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•The Americas before and after 1492: Current Geographical Research

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Articles

The Americas before and after 1492: An Introduction to Current Geographical Research

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Abstract. The controversy over the Columbian Quincentenary identifies two broad issues of fundamental interest to geography: (a) the decimation and displacement of indigenous peoples, leading to creation of new human and cultural landscapes; and (b) the relative ecological impacts of indigenous and Colonial land use, as a prelude to the global environmental transformation introduced by the Industrial Revolution. This introductory essay outlines the contributions of ten critical or synthetic reviews, setting them in a wider context of contemporary research, as a web of related themes focused on the Americas before and after 1492. These themes include: (a) pre-Columbian population densities, environmental impact, and the myth of the Indian as Ecologist; (b) the labor intensity and technological sophistication of pre-Columbian agriculture in many areas; (c) the human implications and landscape impact of catastrophic indigenous depopulation; (d) the process of Spanish settlement and landscape transformation; (e) diffusion, continuity, and syncretism in the residual indigenous landscapes; (f) the divergent policies and impacts of French and British colonization, and the comparatively limited attention given to Native American and African contributions to the North American cultural landscape; and (g) the different perceptions, cartographies, and geographies of the explorers, the indigenous peoples, and the European scholars engaged in the Columbian Encounter. The final discussion identifies themes that cannot yet be adequately reviewed, especially the impact of Colonial settlement upon the environment, as distinct from the consequences of the Industrial Era, its technology, and its demand for raw materials. The debate raised by the Encounter can and should refocus geographical research on related cultural and environmental questions that require fresh attention.

Key Words: Precolumbian agriculture, indigenous cartography, environmental degradation, depopulation, diffusion, Colonial landscapes, ecological myths, European perceptions, the Quincentenary.

From Polemics to New Research Perspectives

CELEBRATION and anti-celebration. For several years the media have played up the polemic of the Quincentenary, pitting Columbus the icon against Columbus the symbol of New World genocide and environmental destruction. While one group celebrates the Columbian voyage and the creation of a new Euro-American world, the other laments the depopulation and deculturation of the Americas. Pickets, mainly organized by American Indian organizations, greet visitors at museums displaying artifacts or maps from the period of 1492, or interact with the smallish crowds watching the arrival of replicas of Columbus's ships in Miami or Galveston.

But there is little evidence of a groundswell

of American interest in the ongoing debate, let alone of any emerging position as to whether the "Discovery" was a good thing or not. Perhaps the continuing media hype has led to a premature sense of fatigue. Perhaps, too, the issues raised do not seem relevant for Americans today, since Columbus was an Italian and the arguments seem to concern Spaniards and Native Americans. In contrast to the hoopla of 1892, which Chicago, somewhat misguidedly, celebrated as the birthday of the New World, contemporary Anglo-Americans may have scaled back their historical horizons to Plymouth Rock and 1776, leaving 1492 for Hispanics to worry about.

But the Quincentenary cannot be dismissed that conveniently. The year 1492 dramatically changed intellectual conceptions of the world. It brought the peoples of two semi-isolated hemispheres into confrontation, creating new "realities," the moral implications of which cannot be ignored indefinitely. It also opened the way for biological and technological transfers on a vast scale, creating novel cultural, economic, and biotic configurations in the "New" World, with significant repercussions on the "Old." In an increasingly integrated world system, the growing momentum of intercontinental energy flows favored the Industrial Revolution, with its once almost unimaginable impact on the quality of global environments. The Columbian Encounter set in motion immense social and environmental changes that will continue in the future, and which affect the lives of all Americans, whether they are aware of them or not.

Amid the flurry of ideological controversy, glossy picture books, and surrealistic media events, a coherent current of analytical studies has begun to emerge. This is reflected in the publications accompanying the museum exhibits *Seeds of Change* (reviewed in this volume) and *Circa 1492* (Levenson 1991), or in the special issue of *Newsweek* entitled *When Worlds Collide* (Fall 1991). It is also documented in the Smithsonian trilogy *Columbian Consequences* (Thomas 1989–91), sponsored by the Society for American Archaeology, a special issue of *Historical Archaeology* (Vol. 26, No. 1, 1992), and in the Islamic perspective of Lunde (1992), works that provide critical and informative perspectives on the Encounter. Geographers were involved in several projects, including the versatile volumes of *North American Exploration* (Allen 1992). Geographers also organized and contributed invited papers to the 1992 scientific symposium of SCOPE—an international agency dominated by biologists—devoted to the global legacies of the Columbian Encounter (Turner 1992).

Not surprisingly, historians have been prominent in reevaluation of stereotypic and entrenched ideas (Axtell 1992). Anticipating the current disgrace of inaccurate high school textbooks, Axtell (1987) reviewed the mass of half-truths about "other" Europeans, Indians, and the Age of Discovery that mark such books. A comprehensive study of the historical context of Columbus (Phillips and Phillips 1992) offers a welcome antidote to both the acid and the saccharine (mis)representations of that ambiguous figure now in circulation.

Contrary to what one might assume, the Quincentenary has also prompted sober introspection among Spanish historians, and a recent congress in Sevilla focused on the social context of growing intolerance for ethnic diversity on the Iberian peninsula during the century before 1492 (Benito et al. 1991). Throughout the U.S., students are engaged in public debate, and panels of invited speakers argue among themselves or try to address searching questions from the floor. Critical classroom screenings of films such as *Dances with Wolves* and *Black Robe* are heightening awareness of the value of cultural diversity. In anthropology, geography, and history departments, existing course listings are being coopted to hold seminars or give courses on the Columbian Encounter. The themes discussed are not about the Columbian diaries or landfalls on some obscure island, but about cultural diversity or transformation of the world we now live in.

It is commonplace that the controversy and debate raised by important issues serve to refocus research on questions that require new or renewed attention. That is precisely what the contributors to this volume have attempted to do, in writing ten critical or synthetic reviews related to the impact of 1492 on human landscapes of the Americas. The focus of the collection is on principles, processes, and perceptions. One pertinent question is the myth or reality of a pristine American wilderness before the arrival of Columbus; the resulting discussion brings together a body of contemporary

research on Prehispanic demography, agrotechnology, and resource management. A second question concerns the human impact of the Encounter; here attention focuses on the demographic collapse that followed the introduction of Old World epidemic disease, which demands attention to the scale of the human tragedy it represents, as well as an examination of its implications for settlement discontinuity and transformation of the human and cultural landscape. A third question centers on the new societies that emerged in the Colonial world; how did they shape and manage their diverse cultural landscapes? A fourth and final question comprises the different perceptions, cartographies, and geographies—of the explorers, of the Native Americans, and of the scholars engaged in the Encounter. Geography encompasses a broad spectrum of environmental and cultural, as well as interconnective and integrative concerns. We hope that the papers will prove innovative and provocative to other disciplines as well as our own.

Constraints of space and time have set limits to the number of authors, to the temporal focus, and to the depth at which specific problems could be explored. Within these constraints, the individual papers form a web of interlinked contributions, selected as examples from a wide spectrum of current research. They address, often in unconventional ways, conceptual issues underemphasized in the specialist literature. They also illustrate research methodologies and implicitly identify potential resources in libraries, in archives, or in the field. The authors represent American, Canadian, and German universities, and include one anthropologist. Finally, the bibliographies are broad and current, and include works in languages other than English.

This introductory essay attempts to set a wider context of contemporary research for the individual papers, in addition to highlighting their contributions. Themes that could not be covered by our collection of essays are sketched out in the accompanying discussion, to facilitate a broader overview of the Americas before and after 1492. Some basic questions, such as the environmental impact of European settlement, cannot yet be resolved, because the requisite database is not available; they will require many more research projects in the coming years. Long after the polemics have died down, the search to understand the questions raised will go on.

A Persistent Myth: The Indian as Ecologist

One of the fundamental questions brought into focus by the Columbian controversy concerns what William Denevan (this volume) calls the myth of a pristine New World landscape in 1492. The idea goes back at least as far as the romantic primitivists of the nineteenth century, but has recently been given new meaning. Sale (1990) claims that New World peoples lived in harmony with nature and refrained deliberately from altering their environments, to the degree that they were somehow able to maintain an idyllic ecological equilibrium. Europeans, by contrast, had a ruthless land ethic, were driven only by materialistic goals, and introduced an agrosystem that was, by definition, harmful. Sale believes the result was environmental destruction of apocalyptic proportions.

The central issues thus are twofold: (a) whether Native American peoples did or did not alter or degrade their environment; and (b) whether or not European settlers had an immediate and drastically negative impact on the environment (Butzer and Butzer 1992). The first entails an assessment of aboriginal technology, land use, and population levels, as prerequisite for evaluating their environmental impact.

The New World was not an empty land. As Denevan argues, the Americas at the end of the 1400s supported a population of 43–65 million inhabitants distributed as follows: close to four million people for North America, almost 20 million in Mexico and Central America, three million on the Caribbean islands, and 24 million in South America, two-thirds of whom lived in the Andean region. Most of these depended on agriculture of varying degrees of technical sophistication. Prehispanic built environments remain conspicuous in the landscape today, ranging from the ruins of great cities and monumental ceremonial centers, to field patterns in eastern North America or Amazonia and traces of road systems in New Mexico or Peru. Some of the most convincing evidence to this effect, namely extensive agricultural landforms such as raised fields or terraces in now-uncultivated areas, has been compiled by ge-

ographers since the landmark observations of Denevan in the early 1960s. In this context, the expanded field researches of Denevan and Turner, and also those of Tichy (1974), Donkin (1979), and Siemens (1989), find one of their several practical applications.

A wide range of ethnohistorical, biotic, and paleobotanical arguments are reviewed by Denevan to demonstrate ecological modifications of the temperate and tropical woodlands as well as the prairies and savannas of the New World. To some degree these biomes were humanized in terms of physiognomy, species composition, and reduced biodiversity—long before the arrival of Europeans. Native American use of fire, clearance for cultivation, and other forms of manipulation or exploitation had left an unambiguous imprint: the forests of eastern North America were relatively open, the prairies of Indiana and Illinois were unable to return to a woodland-grass mosaic despite the shifts to moister climate during the later Holocene, and the Amazon rainforest was (and remains) anything but virgin.

These thematic and regional arguments could be complemented by abundant references to specialized diachronic studies, such as palynology and limnology, which directly identify long periods of deforestation and soil erosion in prehistoric times. The implications of such studies in Mexico, Guatemala, and Honduras are profound. They corroborate Denevan's evidence that "primeval" vegetation, even complex rainforests, can regenerate in several centuries, given complete settlement abandonment. They also show that indigenous agriculture and high populations have invariably led to fundamental biotic change and frequently to significant soil erosion. Populated landscapes must generally have been open landscapes, if not degraded ones. Such intensive disturbance can be documented not only across many centuries, but even for time spans as long as two millennia. One may also wonder whether the Maya population collapse in Guatemala ca. A.D. 1000 was facilitated by unsustainable kinds of land use.

For several generations, leading palynologists insisted that prehistoric land use could not be detected in pollen profiles anywhere in the eastern U.S. The problem was that they concentrated on bog sites rather than settlement areas. By changing that strategy, Delcourt et al. (1986) were able to demonstrate that prehistoric settlement in Tennessee was also accompanied by forest clearance and weed explosions, coeval with pollen and macrobotanical remains of maize and other cultivated plants. But the continuing prominence of tree pollen suggests much more localized deforestation in Tennessee than in Middle America.

In effect, indigenous land use before 1492 has left a very tangible record of ecological impact in the pollen and soil record, much as it did in prehistoric Europe (see Butzer 1982, chap. 8). That is surprising in one sense, since Native Americans lacked the large domesticated animals commonly assumed to have had major repercussions on ecological equilibrium in the Old World. The empirical evidence therefore contradicts the romantic notion that Native Americans had some auspicious recipe to use the land without leaving a manifest and sometimes unsightly imprint upon it. As Denevan argues convincingly, the "pristine Precolumbian landscape" is indeed a myth. That has direct and indirect implications for contemporary ecological management, as discussed below.

Reconstructing Pre-Columbian Agriculture

Exactly how did Native American farmers use the land in Precolumbian times? William Doolittle (this volume) and Thomas Whitmore and Billie Turner (this volume) marshal a suite of cogent arguments as to the intensity of indigenous agriculture and the sophistication of many of its technologies.

Agriculture was practiced in two major regions of North America, in the eastern woodlands and in the Southwest and the adjacent parts of Northwest Mexico. But depicting agriculture on a map is complicated by the gradational nature of dependence on cultivated food plants as well as by changing patterns over time. Maps for A.D. 1200, 1500, and 1750 would show different distributions. The ethnographic record includes: (a) hunter-foragers without agriculture, primarily in California, the Pacific Northwest, and in the boreal woodlands of Canada; (b) hunter-foragers who planted supplementary crops, mainly in the center of the continent; and (c) Indians who depended primarily on domesticated plants, but who also used a substantial component of wild animal and plant foods, as in the eastern U.S. and in parts of the Southwest (Butzer 1990).

Doolittle deals with the group (c) and focuses on potential criteria to identify degrees of agricultural intensification, i.e., greater labor inputs to increase crop yields per unit area over a particular span of time. Intensification is particularly relevant to the potential impact on the environment, because it is linked to the persistence of agricultural efforts in a specified area. For example, was a particular plot cleared and cultivated once every twenty or thirty years, or was it permanently kept open and planted every other year? The former would characterize extensive, slash-and-burn agriculture, while the latter would represent a form of intensive agriculture. People also select among their options according to the quality of soil, while agricultural activities can vary considerably during the course of a century or two.

To deal with such problems realistically, Doolittle chooses to use surrogate data that can either be derived from early ethnohistorical reports or identified in the field. These include physical evidence for canal irrigation, terraced fields or terrace-like check dams (in channels or across valley floors) in the Southwest, or ethnohistorical evidence for large cultivated areas amid permanently cleared lands in the eastern U.S., a record that is complemented by visible traces of systematic field-surface modification such as ridging or hilling (small, regular planting-mounds). Household or house-lot gardens, with careful tending of a diversified array of plants, were reported in both the East and Southwest.

All these features imply special efforts and a considerable investment of labor; they can therefore be considered as proxy evidence for intensification. Most examples of this kind were reported from or are found on better floodplain or valley-floor soils, and observations by early explorers suggest that such cultivation was effectively permanent. But this does not clarify whether large, rather than limited areas, were cultivated every year, or every other year, or whether such practices could be sustained indefinitely.

The problem is that on all but the most fertile soils, yearly cropping is almost impossible to sustain without application of fertilizer, or rotation of grains with legumes, or both. Traditional agriculture in the Mediterranean Basin and Europe was overwhelmingly based on a two-year cycle of crops and fallow, with productivity maintained by animal manure, that accumulated during four–six months of grazing on stubble, grass, and weedy plants (Spurr 1986; Vassberg 1984; Butzer 1992c). The so-called three-field system improved productivity in some areas during the Middle Ages, by inserting a year of legume cultivation, which helped restore soil nitrogen.

What remains uncertain in the New World is the range of *alternative* methods devised to maintain productivity without manure. For example, ridging or hilling, which involves removal of topsoil that was piled up on linear or round surfaces, is equivalent to deep mixing by a plow, and it can double the thickness of topsoil. Household wastes and night soil are limited, but permanent intercropping of beans with maize may have been practiced on a large scale during late prehistoric times, a method that would retard soil depletion.[1] One study in central Mexico suggests that the size of house gardens, presumably devoted to complex intercropping, ranged from 0.3–0.9 ha per household during the early 1500s (Williams n.d.). Such remarkably expansive "gardening" could represent one possible solution to the problem.

