see Larsen 1994) did a millennium later. Under Gregory the Great, the Mediterranean church split between eastern Byzantine and western Roman seats of power. There was apparently a decline in southern Burgundian monasticism.

Cultural entities now showed a distinct southward momentum. The period began "Irish" rural missionary monasticism in Burgundy north of the Rhône-Saône junction. These churchmen, unlike their earlier counterparts, functioned apart from any secular ecclesiastical control. Their organization was based on heterarchical alliances with other monasteries, kin groups, and royal patronage (Wood 1981). In Burgundy, a local government controlled matters of state. The state was dominated by Brunhild (d. 612), a Merovingian queen ruling in the name of her grandson; she spent much time establishing monasteries and churches. Both the ecclesiastical and political aspects of culture had distinctive northern, even Celtic characteristics. These characteristics,

particularly of monasticism, were very much like those of the High Middle Ages (see Gimpel 1961).

SUBEPISODE 4.1

This subepisode occurred between about A.D. 700 and 829. Following A.D. 700 (and continuing to A.D. 1100), sea level reached a point higher than the present-day level. This was the mark of a global warming trend; solar emissions increased (Eddy 1994; Landscheidt 1987) and were the source of the warming. Political and social trends continued on a correlated positive trajectory until A.D. 829, when the Nile River froze over and appeared to herald a cold climate reversal; this may be reflected in a brief drop in sea level. No global climate reason has appeared in the literature.

At the beginning of the global warming, a struggle between the North Sea Carolingians and Mediterranean Saracens developed. The Carolingians were clearly on a favorable trajectory through the late 700s. They had the population energy to press the limits of their control to include the western Roman Empire and beyond to the north. In 800, the agents of Aachen (Aix-la-Chapelle) reached Rome, and Charlemagne was crowned Holy Roman Emperor by the Pope.

On the North Sea, the Carolingians controlled an extensive and rapidly growing trade network (Hodges 1984). *Emporia*, centers of trade and craft, developed from the seventh through eighth centuries. They flourished in the interstices of royal power outside hierarchical royal governments (Wood 1994:302). Trade arrangements on the North Sea collapsed in the 830s before the Viking raids began in A.D. 843 (Hodges 1984:198; Hodges and Whitehouse 1983; Whitehouse 1989). The period of decline lasted about 50 years. The Vikings reached as far inland as Burgundy in the years following 830 (Berry 1987:477). The Carolingian empire broke into a number of pieces.

Burgundy prospered under the Carolingians, although Augustodunum was wrecked during the Arab invasion of 731–732, and its capture was an important part of their strategy for control of Europe. Though not well understood (Geary 1988), they apparently treated the Rhône-Saône corridor in the same fashion that Julius Caesar did, as a critical trade link. After the eighth-century disruption by Saracens and Franks, "Irish" rural monasticism began to integrate with the southern urban monasticism following the rule of Saint Benedict (Wood 1981:18–19). The southern grain complex culture integrated with northern vegetable and cattle adaptations through a three-field system in which vegetables were planted in rotation (unlike the Roman two-crop system, Gimpel 1976:51–52). Fields were plowed and manured by cattle (Rösener 1992:117–120). Grape culture was spurred by monasteries that produced wine for the sacrament, consumption, and sale.

SUBEPISODE 5.0

A long period of solar emissions began, and sea level rose as the first millennium came to a close. A three-direction triple assault began around A.D. 900. First, the Norse abandoned the practice of piecemeal raiding and launched a strong invasion beginning in A.D. 886. Then Saracens invaded southern Europe in the 890s. Finally, the Magyars appeared, coincident with a brief downturn in sea level in the early 900s. By A.D. 1000 all had converted to Christianity and become a bulwark against eastern invasions. This is reminiscent of cultural effects seen elsewhere when high solar emissions and El Niño interact at the beginning of a globally warm period (Gunn 1991, 1994b). In this welter of invasion, Richard, the first de facto Duke of Burgundy, assumed power and was succeeded by a dynasty of regional rulers. By A.D. 1180, during the High Middle Ages, they had turned their allegiance to the northern Capetian kings in Paris. European population reached 70 million by A.D. 1300—France alone grew to 20 million, to account for nearly a third of the people in Europe (Gimpel 1976, 57).

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