These open questions notwithstanding, the criteria proposed by Doolittle imply a measure of intensification as well as permanent clearings in at least some areas, an argument consonant with the botanical and pollen evidence from the Little Tennessee River Valley (Delcourt et al. 1986). Since the ethnographic record is finite, Doolittle urges considerably more field research devoted to recording agricultural landforms so as to add detail to the map. More paleobotanical studies are also needed, both within and outside of archaeological excavations (see Hastorf and Popper 1988), as are analyses of soil nutrients (see Sandor 1992). These may eventually afford a fuller understanding of cropping practices, of the spatial extent and permanence of clearance and cultivation, or the degree to which cultivation every other year, for example, may have been sustainable. Attention must also be paid to possible evidence for pre-European soil erosion, potentially preserved in the record of slope and stream deposits along North American valley floors.[2]

Whitmore and Turner employ criteria similar

to those of Doolittle, but they focus on three mesocale environmental transects in Mexico and Guatemala. The "Cortés transect," following that conquistador's route from the coast at Veracruz to Mexico City on the high plateau, is an obvious choice. For the tropical lowlands, these authors single out raised fields, ditches, and canals preserved in the coastal wetlands, and the subtle but visible patterning of fields and embankments on higher ground. Ethnographic analogy is used to infer a complementarity of rain-fed and seasonal wetland cultivation, in addition to household gardens and orchards of fruit trees or cacao, at or before the time of Conquest. On the piedmont of the plateau escarpment, there are terraces and remains of dams; at higher levels, less permanent forms of agriculture are posited in the cloud forest ecozone. The semiarid climate and frost hazards of the plateau favored a patchwork of rain-fed cultivation on slopes modified by rock-faced terraces or vegetated berms (*metepantli*), interspersed with irrigated tracts, fed by floodwaters, small dams, or canals. Wetlands in the basin centers were partly converted into elaborate hydraulic systems, with cultivation on raised *chinampa* surfaces.

The "Montejo transect" cuts across the subhumid Yucatan Peninsula, where two mesoenvironments are distinguished: karstic plains with orchard-gardens and rain-fed maize on thick soils, and rolling karstic hills, with slash-and-burn agriculture on shallow soils. The "Alvarado transect" cuts across Guatemala from the humid Pacific coast to the *tierra fría* of the highlands. Agriculture in the uplands was intensive, with evidence of terracing, hilling, and possibly raised fields, while the piedmont was used for irrigated gardens and cacao plantations.

Spanish intrusion and depopulation by disease left the tropical lowlands of the Cortés and Alvarado transects empty; the Gulf Coast was converted to Spanish livestock raising, the Pacific sector to small-scale Spanish commercial plantations. In the high country as well as on the plains of Yucatan, the Spaniards introduced the plow and Old World livestock, and competed with the residual indigenous population. These issues are developed and discussed further below.

The approach proposed by Whitmore and Turner resembles the vertical ecozonation model, but emphasizes different patchworks of agricultural microsystems that were attuned to small-scale environmental variation within each elevation zone. Collectively these adaptations represented a complex human landscape, in which large areas were often substantially modified in order to produce food for large populations.

Given a denser database and greater vertical differentiation of agricultural land use than in North America, this three-dimensional model is particularly suitable to synthesize several mosaics of indigenous land use. As a heuristic device, it presents an inviting challenge for field and documentary studies to flesh out at the micro- and mesoscale. Such research could also contribute to interrelated issues such as the benefits and drawbacks of traditional ethnoagriculture, the possibility of excessive stress on resources during periods of peak pre-Conquest population, and the comparative productivity of Precolumbian and Postconquest agrosystems.

The papers of Doolittle and Whitmore-Turner are both directed toward indigenous agriculture at or shortly before the Contact Period. They represent complementary methodologies to reconstruct the human landscapes of the New World, by means of case studies, for about the year 1492. Synchronic in focus, they provide methodologies for delineating varying levels of prehistoric population pressure and the extent to which specific environments were humanized or even degraded. But the diachronic perspective remains important. Thematic historical studies, such as the evolution of irrigation technology (e.g., Doolittle 1990), or detailed local studies of smaller areas over time, such as the work of Veblen (1975) on the forests of Totonicapan, draw attention to processes such as incremental change, longer-term adaptation, and response to crises. Such historical monitoring of land use and landscape change can provide a critical tool to examine the long-term impacts of traditional agriculture or to anticipate the hidden costs of high-technology development (Butzer 1992a).

Depopulation and Discontinuity

The conquest of one society by another is inevitably brutal, whether it be the Spanish subjugation of the Taíno or Aztecs, or the Puritan elimination of the Pequod. The conquered are traumatized and the conquerors dehumanized, both by the killings and by the subsequent uprooting of people and the violations of human dignities and freedoms. Hundreds of culture groups disappeared in the aftermath of 1492, and dozens of other societies were significantly changed. Displacement or elimination did not even end with the Colonial era, as the expulsion of the Cherokee or the shooting of women and children at Wounded Knee remind us, without the need to invoke similar atrocities in independent Latin America. But no purpose is served by special pleading or assessing culpability. Conquest is horrible and all participants are guilty of excess, Spanish or British, European or Native American.

The human tragedy of the European conquest, however, was unprecedented in scale, not because of its unquestionable brutality, but primarily through the spread of epidemic disease. By an accident of geographic isolation, the pathogens that evolved in the Old World, and which repeatedly wreaked havoc there, were excluded from the New World for many millennia. This battery of Old World epidemic diseases had several origins, but most were the result of coevolution between people and domesticated livestock.[3]

Early European contacts with the New World introduced new epidemics, in rapid succession, to populations without immunity, as George Lovell shows in his paper. Influenza, smallpox, measles, mumps, and pneumonic plague arrived first, followed by typhus, diphtheria, malaria, and yellow fever. The result of each pandemic was disastrous, and before a population could rebound demographically, a new epidemic struck, so that the "die off" became cumulative, eventually leading to demographic collapse (Whitmore 1991).

Lovell deals with both the demographic and human dimensions of the tragedy, as documented in five representative areas: Hispaniola, central and northwestern Mexico, Guatemala, and Peru. He evaluates a vast body of literature to demonstrate (a) the scale and universality of the disaster; (b) the trauma and significance of the first pandemic in each area, either in destroying an entire population or in breaking the resistance of indigenous peoples; (c) the advance of disease, even ahead of the invading Spaniards; and (d) the persistent problems of diagnosing exactly what diseases were responsible.

Lovell employs an unusual body of medical writings to show that clinical diagnoses are difficult at best. Disease symptoms change their characteristic form over time, e.g., hemorrhagic smallpox or pneumonic, rather than bubonic plague. Compound epidemics also cannot be excluded.[4]

Given the fragmentary demographic information for the early contact period, the computer simulations of Whitmore (1991) offer an alternative perspective, anchored as they are in more reliable population data of the late 1500s, and predicated on contemporary epidemiological indices, flexible demographic profiles, and further mortality through postepidemic famine. For the Basin of Mexico, Whitmore (1991) arrives at an 89 percent reduction from 1.59 million inhabitants in 1519 to 180,000 in 1607. Denevan (this volume) estimates a 74 percent decline in North America, 1492–1800, and 89 percent for the hemisphere as a whole from 1492–1650.

The numbers do matter, as Lovell contends. They matter, above all, because they set parameters for a demographic disaster that remains unparalleled in human history. Whether we favor the lower or upper part of Denevan's estimates for a New World population in 1492, we must still deal with the appalling implications of between 40–60 million people succumbing to disease and famine as a result of the Columbian Encounter. Lovell suggests that this disaster contributed to the military defeat of the indigenous peoples of the New World.[5] Some entire societies, such as the Taíno, disappeared as a result. But numbers provide only an unsatisfactory surrogate for the scale of the human tragedy involved. Lovell is keenly aware of this and introduces a sampling of poignant human testimony from the period. This allows us to appreciate, in some small way, the horror of what transpired.

The numbers also matter from an environmental perspective, because they have to be reasonable for an overwhelmingly agricultural population, given the technology, communications, and limited sources of fertilizer in 1492. For the Basin of Mexico, the 1.6 million figure of Whitmore is a third higher than the 0.8–1.2 million estimate of Sanders (1981), based on

subjugation of the Taíno or Aztecs, or the Puritan elimination of the Pequod. The conquered are traumatized and the conquerors dehumanized, both by the killings and by the subsequent uprooting of people and the violations of human dignities and freedoms. Hundreds of culture groups disappeared in the aftermath of 1492, and dozens of other societies were significantly changed. Displacement or elimination did not even end with the Colonial era, as the expulsion of the Cherokee or the shooting of women and children at Wounded Knee remind us, without the need to invoke similar atrocities in independent Latin America. But no purpose is served by special pleading or assessing culpability. Conquest is horrible and all participants are guilty of excess, Spanish or British, European or Native American.

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and what impact they had in Mexico during the first century of settlement. The land grants are indispensable to understanding how Spain fashioned a new Colonial landscape. Indirectly they serve as a vehicle to explain the nature of the relationship between the colonizers and the indigenous peoples in the rural world. In regard to urban policies, see Butzer (this volume).

A fundamental feature of the land grant policy was that it favored prominent citizens who had rendered service to the government, specifically officials and officers, rather than common immigrants with farming backgrounds. Titles were also secured by the religious institutions, the friends and relatives of the powerful, or "front men" for wealthy public officials engaged in accumulating larger holdings—contrary to the formal policy of awarding limited parcels of land to any one person. Even when titles were given to common settlers, in outlying areas such as the Bajío (after 1570), such land tended to be sold off to the expanding estates (Murphy 1986). As a result, institutional structures in the Spanish New World were heavily weighted against a small freehold tradition (also Butzer 1992b).

Land grants began to be awarded in numbers during the early 1560s, which steadily put Indian properties at risk from Spanish acquisition. Traditional Indian lands were sacrosanct under Spanish law, but only as long as they were cultivated. Indian depopulation in Mexico, underway since 1520, took on alarming proportions after the pandemic of 1545, and was transformed into a demographic collapse by the epidemic disaster of 1576. By 1580 there simply were insufficient numbers of Indians to cultivate all the village fields. Indian settlement amalgamation (*congregación*), begun in the late 1540s, resumed in the late 1580s to aggregate the few surviving families of many villages into new nuclei. Although *congregación* did not generally alter the surviving Indian landscape as much as might be expected, primarily because compliance was incomplete, it did lead to significant abandonment of Indian lands in some areas.[6] But nucleation in new towns was also weakened by a steady migration of Indian wage labor to live on Spanish farms, locally or in other districts such as the Bajío. This again reduced the work force of traditional communities.

It was depopulation and *congregación*, and outmigration from Indian communities, that accelerated the expansion of Spanish landholdings. As Prem explains, the archival documentation for land grants can be used not only to reconstruct the procedure of land allocation, but also to identify regional settlement histories and the different roles of the Spaniards and the Indian elites in this process. Prem presents that information in a systematic context, by comparing Spanish acquisition in three major regions of central Mexico, based on a number of supporting studies. Several major conclusions emerge:

(a) The alienation of traditional Indian land holdings began on a large scale after 1580, indirectly through awards of abandoned lands, or directly through purchase.
(b) By the early 1600s, the great majority of Indian properties west of Puebla and in the Basin of Mexico had been acquired by Spaniards. Sheep raising, restricted to rough terrain and mountain slopes, was much less important than agriculture; Indian irrigation networks were coopted with little change in some areas (Butzer and Butzer 1992), while in others irrigation was expanded or introduced, based on Spanish initiative.
(c) Indian wage labor provided the work force on Spanish farms, operated by managers for owners living in Mexico City or Puebla. Farm holdings were steadily expanded through purchase and other methods, leading to the consolidation of relatively large estates.
(d) In more peripheral areas, such as the valleys of Toluca, Mezquital, San Pablo, and Oaxaca, Spanish acquisition of Indian property was far less complete, while livestock raising increased in importance with greater distance from Mexico City.

The first century of Spanish settlement created a rural landscape in central Mexico that was largely, but by no means exclusively, controlled by Spaniards, many of them wealthy. Agriculture produced large quantities of wheat for urban Spaniards, but maize retained its prominence as the staple of the Indian majority, apart from the fact that wheat, as a winter crop, did not thrive without irrigation (Butzer 1992b). Introduced livestock, mainly sheep, grazed on uncultivated land, beyond the former limits of Indian agriculture. In addition,

overstocking of dormant winter pastures, reflecting recurrent frost and drought, was mitigated by well-organized transhumance patterns, as sheep were driven to public lands in the tropical low country or far to the semiarid north (Butzer and Butzer 1992).

Beyond the heartland of central Mexico, regional settlement histories were very different (Butzer and Butzer 1992). A second nucleus of Spanish agriculture developed in the Bajío lowlands, with livestock economies dominant further north. The Gulf lowlands included large tracts dominated by Spanish cattle raising, while transhumant sheep were grazed on winter pastures, primarily on the piedmont. At the same time, old centers of Indian agriculture in Michoacan, Oaxaca, and along the plateau escarpment northeast of Mexico City remained overwhelmingly in Indian hands. For the administrative region of New Spain, which excludes the west and north of Mexico, Spaniards controlled about 25 percent of the land in the 1640s; they farmed some 4000 km^2 and ran perhaps 6–8 million sheep and 1.5–2 million cattle (Butzer and Butzer 1992). The Indian agricultural domain probably represented about 45 percent of New Spain, with the remaining 30 percent constituting what by Spanish law was public land.

In sum, there was a considerable degree of continuity in terms of Indian ownership. But the large or small nodes of Colonial settlement, the new market orientation for wheat and animal products, the introduction of domesticated stock as a major element of the rural landscape, the recasting of Indian settlement in the form of new gridiron towns, and the partial elimination of dispersed settlement, all serve to highlight a fundamental discontinuity. New Spain had also become a dual society, with separate Spanish and Indian towns, and residential segregation in the cities—not in order to "exclude" the Indian population, but to preserve a degree of Indian local autonomy and avoid intrusion by Spaniards into the Indian domestic sphere (Butzer 1992b).

This new cultural landscape of Colonial Mexico evidently continued to evolve. By the 1700s, great estates dominated much of the countryside, and palatial residences were built on some of them. A century later, most rural Indians lived in new satellite hamlets around such haciendas. But the great estates only reached their zenith on the eve of the Mexican Revolution, in 1910. By then, most rural Mexicans, Indian and Mestizo alike, had been reduced to a dependent class (Nickel 1978).

This overview of Spanish colonization outlines discontinuity and change in the cultural landscape of New Spain. Many of the principles and processes are also applicable, in general terms, to other parts of the Spanish Americas. Yet each region provided a unique context, with divergent development. The best Spanish administrators were sent to Mexico and Peru, and it was here that the legal safeguards for indigenous rights were most consistently enforced. In the other colonies, Spanish officials tended to be less competent, enlightened, or incorruptible. As a result, some colonies had a sorry history of abuse, and others were totally dominated by entrenched Colonial elites. These differences in socioeconomic evolution during three centuries of Colonial rule contributed significantly to the fragmentation of Latin America after independence.

Diffusion, Continuity, and Syncretism in the Indigenous Landscape

Our focus now shifts from the active role of the Spaniards to that of the indigenous people. Native American languages continue to be prominent in the highlands of Middle America and the Central Andes, and a wealth of Prehispanic cultural traits has been reported from some areas by anthropological investigations. Do such cultural landscapes reflect continuity into the present from a Tarascan, Zapotec, Mayan, or Inca past?

Daniel Gade (this volume) examines that proposition for the seemingly intact indigenous society still esconced in the mountain redoubts of the Central Andes. Instead of emphasizing the negative impacts of the Conquest, he examines the ability of Andean peasants to manipulate and incorporate elements of Spanish culture into their lifeways. Diffusion of information was a key component of the Columbian Encounter, but rudimentary lists of plants or animals transferred from one hemisphere to another convey little information and also do injustice to the complexity of cultural screening or ecological adaptation. Studies of diffusion should therefore consider how new traits were

tested, and accepted or rejected, and what the consequences of incorporation were.

Spanish introductions had their greatest impact in accessible valleys and basins at intermediate elevations of 2500–3500 m, where the climate was temperate and the ecology analogous to that of upland Spain. Gade distinguishes between the many Spanish traits introduced by the new settlers and the limited selection of such traits that found approval among the indigenous people. This second repertoire is of interest here. Wheat, barley, broad beans, and a number of condiments, including onions and garlic, were tested and found to be advantageous plants to incorporate within the existing agrosystem. Mediterranean fruit trees did not do well in the montane climate, but Old World bananas and oranges or Mexican *capuli* cherries did.

Spanish livestock gave greater subsistence security and proved to be more important than the Old World plants. In the wake of depopulation and increasing labor shortage, they provided food with relatively little work or facilitated transport and plowing. Donkeys, as well as mules and horses, were superior to llamas as beasts of burden. Sheep were acquired by 1560, with large flocks verified by the 1590s; they provided meat and sometimes milk, and their soft wool could be interwoven in textiles. Unlike in Mexico, distinctive transhumance patterns did not develop on a large scale. Goats proved to be versatile grazers on very steep slopes, just as pigs became waste processors in the villages. Castilian chickens were good producers of eggs, and displaced the domesticated muscovy duck. But grazing sheep and goats could also lead to soil erosion, and their intrusion into fields of standing crops periodically led to damages.

The light Andalusian plow, pulled by oxen, provided distinct advantages over traditional spades or digging sticks to cultivate relatively level terrain and less stony soils. With only one plow team and plowshare per village, collective or open-field cultivation of crops was introduced. Wheat was threshed by means of animal trampling. Simple Spanish gristmills were also incorporated, while ovens replaced baking pits. Construction with adobe or *tapia*, a puddled-mud technique, expanded greatly because of the Spanish introduction of wooden molds to preshape adobe bricks, while a mix of lime-rich mud and straw could now be poured, as tapia, into box-like wooden frames. Jointed beams simplified roof construction, roof tiles were more durable than thatching, and wooden doors set in wood frames provided greater security.

As in Mexico, the Spaniards tried to remodel the indigenous settlement pattern, moving people from scattered farmsteads or loose hamlets, next to their fields, into new gridiron towns. The native population again resisted nucleation, so avoiding assimilation to Spanish urban living.

Gade argues that the indigenous people of the central Andean world selected ideas and material traits that served to enhance family security, reduce subsistence risk, and offer a broader and more versatile diet. Spanish traditions were simplified and then recombined within the Inca agrosystem. Such syncretism is evident in the agricultural components, diet and folk medicine, settlement patterns and clothing, as well as in spheres such as religion and language that are beyond the scope of Gade's paper. Taking its present shape about 1650, this modified and enriched Andean lifeway has remained remarkably stable across three centuries, presenting an increasingly archaic cast over time. Many originally Spanish components today are perceived to be indigenous. But they demonstrate that the visible cultural landscape is not a simple legacy of the Inca past.

The selective acculturation described here was limited to a particular vertical ecozone. At lower elevations, Spanish transformation was more or less complete, while at higher elevations indigenous patterns of land use and settlement proved their competitive value and still persist. This is an exemplary study of information diffusion and adaptive change, that suggests a methodology to examine persistence and change in the cultural landscape. The evidence for selective acceptance of Spanish crops, animals, and management techniques among the indigenous peoples of Mexico implies a similar pattern of qualified acculturation (Butzer 1992b).

Diffusion after 1492 was a two-way street. A number of New World plants were disseminated in the Old World rapidly, others more slowly. Maize promptly displaced several species of millet, becoming a key fodder crop in southern Europe, and a major source of human nutrition in West Africa, India, and China. Po-

tatoes became a staple in many parts of Europe during the 1700s. Cassava roots (manioc) spread through West Africa and southern Asia. These three food sources remain a cornerstone for the livelihood of more than a billion people in the eastern hemisphere.

Other New World cultigens also enjoyed success overseas: sunflowers, for the oils and chewiness of their seeds; several varieties of beans; the tomatoes, without which Italian cuisine would be flat; the popular vices of cacao and tobacco; as well as chili peppers, pineapples, vanilla, peanuts, and quinine. European colonists in the New World adopted the same plants, after some initial reluctance. That is one meaning of the Columbian Exchange (Crosby 1972), the beginning of a global migration of foods that has generally improved the quality of human life (See Langer 1975; Lunde 1992, 47–55).

The scope of this exchange requires a second look at the implications of adopting new plants and management techniques into an existing agrosystem, or new foods into a traditional cuisine. Do wheat, sheep, and garlic make the Inca more Spanish, or do tomatoes and maize make Italians more Mexican? Such questions are sufficiently disconcerting to demand another look at acculturation.

Maize in Mesoamerica or wheat, wine, and olive oil in the Mediterranean world are more than foods. They carry additional levels of meaning in the symbolic and ideological sphere. Such cultural interpretations are lost when they become part of an alien cultural repertoire, in which they may or may not acquire new symbolic meaning. The acceptance of isolated new traits also differs from acceptance of a "package" of traits. Testing and eventual acceptance of a single new food plant at a particular time requires a perceived equivalence in form or function, and perhaps substitution for an indigenous "equivalent" with little or no symbolic significance. The acceptance of a whole array of new traits at once is another matter. In the Andean example, it would certainly require considerable structural readjustment in terms of work scheduling, resource management, and dietary strategies, if not also in perception, social norms, or cultural values. The modern Andean conviction that their adopted elements are *criollo*, or autochthonous, underscores the point.

Andean or Mesoamerican syncretism does indeed suggest a reduction of cultural distance between Indian and Spaniard (see Graham et al. 1989), as does the Spanish acceptance of maize, adobe housing, Indian mates and early marriage patterns, or a large indigenous vocabulary (Butzer 1992b). Such changes argue for a degree of acculturation.

British and French Colonization

France and Britain had little experience in colonization when they entered the American theater a century later than Spain. By then, epidemic disease in North America had taken a heavy toll. Agriculture had retracted in some areas and indigenous populations had been generally thinned, so that there was little immediate conflict over land. But French and British policies and expedients for settlement differed, as they also differed from those of Spain, reflecting particular circumstances and historical precedents.

Although the immense estuary of the St. Lawrence River invited exploration as a potential water route to Asia (see Allen, this volume), control over the fur trade may have been a key motive for French engagement in 1605; there also were fishing rights to secure (Harris and Warkentin 1974; also Harris 1987). Settlement was initially placed in the hands of *seigneurs*, who played a similar role in the French countryside to an English squire. The seigneurs assigned land to groups of colonists as permanent leaseholds in return for a variety of rents and tithes on production. Beyond providing some minimal services such as a gristmill, the seigneur normally lived in a larger settlement and played no direct role in the development of land use patterns (Harris 1984). Distinct regional solutions were found, tuned to the local ecology, and based on French and central European experience (Harris and Warkentin 1974, chap. 2).

In Acadia, coincident with the later Canadian maritime provinces, soils were poor except in the coastal valleys. The high tides of the Bay of Fundy generate diurnal surges of water far upstream, converting the valleys into wetlands. These were reclaimed by French settlers who built dikes to restrain the daily tidal bore, while profiting from the fresh increments of fertile flood silt to create a kind of mini-polder landscape along the valley bottoms (Harris and Warkentin 1974, 28–29).

Another remedy was found along the St. Lawrence River and its main, south bank tributaries, in present-day Québec. Here clusters of farms were aligned along Pleistocene shoreline ridges, immediately above the floodplain meadows. Long lots, ten times as long as their width, stretched back across the old alluvium at right angles to the ridges. This long-lot system was developed in eleventh-century Europe to colonize unutilized floodplains and forested watersheds. During the 1700s, it also became a hallmark of French settlement in Louisiana and around French fur-trading posts at strategic river or lakeshore sites in the American Midwest. By about 1800, the striking long lots began to interfinger with irregularly-shaped properties measured by the British (and Spanish) metes and bounds system along the Mississippi River (Harris 1990). The imprint of France remains visible today in field patterns that record the properties and the toil of its pioneer settlers across the interior of North America (also Walthall 1991).

Given the initial abundance of land and weak market demand, French settlers in the New World abandoned familiar labor-intensive forms of agriculture, such as three-course rotation of crops, heavy manuring, and improved stockbreeding (Harris 1984). Tree stumps were left to rot in the ground, manure was rarely used, and a two-course crop rotation substituted. Such extensive agriculture gave mediocre yields, but disintensification with respect to European antecedents also characterized the Thirteen Colonies.

The British settlement experience, outlined by Carville Earle (this volume), was more complex than that of France, reflecting distinct but homogenous socioeconomic groups of immigrants from different parts of England ("ethnocultural pluralism"). The first tentative probings of the Atlantic Seaboard were linked to sixteenth-century piracy ("privateering") on Spanish shipping. Reluctant to engage directly in American settlement, the British Crown awarded concessions ("monopolies") to chartered companies, who sought new investments on the Atlantic Seaboard, where the Hakluyts had pronounced the "mediterranean latitudes" of Virginia and North Carolina optimal for settlement. This decentralized strategy spawned semiautonomous colonies, each centered on a key town that served as administrative center and economic entrepôt. Each colony also drew on a different reservoir of immigrants: Puritans from East Anglia in New England, Quakers from northern England in Pennsylvania, aristocratic planters from southern England around Chesapeake Bay. The first two areas attracted immigrant families, while the plantation colonies had the capital and the incentive to bring in single males, too poor to pay for the voyage, as indentured servants.

Reflecting the immigrants and their economic goals, contrasting rural economies developed on the Eastern Seaboard: (a) small-scale agriculture, primarily designed to meet household subsistence needs in New England and overseas grain markets in the Middle colonies; and (b) commercial agriculture, successively emphasizing tobacco, indigo, tidewater rice, sugar cane, and ultimately cotton, from Chesapeake Bay to Charleston. The northern sector experienced population growth and urban expansion, benefitting from immigrant surges from several dissenting groups from Great Britain and later, Germany. By 1700, Boston had close to 7000 inhabitants, New York 4500, and Philadelphia 3000, while the largest town in the southern sector, Charleston, had only 2000.

With little female immigration and a less healthy climate, demographic expansion was slow in the south, and labor scarce. Indians were enslaved, but they were quickly displaced by white indentured servants and, after 1680, by African slaves imported from the West Indies and Africa. Planters and merchants, in turn, collected the produce of these bonded laborers and rice, tobacco, and indigo were exported directly to England and the Continent—all of which accorded nicely with the Crown's mercantilist aims. Plantation crops gave out north of the Chesapeake, and farmers there turned toward mixed farming systems which accented wheat and corn for export in the Middle Colonies and localized subsistence in the less hospitable environs of New England. Northern merchants directed grain exports among the various markets in the Atlantic economy and, led by Bostonians, assumed control of the intercolony trade linking the various economic sectors and regions. These vigorous coastal enclaves were filling up by the early 1700s, and soon after Scots-Irish, German, English, and Welsh settlers spilled over into the

less desirable piedmont to the rear of the plantations around the Chesapeake estuary. The rapid pace of interior expansion between 1700–50 tested the Empire, occasioning, among other things, hostile Indian responses, French fears of British colonial pretensions, confusion over titles to land, and sectional strife between interior settlements and colonial administrations based along the coast.

Characteristic of the decentralized and multiethnic British colonial enterprise was its diversity, reflected not only in its varied economic pursuits, but also in its imprint on the landscape (see Mitchell and Groves 1987). River-front, long-lot field patterns are mainly found in New England and other patterns of long lots around Philadelphia; these generally date to the initial settlements. Metes-and-bounds surveying became dominant, however, and town plans increasingly regular. Subsistence-oriented agriculture disintensified, with two-course crop rotation increasingly common. The German settlers retained their three-field system, but the Finns and Swedes on the Delaware followed a more familiar shifting pattern of clearance and bush fallow, akin to that of the local indigenous peoples; this was subsequently adopted by the Scots-Irish settlers that spearheaded settlement beyond the Appalachian perimeter (Jordan and Kaups 1989). Further south, tobacco producers also deployed shifting cultivation for maintaining soil fertility in the Chesapeake, while rice planters in the Carolina low country engaged in microreclamations of estuarine marsh (Hilliard 1978).

Although latecomers to the colonial process, the British colonies on the mainland enjoyed spectacular, if often cyclical, advances. Fueled by the export of plantation crops and grains to eager Atlantic markets, population and economy on the seaboard grew by more than three percent per annum, the area of settlement by more than two percent. The infrastructure of trade and commerce which sustained these advances, in turn, enabled these colonies to take the lead in movements of independence and industrialization during the Age of Revolution (1770–1830).

Rates of immigration were by no means proportional to the subsequent size of European populations in the New World. Table 1 compares Spanish, French, and British colonization, using the first century of immigration and settlement as a reference point. Caribbean settlement evidently met with little demographic success, as a result of disease, low birth rates, and low life expectancies (see Gemery 1980; Curtin 1989). Surprisingly, many more British and French emigrants went to the Caribbean than to mainland North America. New England had greater demographic success than the Chesapeake region or the tidewater south. Spanish population growth with respect to immigration was twice that of its British counterpart. Although Spanish regions of immigration are obscured by a lack of separate data for Central America, and by a steady stream of transmigrants from Mexico and Central America to Peru, demographic growth was greatest on the Mexican Plateau and in the dry, temperate lowlands of Peru.

Table 1. Demographic Patterns of Key European Colonies during the First Century of Settlement

	Population (in thousands)	
	Immigrants	Europeans
Spanish Colonies to 1600		
Mexico	90	92
Central America		20
Caribbean	22	12
South America	63	116
Total	175	240
French Colonies to 1700		
Quebec	7	13
Acadia		2
Caribbean	38	6
Total	45	21
British Colonies to 1700		
Newfoundland	39	3
New England		93
Mid-Atlantic region	116	54
Southern region		104
Caribbean	222	36
Total	377	290

Sources: Based on Boyd-Bowman (1976), Butzer (1992b), Gemery (1980), Mitchell and Groves (1987).

A notable difference between the different colonial systems is that 48 percent of the Spanish settlers lived in towns with more than 2500 Europeans at the end of the first century (Butzer 1992b), while only 5 percent of the population in the British colonies would qualify for such a definition of "urban" in 1700. This not only reflects different social preferences, but also the limited opportunities for small freeholders in Spanish Colonial agriculture. The colonies of these three powers evidently were very different.

Although there finally are two good historical texts on the Caribbean world (Watts 1987; Richardson 1992, chaps. 2–3), that region tends to fall between the cracks for American historical geographers and their Latin Americanist counterparts. But as Table 1 suggests, North America was at first little more than an adjunct to the British and French colonial enterprises in the Caribbean, at least in regard to financial returns (see Meinig 1986). The southern Atlantic Seaboard begs to be studied in conjunction with the Caribbean. It also bears mention that the African role in the circum-Caribbean plantation complex (Curtin 1990) has been comparatively neglected by geographers. For example, *Historical Archaeology* recently devoted an issue to Southern plantations that examines the cultural record and livelihood of African slaves (Vol. 24, No. 4, 1990). The volume of involuntary African immigration (Table 2) consistently exceeded that of European colonists. Some 8.8 million African slaves were imported to the New World by 1810 (Rawley 1981), compared with roughly 1.8 million European emigrants. But death outnumbered births among African slaves, as a result of epidemics, famine, malnutrition, suicide, a deficit of women, and high infant mortality. Consequently their numbers had to be constantly replenished through "imports," even when the plantation economy was not expanding. More attention needs to be devoted by historical geographers to the links between Africa and the New World as manifest in the cultural imprint.

Table 2. African Slave Imports to the European Colonies during the First Century of Settlement

	Number of imports (in thousands)
Thirteen Colonies (to 1700)	29
British Caribbean (to 1700)	264
French Caribbean (to 1700)	156
Dutch Caribbean (to 1700)	120
Spanish Colonies[a] (to 1600)	75
(1600–1700)	295
Portuguese Brazil (to 1600)	50
(1600–1700)	560
Total to 1700	1,553[b]

Sources: Based on Curtin (1969), Rawley (1981), and Klein (1986).
[a]Primarily for mining in Mexico and Colombia and for agriculture in lowland Peru and the Gulf-Caribbean region.
[b]Includes 4000 to Danish Antilles.

The integration of Native American themes into the repertoire of American historical geography is more advanced, but it remained for a historian, William Cronon (1983), to highlight the competition and complementarity of Euro-American and Native American subsistence ecologies. Some examples of related research by geographers can be cited. Ray and Freeman (1978, 231–60) illustrate how the "frontier" can be seen as an arena of interaction, even beyond the periphery of European settlement. Similarly, Albers and Kay (1987) sketch a startling alternative scenario for the Native American presence by showing that indigenous peoples had a remarkable capacity for multiethnic coexistence. Contrary to the stereotypic view, a sizeable number of early settlers did take Indian mates, as Jordan and Kaups (1989, 87–92) argue from historical and contemporary evidence. The large French-speaking minority of the Canadian Plains, the Métis, are mixed-blood descendants of French fur traders (Brown 1983). There also were smaller and little known multicultural communities among the trappers who began the settling of the Mountain West (Lecompte 1978, 62–67, 221). Beyond the genetic contribution to American bloodlines, there are good grounds to posit that Indian women facilitated frontier expansion and shaped its society.

European settlers moving inland from the coast, and their descendants crossing the mountain passes to the interior, continued to encounter settled or recently-abandoned agricultural landscapes. Aided by Indian guides and surviving on Indian foods, the pioneers at the head of the Euro-American advance followed the signposts of cleared fields and orchards that recorded the long experience of Native Americans in selecting good soils and managing local ecologies with a similar technology (Butzer 1990). As the Spaniards in another time and place, British and American settlers followed readily in the tracks of indigenous farmers, only to be frustrated where these gave way to mobile hunters or foragers. A new cultural landscape was built on the traces of an older one, regardless of whether abandoned or functional. These perspectives of interaction, ecological convergence, and superimposition imply a less ethnocentric vision of America's past. They do need to be investi-

gated, sooner rather than later, by a new generation of geographers.

Multiple Perceptions, Cartographies, and Geographies

The very terms "New" World and "discovery" highlight the dialectic between Europe and the Americas. The irony has not escaped a succession of humorists who describe the Indians greeting the landfall of 1492 with comments such as "we have been discovered!" or "You must be Columbus." Three of the papers in this volume explore perceptions, cartographies, and geographies, well-documented in the case of the Europeans, fragmentarily preserved in the case of the indigenous peoples.

If Columbus had not crossed the Ocean Sea in 1492, another explorer would have done so within a very few years. Ship construction, nautical skills, and knowledge of the ocean currents and wind patterns had improved dramatically during the fifteenth century, setting the stage for bold voyages into the open sea. But captains did not set sail into the unknown without a body of empirical and nonempirical information sufficient to convince them that such a venture promised success.

The vision of Columbus, in expecting to find Asia in the west, was built on his interpretation of flotsam washing up on the beaches of the Madeiras, his reading of Medieval travelers' accounts and fables, his belief in Ptolemy's incorrect estimate of the earth's circumference, and the conviction that he had a divine mission (see Phillips and Phillips 1992, 100–11). The paper by John Allen (this volume) takes the premise that Europe was conceptually and operationally prepared for the eventual discovery of new lands to the west. He argues that the initial voyages of exploration were based on existing geographical lore and on observation and experience, as well as on myth, legend, and rumor. In their turn, the subsequent voyages were influenced by the accumulating experience of earlier ventures and the evolving geographical images of the New World.

Allen reviews the many categories of lore available before 1492, including: ocean voyages in classical antiquity; legends of early Medieval, Celtic exploration in the North Atlantic, based in part on Irish knowledge of Iceland prior to Viking (Norse) discovery and settlement; surviving information about the Viking settlement of Vinland (Newfoundland) ca. A.D. 1000, and recurrent Medieval tales about mid-Atlantic islands or voyages into the unknown. On our part we continue to speculate whether some of the Portuguese, British, and Breton fishermen known to have fished off the Newfoundland banks after 1500 may have stumbled upon North America some twenty years earlier. Allen traces the information for the voyages of the Cabots—Genoese navigators sailing with Bristol sailors in the service of England—who rediscovered Newfoundland in 1497 and explored parts of the Atlantic Seaboard from 1498–1509. Unlike Columbus, the Cabots followed the trajectory of their Celtic and Viking precursors, by steering out to the northwest. Thus the notion of a Northwest Passage to Asia was born.

Following the British initiative, France engaged the Florentine navigator Verrazzano to explore the Atlantic coast of North America in 1523, leading Cartier to explore the St. Lawrence River in 1534 and 1535, with an unsuccessful attempt to found a first settlement at Québec 1541–42. Cartier's penetration upstream to present-day Montréal not only had a revolutionary impact on cartography, but directed the later French Colonial enterprise to the river and lake systems of the continental interior, to establish the theoretical and experimental basis for North American exploration during the next three centuries. The remarkable resolution of the Mercator map of 1569 reflects these feats.

Brian Harley (this volume) reverses the perspective by critically examining the historical claims of these maps to "truth." The Renaissance revolution in cartographic knowledge and cognition coincided with a fundamental shift from portolan charts, designed as aids for navigation, to documents increasingly used for geopolitical ends. Decorated with national flags, coats of arms, and the names or portraits of discoverers, some maps became a visible record of conquest and imperial claims, demarcating national boundaries. Other ideological statements include crosses and religious inscriptions or portraits. In one form or other, maps had begun to represent reified symbols of power—a tradition continued until after World War II by the use of distinctive colors on maps and globes to represent the overseas possessions of the imperial powers.

By the early 1500s, maps can also be seen as media to present the New World as a "theater" for European colonization. Indeed, a second level of symbolic intent can be inferred. The imposition of European place-names and the engraving of a Christian, European landscape with churches and a europeanized environment can be viewed as a means of cultural appropriation and transfer. In order to attract settlers or console emigrants with memories of the Old World, such maps, deliberately or not, projected a new geographical "reality." Maps became tools with which Europe could impose its own image, values, and aspirations on the newly discovered world. Finally, maps based on exploration could precede actual colonization, thus anticipating and even shaping government policy. This explicitly revisionist stance shatters ethnocentric preconceptions, allowing us to see the Age of Discovery in a more objective light (see also Axtell 1992).

At the same time, Harley raises the matter of indigenous cartographies, noting that histories of cartography and published collections of historical charts tend to ignore Native American maps. Such maps of indigenous origin, mainly dating to the early Colonial period, are well-documented in Mexico. Harley explores this arena briefly, arguing that, like some Medieval maps, their Middle American counterparts projected space and time onto the same two-dimensional plane, to create "spatial histories" that combine geographical perceptions, ancestral migrations, and dynastic histories. On a much broader level, Indian geographical knowledge was also incorporated into European maps of the period. It is known that explorers used Indian guides, that some Europeans commented on Indian mapping abilities, and that a few mapmakers of European origin specifically acknowledge Indian contributions to their charts. Finally, on more tenuous grounds, Harley suggests that Indians may have reappropriated European cartographic traditions as tools of resistance.

The three maps added after Brian Harley's sudden and premature death are accompanied by an addendum by Karl Butzer and Barbara Williams that explains and suggests a first level of interpretation of the superimposed perceptual and conceptual landscapes the maps illustrate. These maps, dating from ca. 1580, suggest a transition between indigenous and European cartographic traditions and therefore serve to introduce the reader, in stages, to the unfamiliar form of spatial representation discussed by Harley.

Integrating the two main thrusts of his paper, Harley reveals the coexistence and dialectic of indigenous and European cartographies. The purpose of his revisionism is not to denigrate the feats of the individuals central to the Age of Discovery, nor to impugn the strength of intellect and will reflected in the European achievements of the period. Rather it is to open our vision to a broader context that allows greater analytical facility. Only by removing the introverted blinders imposed by ethnocentrism—an adaptive feature of all cultures—can we appreciate the wealth of skill and experience embodied in another cartographic tradition or even hope to understand the perceptions of Native Americans in 1492.

The intellectual confrontation of Europeans with the environment and the peoples of the New World posed a similar problem, compounded by dogmatic world views inherited from a Classical and Medieval past. That particular Encounter provoked novel methods of empirical description, organization, analysis, and synthesis that mainline historians have been unable to fully appreciate. As a result the impact of the Encounter on science in general, and geography in particular, has been understated and overlooked or largely forgotten. The paper by Karl Butzer (this volume) examines seven methodological spheres: observational skills, environmental analysis, classification of biota, ethnography, town planning, geographical synthesis, and a scientific framework for the natural history and peoples of the New World. The presentation centers on exemplary individuals, who illustrate the diverse backgrounds, abilities, and interests of the period. Many came from rural backgrounds and had little formal education, but this may have been advantageous in examining New World phenomena, both in their own right and in comparison with similar categories in the Old World. Geography itself was the unifying theme for these diversified strands of scientific analysis, which illustrate the intellectual prowess of Spain during the century from 1492–1590.

A comparative study of the observational skills and geographical sophistication of indigenous Americans must await further research along promising avenues for investigation. The opportunities identified by Harley represent

one such window, and a comprehensive study of the environmental and cultural content of the maps accompanying the *relaciones geográficas* of Mexico (see Butzer, this volume) is a must. But proper symbolic and historical interpretation require special skills, as Rincón-Mautner (1990) points out, in studying the *pinturas* preserved in villages of the Mixteca. A second window is suggested by Barbara Williams's examination of Aztec soil taxonomy and comprehension, measured against contemporary folk soil taxonomies (B. Williams and Ortíz-Solorio 1981; B. Williams 1982). Yet another window is suggested by the first-hand indigenous information recorded in the sixteenth century by Bernadino de Sahagún (see Butzer, this volume). His linguistic analyses allowed him to recognize the links between the world of appearances and the cognitive structures underlying it. A study of indigenous conceptualization of culture and landscape in semiotic terms is indeed possible, based on Sahagún's rich materials.

In such a context the Renaissance myth of the American Noble Savage and its latter-day counterpart, the Indian as Primitive Ecologist, appear grossly reductionistic. Denevan's quotation from Shetler envisions Native Americans as "transparent" in the landscape, "living as natural elements of the ecosphere." This is a perception as tenacious and just as ridiculous as the British view of North America as a "howling wilderness" (Bowden 1992). Such myths are pejorative to Native Americans by reinforcing an image of technologically primitive aborigines, blending into the forest. Conservationist attitudes toward resources and nature do not guarantee that "working with nature" will be possible in practice (Tuan 1968), especially in the face of subsistence stress.

A Devastated Colonial Landscape and Other Open Questions

From the myth of the Indian as Ecologist, we come full circle to the issue of a "Devastated Colonial Landscape." That question has little direct connection with the concerns of contemporary ecologists about deforestation, endangered species, and air or water pollution. A global Industrial Revolution intervened between the twentieth century and the landing at Plymouth Rock, and from 1776–1821 the New World colonies moved to independence. The parameters and perspectives for what transpired after 1776 are different, reflecting a spate of technological innovations, accelerating demand for distant raw materials, rapid population growth, and a more complex global network integrating raw materials, industrial production, and markets.

The precise question in regard to a hypothetical Devastated Colonial Landscape centers on: (a) the livestock, domesticated plants, and weeds introduced by Colonial settlers, in conjunction with particular management techniques and a plow technology; and (b) whether or not European land use and resource management were exploitative and destructive. Several potential lines of investigation can be followed up, at the local or regional level:

(1) palynological, ethnobotanical, and archival research on local vegetation change during the last five centuries or so;
(2) field investigation of slope soils and sediments as well as alluvial microhistories, tied into an informed diachronic context for land tenure, land use, and management techniques in a particular watershed; and
(3) documentary research on regional land use and management, and on contemporaneous evidence for soil depletion or erosion, deforestation or woodland regeneration, flood events and their recurrence intervals, rural population pressure or depopulation, and so forth.

This type of environmental history requires sustained study and cannot be proclaimed from a hilltop by the sweep of a hand. No wonder that this "chapter" cannot yet be written and, in fact, no single person can assemble the scattered pieces of evidence that currently are available, often in scattered and unpublished reports.

The degree to which disintensified European agriculture in eastern North America had serious ecological consequences before 1776 appears to be an open question (M. Williams 1989). Nor is it clear what impact reintensification had, beginning anywhere between the late 1700s and the late 1800s. Plantation agriculture did lead to soil erosion, when cotton cultivation was initiated on the southern piedmonts during the late 1700s, but that pertains to another era (Trimble 1974, 1985; Earle 1988). The vast clear-cuttings across the eastern woodlands, to feed the ovens of the early iron mills, reached their climax in the Upper Midwest during the 1830s, and soil erosion, not surprisingly, followed in their wake (Knox 1987). There is as yet no case to accuse Colonial settlers of the Atlantic Seaboard or the St. Lawrence Valley of landscape devastation. If anything, as Denevan argues, the forests of eastern North America regenerated between 1500–1750.

For Mexico, it is popular to point to the introduction of Spanish livestock as an agent of ecological deterioration, but here again the evidence is far from convincing, at least for a general indictment. A reconstruction of vegetation from documentary evidence for the Bajío ca. 1590 shows that riparian forests were still essentially intact, woodlands on watersheds were at least as extensive as during the present century, and any evidence for degradation was limited to old areas of Indian agriculture (Butzer and Butzer 1992). Along the watersheds of the Basin of Mexico, despite extensive documented cutting of timbers for construction, mountain streams continued to provide reliable sources of water not only for irrigation, but also for the operation of grist and fulling mills, at least until the 1630s (Butzer and Butzer 1992). None of the available pollen profiles from Mexico show evidence of active devegetation or weed explosion during the Colonial era, although resolution is low, and livestock grazing may have slowed forest regeneration in the wake of Indian depopulation.

There is conspicuous evidence of Prehispanic soil erosion in central Mexico (Werner 1986), but little to support a Colonial counterpart. At Tula, Hidalgo state, the rate of valley sedimentation was cut by 75 percent following Indian depopulation, although at some later point the river did cut down its channel (Butzer 1992a). Near San Miguel Allende, north of the Bajío, there were no extreme flood events from well before 1500 until after about 1750, when flood silts began to accumulate on the Río Laja floodplain (Charles Frederick 1992); this matches the absence of historical records for destructive floods in the Bajío before 1750. In the Mixteca of Oaxaca, cited by Lovell (this volume) as an example in point, landscape devastation is better correlated with the deep channel trenching which followed somewhat later than an increase in stream alluviation during early Colonial times (Rincón-Mautner 1992). Such examples warrant much greater caution in drawing intuitive conclusions.

The continuing absence of evidence for at least a general trend to environmental disturbance in Mexico before the mid-1700s probably has an explanation. Livestock were deliberately managed in a highly mobile fashion; based on older Iberian experience, overstocking on confined dry-season pastures was avoided by long-distance transhumance for sheep and medium-distance mobility for cattle (Butzer and Butzer 1992). This goes to the heart of Sale's (1990) indictment of the European land ethic.

The empirical evidence shows that European land use was overwhelmingly conservationist since prehistoric times, despite periodic local or regional crises in environmental stability (Butzer 1982, chap. 8). If anything, one must be impressed that the agricultural productivity of the Mediterranean Basin has been sustained through more than 6000 years of farming and pastoral land use. Livestock can indeed be very destructive to the environment, when poorly managed. But the mounting biophysical evidence shows that, historically, equilibrium management was the rule rather than the exception (Butzer and Martí 1991). Perhaps a different question is in order: When, where, and why was conservationist European agriculture abandoned in the New World?

This brief sketch is designed to show that the case for a devastated Colonial landscape is neither proven nor evident before the mid-1700s. But that does not preclude future demonstration that some areas were indeed degraded and at an early date, a development that seems more probable than not. The discussion has also been limited to visible environmental impacts. More subtle changes, such as reduced diversity or species replacement in the tree or ground cover, will certainly have taken place as a result of livestock activities or settlement expansion; but these can only be detected by more fine-grained methodologies. What the evidence outlined here does make clear is that *assumptions* about European land use practices are unwarranted.

Environmental history is a scientific endeavor, as was understood by those innovative historians who founded the journal *Environmental Review*. Its purpose is to test hypotheses empirically, and to seek explanation for observed phenomena. The history of New World biota and soils, in relation to human land use

and modification, is of singular importance and deserves a new round of attention by geographers, especially in North America. Demanding good temporal controls for observed change, and distinguishing processes before and after 1776—for example—is not at all specious: the methods and motivations of concurrent land use must be understood. The complexity of deforestation and forest regeneration, with different plant successions and dominants, is illustrated by the Harvard Forest Program (Schoonmaker and Foster 1991; Foster forthcoming). Does the closing of a forest preserve to human use today, with inhibition of forest fires, promote a different species composition from that of 1750 or 1400 (Heinselman 1981)? Environmental dynamics have important implications for contemporary ecological management, and simplistic myths, however appealing, can only muddy the waters at a time when critical conservationist decisions must be made for the future.

In closing, two basic issues stand out as the challenge of the Columbian Encounter to geographers: (1) the changing history of land use and attitudes to land, as reflected in the environmental history of the many regions of the New World during the last millennium or so; and (2) the interactive role of Native Americans, European settlers, and Africans in shaping the human and cultural landscapes of the Americas. The myths and polarities proposed by some of the revisionists lack conviction or reality, but they do make the case that there is much more to be learned by examining the record more closely, and by paying greater attention to the indigenous peoples as well as to the Africans, as important participants in the drama and contributors to the outcome. The implications go well beyond an understanding of the past, by placing contemporary questions of ecology, traditional land use, and cultural diversity into sharper focus.

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Notes

1. Available analyses of stable isotopes (carbon and nitrogen) from human bone suggest that beans were not yet an important dietary component during the thirteenth century (Schwarcz et al. 1985).
2. In the case of a preagricultural site in Illinois, human disturbance on an adjacent slope composed of erodible loess led to a substantial increase in sedimentation rates during the two major periods of site occupation, about 8500 and 5200 years ago (Butzer 1977).
3. Smallpox, measles, mumps, diphtheria, and influenza evolved from cattle or sheep viruses, which emerged as deadly human infections among prehistoric animal-breeders in the Near East or Europe. They presumably created catastrophic pandemics in prehistoric times, slowly increasing immunity among generational survivors, but continued to sweep off countless children every 10–30 years until the nineteenth century. Influenza still caused 20 million deaths worldwide in 1918. The bacteria responsible for plague, typhoid fever, typhus, and cholera emerged later, probably in overcrowded settlements, mainly in Asia. Plague swept the Roman Empire in the 540s, sharply reducing populations and flaring up anew for several centuries. After a 600-year break, it reappeared as the "Black Death" of 1347, with echoes into the 1720s. By 1492, most European populations had been genetically selected and were less vulnerable to plague or to typhus, which had provoked an epidemic during the 1470s. Yellow fever, an epidemic disease, and malaria, an endemic one, were both transmitted by mosquitoes and expanded in the Old World tropics through population growth and increasing human mobility. The literature on historical epidemiology in the Old World is hopelessly fragmentary, and cannot be cited here. A partial introduction to the issues can be found in Brothwell and Sandison (1967). General overviews of the Old World antecedents, with limited detail and documentation, include Cartwright (1972), Crosby (1972), and McNeill (1976).
4. José López Piñero (Valencia), a leading historian of medicine, informs me that a more secure identification of the New World epidemics of the sixteenth century would require substantial archival research, not only to document the temporal evolution of a particular outbreak, but also to understand the changing vocabulary used to describe symptoms.
5. Without the demographic collapse, it seems improbable that the Spaniards would have been able to control the populous highland peoples of Middle America and the Andes, thus limiting assimilation and accelerating the decolonization process. The implications of such a scenario, perhaps modeled on Western "intervention" in China (1841–1949), are provocative.
6. *Congregación* was designed to (a) replace Indian population centers with planned, gridiron towns (see Butzer, this volume), a goal that was achieved to some degree, and (b) to eliminate dispersed Indian settlement, by nucleation in such new towns. Success or failure of the latter can be estimated from the prominence or absence of small farm clusters or loose hamlets shown on the 1:50,000 topographic maps that cover the traditional agricultural domain of central and southern Mexico. Swarms of farmsteads or hamlets remain conspicuous in the Otomí areas of Hidalgo state, among the Nahuatl-speaking mountain settlements of northeastern Hidalgo or the adjacent tropical lowlands belonging to San Luís Potosí, and in many parts of Oaxaca. By contrast, the ethnic Nahua heartland of central Mexico generally lacks dispersed settlement, as does most of the former Huastec domain in the Panuco lowlands. It remains to be tested whether high indices of settlement dispersal help identify areas where Indian settlement retained a degree of continuity or whether such landscapes were remodeled after the European intrusion, in the wake of indigenous resistance to *congregación*. A study of Nahuatl (Aztec) toponyms in the area northwest of Puebla suggests that many, if not most, of these place names are "new," i.e., younger than the mid-1500s (Dyckerhoff 1984). For a detailed analysis of the process of *congregación* in Guatemala, see Lovell (1990).

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Addendum: Three Indigenous Maps from New Spain Dated ca. 1580

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Three indigenous maps were selected from the pictorial maps (*pinturas*) that accompany the official geographical reports (*relaciones geográficas*) prepared in Mexico in 1577–85 (see Robertson 1972; also Butzer, this volume). Of the seventy-five extant *pinturas,* thirty-seven are now at the University of Texas, and they illustrate a wide range of European, mixed, and indigenous cartographic techniques. The three chosen here represent a spectrum, suitable to introduce the reader by stages to the several levels of meaning embodied in Mesoamerican cartographies.

The heuristic advantages of the *pinturas* attached to the *relaciones* are several: (a) They were all drawn at about the same time, and their date is known. (b) Each was commissioned for the same purpose, with explicit instructions to draw a town plan and illustrate the "site" and "situation" of such a town (Robertson 1972, 246). (c) The text of the *relación* provides information on the indigenous officials and elders who were the source of much or most of the information collated in response to the various questions posed, and older indigenous maps were sometimes presented in evidence. (d) The information given by a

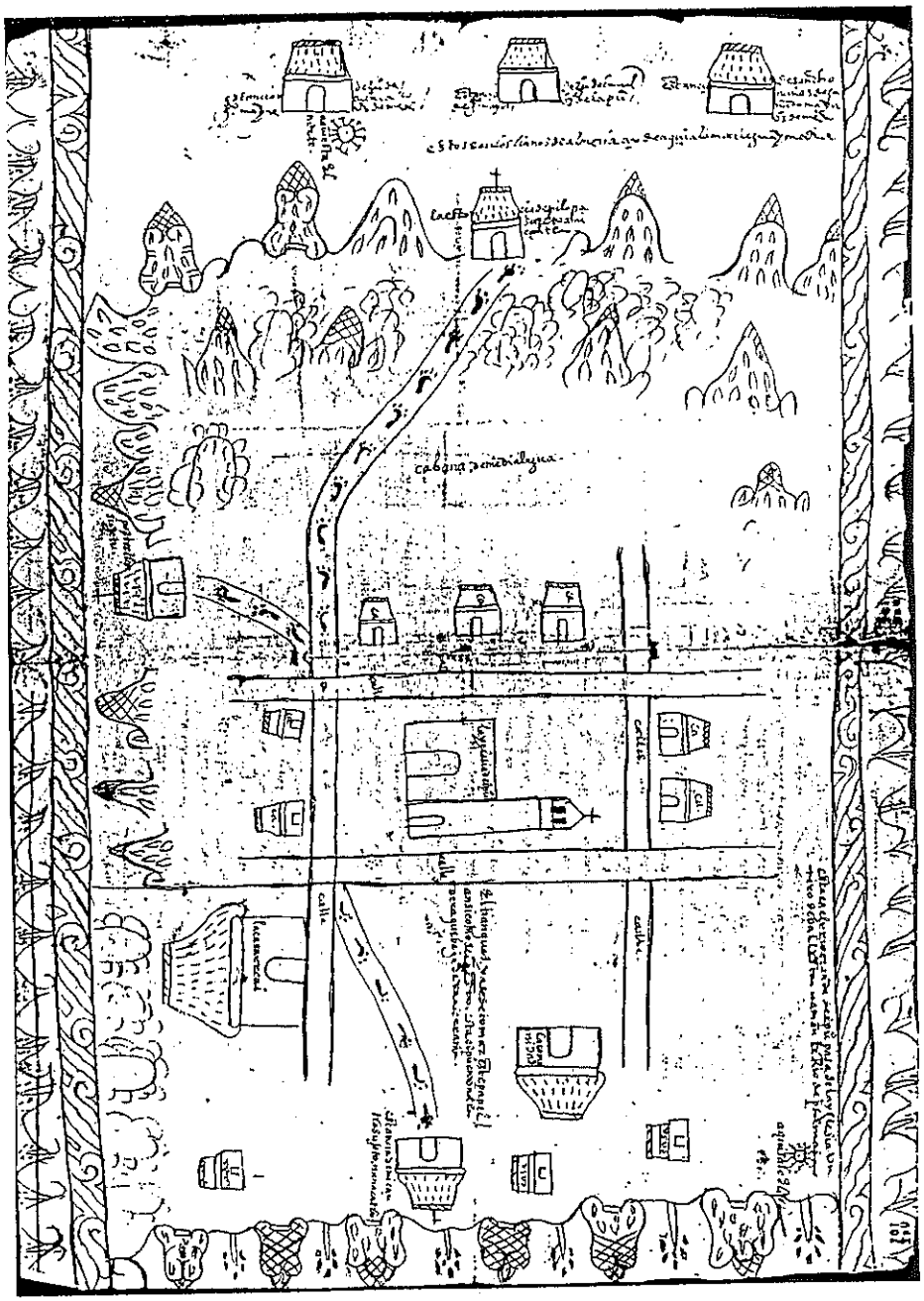

Figure 1. 1579 Map of Misantla, Veracruz. North at top. After Benson Latin-American Collection, University of Texas at Austin, Map JG1-XXIV-13, with permission.

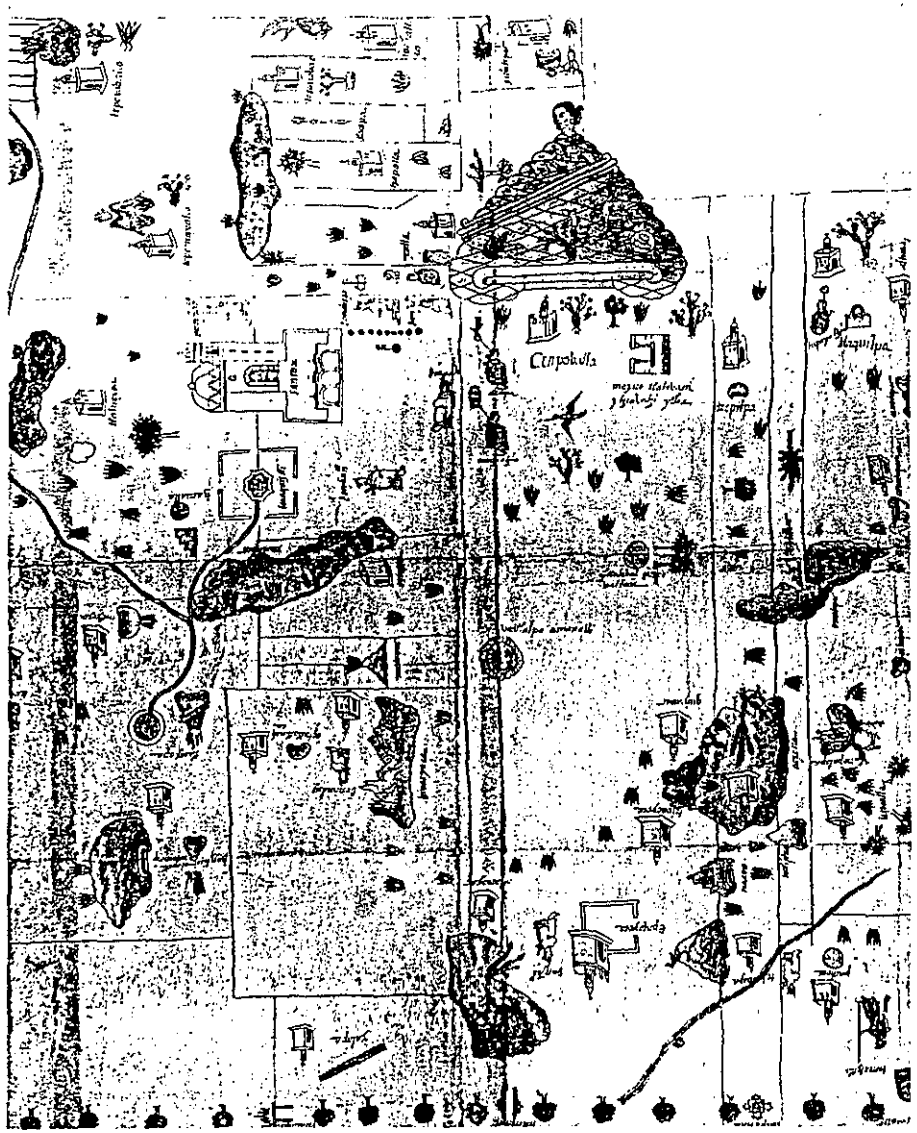

Figure 2. 1580 Map of Zempoala, Hidalgo. South at top. After Benson Latin-American Collection, University of Texas at Austin, Map JG1-XXV-10-4, with permission.

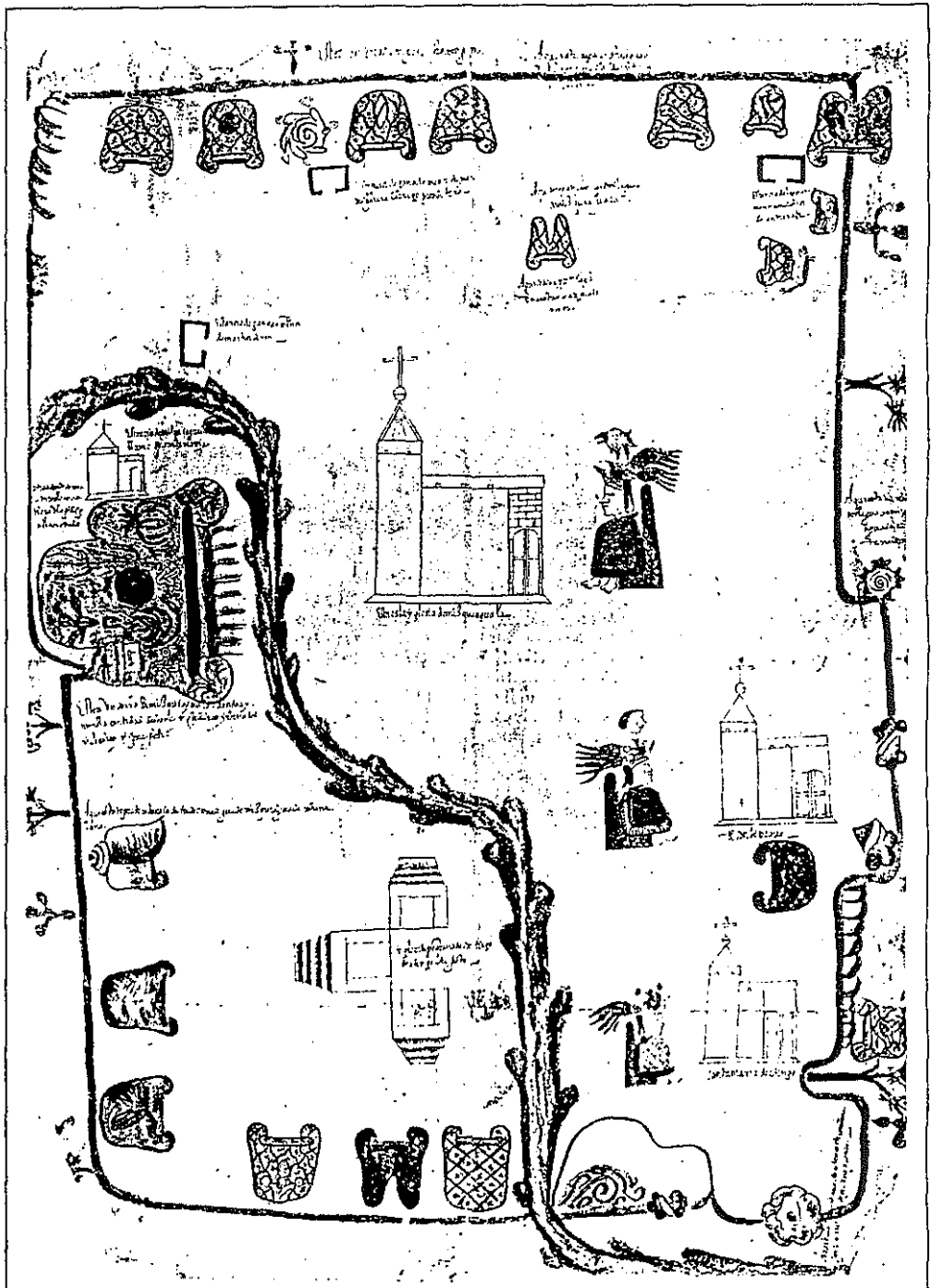

Figure 3. 1579 Map of Atengo and Mixquihuala, Hidalgo. East at top. After Benson Latin-American Collection, University of Texas at Austin, Map JG1-XXIII-12-3, with permission.

relación helps explain the features represented on the corresponding *pintura* (see Acuña 1985a, b). Although drawn in indigenous style, the *pinturas* are not Prehispanic, and they were devised to meet European objectives. But they are ideal as introductions to an unfamiliar cartography, precisely because the context is known, eliminating an excessive number of variables that would otherwise make interpretation unduly difficult.

The three pictorial maps are reproduced and analyzed below. The first appears to be strictly a perceptual map that delineates a visible landscape. The second shows a striking combination of perceptual and conceptual components (see Robertson 1972, 256–57)—an historical, symbolic world, overlain by a contemporaneous cultural landscape. The third is primarily a conceptual map, which seems to express a different idiom. Yet all three are valid and informative cartographic representations of the visible landscape, that have been verified in the field.

Misantla

Misantla is located 112 km north-northwest of Veracruz, in the state of the same name. When the pictorial map (Fig. 1) of this administrative district was drawn, in 1579, the town had an almost exclusively Indian population, speaking the Totonac language. The *relación* was drawn up by the resident Spanish magistrate, with the participation of the parish priest, another Spaniard, and the Indian governor and his officials (see Acuña 1985b, 181–94). The accompanying map is done in black ink on European rag paper. It is inscribed with Spanish glosses, in the same script as the *relación,* but the representational part is replete with indigenous symbols and was drawn by an Indian.

The center of the map is dominated by a schematic, free-hand grid of four streets (*calles*) at right-angles, with the church, the government building *casa real*), and the market (indicated only by the gloss *tianguez*) found in the same relative positions today. The community building ([*casa de*] *communidad*) no longer exists. Footprints mark the roads leading out into the countryside to three dependent villages, symbolized by indigenous thatched roof chapels: Poztectlan (now Poxtitlan), Pilopa, and Nanacatlan, the last two of which are now "lost."

Within its jurisdiction, the town of Misantla is shown adjacent to a series of hills to the west (left side). To the north (top), a broad plain (*çabana*) is indicated, then two rows of hills, and finally three Spanish cattle estates (estancias), on the Gulf coastal plain known as the Llanos de Almeria. Two rivers frame the map to the east and west; the river on the right is identified as the Río de Palmas (Río Colipa?), while that on the left is described in the text as the Río de la Torre. The south side is marked by an irregular line and by a row of trees and hills symbolized by a variant of the *tepetl* or hill glyph. At the northern end, the margin of the map coincides with the Gulf coastline. The frame, in other words, corresponds to the natural features demarcating the jurisdiction.

The *tepetl* hill glyphs along the southern margin are similar to those used in the map of Atengo (Fig. 3), and follow strict indigenous conventions. The trees cannot be identified, although the text of the *relación* mentions two tropical genera (*mamey* and *peruétano*) in addition to *cedro* (bald cypress). Most of the hills in the north approximate European conventions, but two are shown by the indigenous hill glyph. The hatched cones atop the "hills" are problematical, but Misantla is surrounded by steep and conical, basalt hills, now crowned by stands of tropical trees. Comparison of the various hills represented on the map shows that some are "decorated" with upside-down U symbols, that are sometimes used to indicate a cultivated field; the cross-hatching may mean uncultivated. The groups of light, elliptical lines between the hills and west of Misantla also are not decorative but symbolic of some environmental characteristic; these areas would probably have been forested. What appears, then, to be an impressionistic topography is in fact rendered by symbols with specific meaning.

The Misantla map differs from that of Zempoala (Fig. 2) or Atengo (Fig. 3) in that it lacks images of indigenous rulers, or toponyms rendered by indigenous glyphs. It appears to be a perceptual map, with no overt reference to the past.

Zempoala

Zempoala lies 22 km south of the mining center of Pachuca, in Hidalgo state. The *relación* was written in 1580 by a scribe for the Spanish magistrate, in the presence of four Aztec governors and many Indian elders, with the aid of a Spanish interpreter (Acuña 1985a, 67–82). The attached pictorial map is rendered in watercolor on heavy European paper. It is a study in cultural contrasts.

Place names are indicated by indigenous glyphs (the "symbols") while the glosses are in Nahuatl, but in European script. The map is subdivided by red lines, drawn with a straight edge, that, following native convention, probably represent noble properties, while dependent communities are indicated by chapels, drawn in three dimensions. At the same time, historical and contemporary local rulers (*teuctli*) are shown: current and historical Aztec lords (distinguished in the text of the *relación*) are shown with name glosses and glyphs depicting their authority—mantle, seated on a backed straw mat (*icpalli*) and wearing a headdress; earlier, Chichimec rulers are shown bare-headed, standing, and dressed in animal skins; and the Spanish magistrate of Pachuca (in the lower right corner) is depicted by the indigenous symbols for Spanish authority—armchair, robes of office, and staff. The map as a whole is dominated by the large symbolic *tepetl* hill glyph, probably representing the foundation of the Aztec settlement; this is hatched and depicts elements of an unsettled landscape or one under Chichimec domination—plants and animals, including the prickly pear, eagle and serpent (foundation symbols also found in the modern Mexican flag), as well as deer, rabbit, and possible pronghorn. Stone glyphs (*tetl*) also appear as well as the glyph for water (symbolizing the Middle American concept of hills as vessels of water). This great hill, surmounted by a female head rendered in a nonindigenous, perspective view, completely dwarfs the finely drawn Franciscan monastery.

This conceptual aspect of the map, as an historical statement, is completed by the "house" of the ruler of Mexico—depicted by a conventional symbol for *tecpan* palace, a flat-facade structure with a framed doorway and supralintel panel with a disk motif, below and to the right of the foundation symbol for Zempoala; this does not refer to an old palace, but to the site of Moctezuma's defeat by Cortés in 1520.

The visible or perceptual landscape is also shown. The terrain conforms with the plain and several hills described by the text, and the many agaves (*maguey*) and prickly pear (*nopal*, shown with red fruits) are also noted in the text. At least eight other kinds of trees are depicted, one a characteristic clump of yucca palms (right margin, at "Iszocalla"). A tree with small, projecting red fruits is a *capuli* cherry tree; another, with large yellow fruits, is a peach tree; and two trees shown with a dense canopy and hidden red fruits suggest apple trees. Other trees mentioned in the text of the *relación* are quince, walnut, and almond, but these cannot be identified among the remaining arboreal types on the map. Many of the hills shown, in part in three-dimensional form, are conspicuous in the field; some have glosses or place glyphs and may have had symbolic significance as well. The famed aqueduct of Zempoala is shown by four arches in the top left corner. It is linked by a blue line to a blue circle and to a blue octagon within an enclosure marked *tianguiz;* the line marks an irrigation canal fed by a spring, leading to the market square and to the aqueduct. Another blue circle, with a border, is located in the center of the map and the gloss identifies it as the spring "in the plain."

The visible topography and cultural landscape of 1580 is quite comprehensive. It includes natural vegetation, water sources, settlements, fields, and irrigation features, as well as indigenous and Spanish fruit trees. Except that most of the dependent villages have disappeared, the landscape looks much the same today, and the vegetation cover has not changed perceptibly. It appears that this visible landscape was intended to serve as a framework for a higher order of representation, namely the conceptual and historical landscape.

The only conspicuous frame to the Zempoala map is the schematic row of trees along the lower margin (north), which suggest the wooded mountains near Pachuca. However, the outermost "property" lines demarcate a jurisdiction identical to that of modern Zempoala.

Atengo and Mixquihuala

The third pictorial map selected here (Fig.3) includes three Indian towns along the Río Tula in Hidalgo state: Atengo, Tezontepec, and Mixquihuala, located 15–20 km north of Tula. The *relación* of 1579 says little about its indigenous informants (Acuña 1985a, 25–38), who were Otomí speakers. The color map on parchment is an Indian work, although the glosses are entered in Spanish.

The jurisdiction is sharply demarcated by a thick and continuous orange line, along which scattered, unidentifiable trees and schematic prickly pear are shown. The text emphasizes agaves (*maguey*) and mesquites; the former remain common but the latter are now replaced by the South American pepper tree (*pirúl*). The Río Tula cuts across the map prominently, its configuration fairly accurate. The cultural landscape of 1579 is highlighted by the monastery churches of the three towns, as well as a small church (representing a dependent village) and a thatched-roof church complex whose three buildings front a courtyard. These symbols of the Spanish presence stand out from the remainder of the map by being drawn in ink, with the aid of a straight-edge. Three partial enclosures near the top show sheep estancias.

Far more prominent is the conceptual map, presumably representing a symbolic interpretation of the Prehispanic past. It is dominated by Mt. Tunititlan (left center), probably symbolizing settlement foundation, elaborately decorated with glyphs as well as a prickly pear and a branching cactus. The local rulers of the three towns are depicted with their name glyphs and symbols of authority: headdress, mantle, and "throne" (*icpalli*). The *tepetl* hill glyphs that demarcate the margins of the jurisdiction are drawn in bright colors and include glyphs related to toponyms and probably conceptual symbolism. These hills, including one between Atengo and Tezontepec (the two lower towns), approximate the visible topography, but the *relación* mentions temples (*cúes*) on very high hills that were once regularly used for religious offerings (Acuña 1985a, 33).

Although the topography is fairly realistic, the pictorial map of Atengo and Mixquihuala emphasizes a conceptual plan, apparently dominated by sacred points or places. The contemporaneous cultural landscape is shown in a perfunctory fashion, and territorial delimitation was one evident purpose, recalling the map of Misantla.

Towards an Interpretation of the Evidence

The relationships between the *pinturas* of the *relaciones* and traditional, Prehispanic representations are clarified by the 1579 *relación* for Coatepec, an Indian town near Texcoco, east of Mexico City. This detailed report was written by Francisco de Villacastín, "scribe and interpreter" to the royal magistrate (Acuña 1985b, 126–27, 132). His ability in Nahuatl is evident from the complex and sensitive account of indigenous tradition and cosmological symbols that he elicited from the Indian leaders and elders, who were summoned to provide the necessary information. How they presented their ancient charts in evidence can be inferred from the text:

> The explanation [for the name Coatepec] given by the Indian elders and old people . . . and as can be seen by the old *pinturas* they have, which show their ancestors and former elders one on top of the other, so as to remember them . . . And according to the elders and as is apparent from their *pinturas,* there used to be a large white snake . . . above that hill . . . living coiled upon it. And, according to the *pinturas,* that snake disappeared after the founding of the town . . . [The origin of

its founders) is unknown except that the old *pinturas* which the inhabitants of the town have . . . indicate that [the founders] came from distant lands . . . According to these *pinturas*, the town was founded 415 years ago . . . (Acuña 1985b, 132–33).

It appears that the drawings in question combined genealogical histories and symbolic attributions of place with some form of geographical representation. The three maps accompanying the *relación* are primarily perceptual in character, except for one glyph and the symbolic representation of several small (sacred?) hills. The maps that the informants prepared for Villacastín deleted all but the most important conceptual and historical aspects of their landscape, substituting a new iconography of churches and chapels.

The salient importance of the Coatepec report is that it underscores the antiquity of indigenous charts combining spatial, symbolic, and historical information. The maps with the *relación* and those shown in Figures 1, 2, and 3 imply that their traditional counterparts also included a variety of topographical and environmental details, together with a schematic representation of the built environment.

From Columbus to Acosta: Science, Geography, and the New World

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Abstract. What is called the Age of Discovery evokes images of voyages, nautical skills, and maps. Yet the European encounter with the Americas also led to an intellectual confrontation with the natural history and ethnography of a "new" world. Contrary to the prevailing view of intellectual stasis, this confrontation provoked novel methods of empirical description, organization, analysis, and synthesis as Medieval deductivism and Classical ontogenies proved to be inadequate. This essay demonstrates how the agents of that encounter—sailors, soldiers, government officials, and missionaries—made sense of these new lands and peoples; it highlights seven methodological spheres, by examining the work of exemplary individuals who illustrate the diverse backgrounds, abilities, and interests characteristic of the period. These examples include the observational skills of Columbus in 1492, the landscape taxonomy of his son Fernando, the biotic taxonomy of Oviedo, the cultural recording of Sahagún, the regional geography of Cieza, the pervasive role of Velasco in both geographical synthesis and town planning at the government level, and finally, the overarching scientific framework for the natural history and peoples of the New World proposed by Acosta in 1590. The evidence rehabilitates the reputation of Columbus who, like so many others with little or no formal education, had a spontaneous capacity to observe and describe. The origins of Native American stereotypes are identified, but there also were remarkable "insider" studies that, in the case of Sahagún, touched upon the semiotics of culture and landscape. Although Sahagún and Acosta had scholarly training, the confrontation with new environments and unfamiliar peoples probably put observers with rural backgrounds on an equal footing with those steeped in traditional academic curricula. Last but not least, the essay points up the enormity of the primary documentation, compiled by these Spanish contributors during the century after 1492, most of it awaiting geographical reappraisal.

Key Words: Acosta, Columbus, ethnography, geographical planning, gridiron towns, history of science, landforms, López de Velasco, natural history, New World landscapes, Oviedo, *relaciones geográficas*, Renaissance, Sahagún, Spanish geography.

> The world is so vast and beautiful, and contains so many things, each different from the other . . .
>
> —Francisco López de Gómara (1552)

Renaissance Science

THE European encounter with the Americas in 1492 falls within what Western historians call the Age of Discovery. Humanists have long been fascinated with that encounter as a source of myths and images (Green 1968, III, pt. 1; Gerbi 1985; Greenblatt 1991). Historians of science in general and of geography in particular are preoccupied with navigation and cartography (Kimble 1938, chaps. 5, 9–10; Parry 1981; James and Martin 1981, 63–95; Nebenzahl 1990; Harley 1990; Buisseret 1992). The thesis of this essay is that the Spanish encounter with the New World also had a far-ranging impact on environmental and cultural understanding.

The boundless enthusiasm with which the first writers described the landscapes and biota of the New World was integral to the Renais-

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sance, or reawakening of Western civilization. That Renaissance marked an uneasy transition from the Medieval to the modern world, characterized by many cross-currents of thought and expression. One hallmark of the Renaissance was the rediscovery of Classical writings during the fourteenth and fifteenth centuries and their translation from Greek into Latin, as a new source of information, ideas, and esthetic prototypes. But the resulting humanistic resurgence did not immediately lead to more critical analysis, let alone philosophical reassessment. The deference once given to the Bible or Christian theological authority shifted to that of leading Classical scholars, but empirical contradictions to "new" authorities such as Aristotle were only offered with hesitation. At its worst, the rediscovery of Antiquity led to an unproductive antiquarianism that took precedence over new observations and stifled intellectual progress.

Medieval science had already included a component of empirical, practical observation, but was dominated by scholastic discussions or the excerpting of older texts, seldom introducing materials derived from personal observation. The three realms of natural history, consisting of animals, plants, and minerals, had been studied in a compartmentalized fashion, without a grasp of fundamental interconnections, except as an expression of a divine plan. In many ways it was a period of introverted reflection on the self-sufficient truths provided by theology, and the individual was part of an ahistorical cycle of life and death, of suffering in the present and anticipated reward in the hereafter.

The rediscovery of Antiquity provided a new sense of history, identifying new role models of scholars—not only soldiers or kings—who had made their mark in a secular world of the living. Renaissance scholarship included individuals who were motivated and willing to embark on a new search, with a fresh curiosity. Only a minority of these had both the talent and boldness to emphasize the empirical and the inductive, to reexamine deductive theories critically, and to draw conclusions from direct observation or experiment. Although time-honored religious beliefs set constraints to discussion, the Renaissance was the beginning of a spirit of free enquiry, with renewed interest in verification, accuracy, and systematic understanding.

It can be debated whether Renaissance geography was the revitalization of a Classical tradition or the spontaneous product of a new intellectual climate. Two personalities of the later Middle Ages illustrate the problem. In 1410, the French Cardinal d'Ailly (1948) wrote a world description based almost exclusively on Classical sources; it begins with a series of interesting figures for the astronomical subdivision of the globe, but his regional chapters are a mix of old fables and obsolete toponyms, for which endless fictional or mythological explanations are offered. Quite unaffected by such ballast from Antiquity, the Venetian merchant-traveler Marco Polo (1958) left a remarkable account of his travels in Asia (1271–95) that includes vivid descriptions of landscapes and cultural patterns.[1] Pierre D'Ailly and Marco Polo represent two extremes among precursors of the Renaissance, but the pattern remained.[2] My point is not that intellectual roots are unimportant, but that the prevalent Renaissance paradigm overemphasizes the significance of Classical antiquity, to the degree that it obscures the acuity and originality of Renaissance observational skills and comprehension.

The discoverers, explorers, and observational scientists of the Renaissance were at best familiar with a very limited selection of Classical works, that were frequently cited only for effect, sometimes in the final stages of revision (see Cieza de León 1984, xxxiii, n. 12). Strabo, an available and obvious source, was barely used, and Columbus's consultation appears to have been very selective and from a derivative digest in his possession (see Broc 1980, 18, 200; Harley 1990, 37, 42). More influential was Pliny's *Natural History* (1940–56), the *de facto* encyclopedia of the Renaissance (Broc 1980, 15). For cartography and navigation, the tables of geographical coordinates by Ptolemy (1932), and the maps attributed to him, provided a direct or indirect datum for most large-scale charts from the mid-1300s to the early 1500s.[3]

Geography during this period was a part of what was called *cosmography* (Waldseemüller 1966), which included astronomy and nautical science, particularly as applied to cartography. But between Waldseemüller writing in 1507 and Münster (1968) in 1550, cosmography also began to include what today would be called physical and cultural geography.

The present paper is directed to the origins, rapid growth, and crystallization of physical and cultural geography as a consequence of the Columbian Encounter. My argument is that the European discovery of the New World required new observational and descriptive skills, as well as explicit discussion of environmental and cultural phenomena that could no longer be taken for granted: things were either different or similar on the other side of the ocean. Geomorphology soon received a degree of attention that it had never been accorded in Antiquity, and biogeography was reinvigorated. Ethnographic observations gradually added greater depth to the appreciation of cultural phenomena, and these several geographical strands were integrated into what could be called regional geography. All of this was abetted by the Spanish government's official role in normative urban planning.

The study focuses on Spain and the New World, rather than on research developments in other parts of Europe. Renaissance geography in Italy, Germany, and France has received some attention (e.g., Baker 1963; Beck 1973; Broc 1980), but the originality and quality of Spanish geography during the period has been underappreciated, even by Spanish authors (see Becker 1917; Martínez 1945; Arija 1972, versus Menéndez Pidal 1944), The emphasis is necessarily selective, and several key authors have been chosen for closer examination. This focus on individuals is not an attempt to create new icons; it is essential to elucidate the interests, abilities, and limitations of the period. The differences among the individuals selected also reveal the degree to which the evolution of sixteenth-century Spanish geography was multilinear, not unilinear. Geography itself was the unifying theme, rather than a by-product of this scientific evolution.

Observation: Christopher Columbus

The discovery of the New World initiated an unprecedented interest in geography and natural history. Somehow, earlier maritime discoveries by Europeans had failed to generate evocative reports of new lands and peoples. Even the exploration of West Africa instigated by Portugal's Prince Henry "the Navigator" (see Fernández Armesto 1987, 185–200) led to such dreary works as the *Crónica da Guiné* (Beazley and Prestage 1896–98), a leaden saga of seafaring and slave hunting activities from 1434–48, punctuated by incidental comments on indigenous customs; only its commercial prospects stirred interest in Portugal. To the credit of Columbus (Cristóbal Colón), his voyage of 1492 inspired much more than additional coastlines on the portolan charts. Even though he thought he was in East Asia, Columbus recognized the novelty of the landscapes, flora, and people on the other side of the ocean. However observant were other captains or ship's pilots of the period, they lacked his ability to describe the novel in ways that would excite academic and lay curiosity in Europe.[4]

Columbus's credentials as a scientific figure have long seemed unimpressive to his critics. Born 1451 in Genoa under modest circumstances (his father was a weaver), he went to sea as early as age fourteen. During the mid-1470s he sailed the Mediterranean, perhaps on a galley in the service of France; about 1476–84 he was based in Lisbon and the Madeiras, sailing to West Africa, probably with slavers.[5] All we have to attest to his learning are the surviving letters in his handwriting (see facsimiles reproduced in Thacher 1967, III, 84–490; with discussion in Varela 1982, li–lvii); his script was bold and sophisticated, varying in execution according to the formality of the occasion, and comparable to that of educated scribes and notaries of the time.[6] Any doubts about Columbus's ability as a cartographer and geometer are laid to rest by one of his diagrams showing a three-dimensional projection, converted from a sphere to a plane (see Harley 1990, 42, Fig. 36), which is found among his annotated copies of Ptolemy, Marco Polo, and D'Ailly (see Taviani 1985, 446–55; Harley 1990, 34–43). His report on the Third Voyage (1498–1500) also makes numerous references to Classical authors then only available in Latin (see Las Casas 1965, I, 482–96).

Columbus was essentially self-taught, as he admitted in a letter of 1501 to the monarchs of Spain:

> In navigation [God] endowed me generously, of astronomy he gave me what was needed, and the same of geometry and arithmetic, with the talent of mind and hand to draw this globe and upon it the cities, rivers and mountains, islands and ports, all in their proper place (Varela 1982, 251; Las Casas 1965, I, 31) (all translations by author).

Accordingly, he hewed to a pragmatic, cartographic tradition of the period, one concerned

with the making of geographically realistic maps intended for the practical world of navigation (see Campbell 1987).[7]

Columbus's insight and intellectual impact deserve more sympathy than has been accorded him by Carl Sauer (1966, chap. 2) and Kirkpatrick Sale (1990, chap. 5), Whatever his motives and however annoying his use of hyperbole, Columbus attempted to inform about the new lands he saw. His descriptions of the people and their lifeways, incidental to his narratives about encounters with the indigenous inhabitants, contain much useful ethnographic information (see Sauer 1966, chap. 3) and novel insights on the physical environments of the New World.

Columbus was untutored in the sciences, and his lack of botanical knowledge frustrated him: "I believe there are many plants and trees (in the Bahamas) worth much in Spain as dyes or medicinals but I do not recognize them, which I greatly regret" (see Spanish transcription of the First Voyage diary, by Dunn and Kelley [1988, folio 15 recto, lines 25–28]). But his lack of formal training did not prevent his from venturing comparisons of the New World palms with those of West Africa or the Mediterranean: "They have a great number of palms of a different kind than those of Guinea or our own, of medium height, with smooth trunks and very large fronds" (Dunn and Kelley 1988, folio 18 recto, 13–16), nor from recognizing six to eight different classes of palms (1493 letter in Varela 1982, 141). He also noted the distinctiveness of the trees, fruits, and plants of Cuba and of Hispaniola (see Varela 1983, 141). And he commented on the unusual association of pines and palms growing in one river valley (*vega*), whose surface alternated between level hills (*montes llanos*) and low plains (*baxos*) (Dunn and Kelley 1988, folio 29 recto, 26–28; see also Humboldt 1845–47, II, 56).

He likewise demonstrated an intuitive grasp of geomorphology. He found it remarkable that the steep slopes of tall mountains were densely vegetated and not rocky (Nov. 14 and 26, 1492), and that broad rivers debouching into the sea lacked sand or gravel bars (Nov. 27), both phenomena that we would now attribute to deep tropical weathering. On another occasion he defined a *cala* (a local term for drowned valleys of the Balearic Islands and Sardinia; see Butzer 1962) as "a narrow inlet where sea water enters the land" (Dunn and Kelley 1988, folio 24 vuelto 45–25 recto 1). Two sources derived from the lost diary of the Second Voyage (1493–96) offer the first description of a mangrove coast on the southern shores of Cuba; it was replete with *ciénegas* and swamps for two leagues inland, with almost impenetrable thickets of plants and trees (F. Colón 1984, 189). "According to Columbus this region is completely submerged and covered with water and its coasts are marshy and full of trees" (Martyr 1964, 139).

Finally, there are Columbus's instructive, if debatable, climatological ideas. He explained the great heat of the Bahamas by their low elevation and the prevailing easterly winds (Oct. 29). On the daily tropical showers, he noted that late in every day a cloud bank formed on the western part of Jamaica, resulting in rain for an hour or less; this he attributed to the great forests of the island, with reference to his previous experience on the Canaries, Madeiras, and Azores (July 1494, F. Colón 1984, 193–94). He appended a remarkable ecological note. On those Atlantic islands, "they have cut so much forest and trees that hindered them [from expanding cultivation] that such clouds and rains no longer form as they once used to." The observation is telling because it shows that Columbus was aware of and concerned about environmental degradation on the recently-settled Madeira islands.

Much in the manner of more recent field observers, Columbus repeatedly drew analogies between the Old World and the New: a similar tree but with larger leaves than a counterpart on an Aegean Island (Nov. 12); live oaks and arbutus (*madroños*) as in Castile (Dec. 7), healthy river waters as compared with pestilential ones of Guinea (Nov. 27), finely cultivated lands recalling the plains of Córdoba (Dec. 14), weather like April in Castile (Dec. 13), or mountains like those of Sicily (Oct. 28).

Some of the comparisons were motivated by natural curiosity, others by economics, and others still by sheer aesthetics. They give point to his verbal paintings of an exuberant tropical vegetation, nourished by an eternally spring-like climate, and inhabited by peaceful and naked innocents. Columbus thus created an image of an Edenic land that was at once primitive yet familiar, and in so doing his rhetorical analogies delineated a powerful theme in European humanistic thought. He demonstrated an ability to observe, compare, and describe, and there are suggestions of partial comprehension.[8] It was his articulation and dissemination of his ideas, his way of putting words together, and his rhetoric that provoked scientific interest in a New World that he himself refused to believe was new. Columbus, though at times a medieval visionary and mystic and given to Biblical metaphors and prophecies, demonstrated tenacity as an explorer and a longing for greatness and discovery that mark him as typically modern and, in thought, action, and results, unlike other of the great personages of the Middle Ages (Gerbi 1985, 13).

Landscape Taxonomy: Fernando Colón

Fernando, born out of wedlock in Córdoba in 1488, was the son of Columbus who had intellectual ambitions, and who had a profound, if little-known, impact on Spanish geography for a century. At the age of five he saw his father off at the docks of Sevilla, and aboard the Fourth Voyage he served as chronicler in 1502–04 (F. Colón 1984, 162, 288). In between, he was a page at the royal court and privately tutored, in part by a key historian of the voyages, the Italian humanist Peter Martyr (c. 1458–1526). At least some of the natural history observations on the Central American coasts were probably made by Fernando, including the first description of pineapples (F. Colón 1984, 317). He was on Hispaniola in 1509, after which he was sent to Castile to study, "because he was inclined to the sciences and had many books" (Las Casas 1965, II, 370). Indeed, he spent much of 1512–16 studying at the Spanish Franciscan monastery in Rome, under the humanist Pedro de Salamanca (De la Rosa 1906; Ponsot and Drain 1966).

Fernando was precocious by any standards. He was captain-general of the fleet sailing back from Hispaniola in 1509; a year later he began the complex lawsuits against the crown, in regard to the titles and New World revenues due to the heirs of Columbus, who had died wealthy but frustrated in 1506; he proposed a circumnavigation of the globe a decade before Magellan; and in 1517 he began what was probably the most ambitious national project yet conceived for Spain, a countrywide geographical survey.

Although this project was designed for and executed in Spain, it later had great impact on physical observation in the Americas. As reconstructed from the surviving materials (F. Colón 1908–15), its purpose was to:

(a) Inventory all settlements, their dependencies or abandoned sites, any castles or monasteries, the distance to the municipal boundaries in different quadrants, and the jurisdiction (royal, aristocratic, monastic) to which they belonged.
(b) Determine the number of resident households (*vecinos*), presumably as based on local tax rolls and provided by the town councils.
(c) Record the quality of land in each territory (*casco*); this included location with respect to rivers and mountains, types of land use, and over 15 more-or-less standardized categories of topography and natural or spontaneous vegetations (Table 1). These characteristics were recorded along all roads in all directions, specifying rough distances to each change of land use or landscape, hence the designation of the project as an *Itinerario* (Itinerary).

This effort was funded by the crown, with salaries paid to a team of assistants who traveled around the country, following explicit but lost guidelines, presumably issued by Fernando.

Close to 10,000 settlements (perhaps 80 percent of those in Spain at the time) were inventoried before the project was terminated by royal decree in 1523, possibly in retaliation for a renewed round of litigation against the government initiated by Fernando in that year (De la Rosa 1906; Ponsot and Drain 1966; Arranz, in F. Colón 1984, 17). Incomplete and lacking official sanction, the results were never collated into the planned, alphabetical gazetteer (*Vocabulario*), from which a land use and physical map of Spain apparently was to be constructed. The notebooks of raw data were left to gather dust in the remarkable private library of 15,300 volumes and manuscripts that Fernando left behind at his death in 1539. When that library was rescued, at the end of the nineteenth century, only 4,400 of the town inventories and 5,000 of Fernando's books had survived.

Nothing like the Itinerary had ever been conceived before. However abortive or premature it may have been, this sophisticated geograph-

ical survey represents the first attempt to develop and implement a comprehensive field approach to the cultural and physical landscape.

Without questioning the pivotal role of Fernando in conceptualizing his geographical survey, the concepts and terminology used (Table 1) do not seem to have been his own. In his biography of Columbus, Fernando Colón (1984) employed a fairly sophisticated geomorphologic vocabulary, including terms such as *montaña, collado* (hill), *peña* (hilltop, cliff), *llanura* (plain), *planicie* (plane), *ciénega* (marsh), *fango* (swamp), *arroyo, espalda* (high slope, mountain crest), *peñascosa* (cliffed), *pedregosa* (rocky) and *quebrada* (broken topography), none of which are used in the Itinerary (Table 1). Only *llano, cerro,* and *aspera* are common to both, while *sierra, loma, cuesta, derribadero,* and *doblado* are exclusively found in the Itinerary. Most important, *monte* in the Itinerary is exclusively used in the traditional Spanish sense of scrub or woodland vegetation, whereas for Fernando it was a hill or low mountain, equivalent to *cerro*. This suggests that the vocabulary and possibly also the systematic approach should be credited to unidentified Spanish collaborators. Certainly the vegetation categories are those of Spaniards with rural backgrounds and, not surprisingly, none of these terms are used by Colón (1984) in his Caribbean accounts.

The only potential consultants of Fernando that can be identified are Pedro de Salamanca, whom he met in Madrid in June 1517, or Antonio de Nebrija, whom he consulted at the University of Alcalá at about the same time, six weeks before he began the Itinerary (De la Rosa 1906).[9] Nebrija (died 1522), is better known for first attempting to standardize Castilian Spanish as a written language (Green 1968, III, 11–18), but he also had geographical interests: he wrote on atmospheric pressure, worked on navigational instrumentation, and assembled an ambitious chart for the longitudes of Spanish cities, based on true time differences between them (Becker 1917, 96, 122; López Piñero 1979, 213–14). He may have stimulated or encouraged Fernando to attempt a national project, but he had no evident background in geomorphology or botany. One must assume that pragmatic Spanish rural experience was critical in developing the biophysical criteria central to Fernando's conception.

Table 1. Land Use and Landscape Classes Utilized for the Geographical Survey of Spain (1517) by Fernando Colón[a]

- Arable land
  - Wheat cultivation (*tierra de pan* or *labores, labranza*)
  - Olive groves (*olivares*)
  - Vineyards (*viñas*)
  - Irrigated tracts (*huertas*)
  - Minor categories, including almond, fig, citrus, apple, etc. orchards or groves
- Grazing land and degraded woodland (*monte bajo*)
  - Designated pastures (*dehesa*)
  - Rough grass and shrub (*espartinas, monte de atocha*)
  - Sclerophyllous scrub (*lentiscales, romerales, matorrales*)
  - Thorny scrub (*montes jarales*)
  - Scrub oak (*chaparrales, marañales, carrascojas*)
  - Palmetto scrub, possibly abandoned farm land (*palmares*)
  - Rocky surfaces with shrubs (*berrocales*)
- Primary or secondary forest (*monte alto*)
  - Deciduous oak (*robledal*)
  - Live oak (*encinal, carrascal*)
  - Cork oak (*alcornocal*)
  - Pine (*pinal, pinar*)
- Topography and landforms
  - Floodplain (*llano de ribera del rio, vega*)
  - Level plain (*llano, tierra llana, campiña*)
  - Irregular plain (*tierra doblada*)
  - Rough, dissected topography (*tierra aspera* or *derribadera*)
  - Flat-topped hill (*loma*)
  - Hill or peak (*cerro*)
  - Mountain and valley country (*sierras y valles*)
  - Escarpment (*cuesta*)

[a]Derived from F. Colón (1908–15); see also De la Rosa (1906); Ponsot and Drain (1966); Butzer (1988).

Fernando's project, probably conceived within a broader Spanish interest in the basic geography of the New World colonies (see Jiménez 1965, I, 11–37, 267–77), was closely replicated in New Spain in 1547–51 when emissaries were sent out from Mexico City to assemble detailed information on each Indian settlement for taxation purposes. Some 940 such reports, consisting of a paragraph or two of compact data, are preserved and known as the *Suma de Visitas* (Paso y Troncoso 1905a; also Borah and Cook 1960). No dated decree or official explanation is known.

Most of the *Suma* accounts gave the number of taxable households, the dimensions of the lands belonging to the town, and the nature of Indian agriculture and handicrafts (as liable for taxes in kind), together with a description of the topographic setting—*llano, espalda, sierra,* and *fragosa* (rugged) are common terms. Vegetation was characterized by such words as *sabana* (open parkland) or *monte* (woodland); when trees were suitable for timber or firewood, the accounts may specify oak, pine, or key tropical forms. Other features noted include potential pastures for livestock, the presence of wet lowlands (*ciénegas*), and springs or rivers suitable for irrigation. The similarities with Fernando's project are too close to be coincidental, demonstrating that the idea of the geographical survey was by no means forgotten in the deliberations of government at the highest level. Surprising, too, is the implication that lower-placed officials had the competence to make reliable observations of great value for the landscape reconstruction of sixteenth-century Mexico (see Butzer and Butzer forthcoming).

Biotic Taxonomy: Oviedo

Scientific research only began in the New World thirty years after Columbus's fateful voyage, and it was initiated by an unlikely source. Gonzalo Fernández de Oviedo (1478–1557) was a royal official with humanistic credentials who once translated a novel of chivalrous love into Spanish. Raised at the Spanish court, he spent three years as a soldier in Italy, where he became an aficionado of the arts before settling in as a retainer and notary. But at age thirty-five, he was sent to Panama as royal inspector for the gold foundries, and from 1513–47, he spent twenty years in the New World, working in Central America, Hispaniola, and Colombia (Pérez, in Fernández de Oviedo 1959, I, xvi–ccxxxvi). From 1522 onward he devoted a dozen years preoccupied with natural history,[10] for which he lacked any formal training. While in Madrid in 1525, without his records in hand, he wrote a "summary" volume on the natural history of the Indies (Fernández de Oviedo 1950), and in 1535 this was republished in expanded form as the cornerstone of his massive study (410 of 1,900 printed pages, Fernández de Oviedo 1959). Oviedo completed the whole work at age 71. But he clashed repeatedly with Bishop Las Casas over the character of the New World Indians, whom he had refused to idealize, and Las Casas intervened to effectively stop publication of the remaining volumes (see Hanke, in Las Casas 1965, I, xxii–xxiii), which were not printed until the 1850s.

The bulk of Oviedo's work is devoted to the history of Spanish exploration and conquest, but even his derivative accounts single out important geographic and biotic data, such as the comparison of the cold-temperate biota of Patagonia and Newfoundland (Alvarez 1957). For areas Oviedo knew first hand, his accounts are substantive as well as evocative; they teem with nostalgic, comparative images of townscapes and landscapes in Spain or Italy (Gerbi 1985, 188–94). In an era when academics wrote in restrained Latin, Oviedo deliberately presented his materials in Spanish, salting his text with vignettes of Spanish abuse of the Indians, quips about greedy clerics or armchair historians, and candid personal anecdotes. His enthusiasm for the natural world is illustrated by an incident from his travels between Panama and Nicaragua (August 1527). Spotting what he thought were live oaks, in the mountains above the Gulf of Nicoya, he noted that the trees had no acorns. So he stopped his party and had his companions search the ground around the trees until they found a dozen acorns:

> And I ate them, though they were somewhat dry; and they were no more nor less than in Spain—live oaks in terms of the tree and the leaf, as well as the fruit (Fernández de Oviedo 1959, I, 298).

It is probably fair to say that Oviedo possessed modest abilities for synthetic interpretation, and that his primary contribution in natural history was analytical and systematic. Several broad themes preoccupied him:

(a) Domesticated indigenous plants and their utilization by the Indians (book 7);
(b) Wild food or fiber plants, manipulated and exploited by the Indians (book 8);
(c) Taxonomic comparison of neotropical trees and plants with those of the Mediterranean realm, according to physiognomy, leaf arrangements, leaf morphology, and fruits (books 9 and 11);
(d) Recognition of those genera or families with European counterparts, e.g., cherries, grapes, nut trees, pines, oaks, palms;
(e) Inventories of the neotropical fauna, organ-

ized under the categories of quadrupeds (book 12), fishes (book 13), birds (book 14), and insects (book 15), with the recognition that most, but not all, of these diverse animals belonged to families represented in the Old World.

Oviedo was the first to confront the dazzling profusion of unfamiliar plants and animals that made New World biogeography so daunting a subject. Excited but unperturbed, he imposed order through a taxonomy which organized life forms into morphological classes and delineated commonalities and differences with Old World forms. For unfamiliar genera or families, he applied indigenous names that, at the time, were rapidly acquiring an almost universal currency in the tropical colonies of Spain (J. D. Sauer 1976)—the "folk taxonomy" that was generally practiced before the binomial Linnaean classification. His natural history was published promptly, translated into several European languages, and had a profound scientific impact.

Oviedo modeled his taxonomy on Pliny (1940–56), with whom he was familiar, rather than on Theophrastus's more sophisticated conception of plant morphology and ecology, which he did not know. But unlike Pliny, Oviedo's descriptions and organization were based on years of empirical observation, guided by two firm principles: accuracy and inductive approach.[11] By virtue of his lack of formal training, Oviedo broke the mold of Medieval herbalists, who organized their plants alphabetically, not comparatively (Alvarez 1957).[12] In consequence, he offered a bold, biological macro-framework for the New World as well as the first systematic study of natural history since the time of Pliny (first century A.D.).

Although Oviedo seems not to have understood the principles of ecology, his work is filled with suggestions of ecological association that elevate it from taxonomy to biogeography. His is the only document we have that describes the circum-Caribbean region in a relatively unmodified biotic state (Alvarez 1957).

Equally important, Oviedo offered a detailed and focused account of economic botany that remains unique, and that retains its importance for the cultural geography of peoples in the region who have become extinct. In reading these sections, one repeatedly has the impression that Oviedo relied heavily on Native American informants, although he did not admit it. Oviedo's general contributions to understanding the aboriginal inhabitants and their customs also have value. He had no illusions about human nature, and was impartial in his criticisms of Spaniards and Indians and their foibles (see also Gerbi 1985, chap. 19). He heaped sarcastic abuse on Pedrarias, De Soto, and certain other conquistadors noted for their brutality (see also Salas 1954), and he blamed the Indian demographic collapse on Hispaniola squarely on the Spaniards: forced labor and other gross abuses, the resulting suicides, and on smallpox (Fernández de Oviedo 1959, I, 67). His comparative analysis of Spanish exploration or conquest of different parts of the Americas not only convinced him of the common nature of humanity in both world hemispheres, but he was the first to recognize that indigenous peoples of southeastern North America, the Caribbean, and South America had varying forms and levels of human culture (i.e., cultural complexity, a concept later explicated by Acosta [1962, 6.19]). Ballesteros (1957) further detects an implicit recognition of an historical progression of culture.

Like Columbus, Oviedo came to the New World as an amateur and was promptly filled with wonder by what he saw. But unlike Columbus, Oviedo became a dedicated scholar who produced the first great scientific work on the New World. No less an authority than Humboldt (1845–47, II, 298) believed that the foundations of modern physical geography were laid in the studies of Oviedo and Acosta (see below).

Cultural Landscapes: Sahagún

The biggest challenge for the first European observers in the New World was the encounter with new peoples possessed of unfamiliar and puzzling languages, lifeways, beliefs, and values. The problem, then, has been to grasp the indigenous vision of an indigenous world, to move from description to understanding. That vision was elusive because Native American reading of the landscape was set in a different cosmological perspective (see Licate 1980), one which cast the supernatural, the individual, and the community in unaccustomed interrelationships, and lent different meaning to concepts

or material phenomena such as property, labor, dwelling, food, or technology.

In the unhappy tradition of European ethnocentrism, while some enlightened individuals sought to understand, many others recklessly destroyed the cultural diversity that they encountered in the "New" World. Not surprisingly, perhaps, some of the most explicit acknowledgments of Native American creative capacity and achievement come from some of the men who knew them best—the conquistadors. Hernán Cortés, in his letter of 1520 to the emperor, expressed wonder at the splendors of Tenochtitlan (later, Mexico City), its markets, and the great temple in a classic description, expanded in 1552 by his biographer, López de Gómara (1966, II 147–58; see the prose of Simpson 1964, 156–67). Indeed, most of the ethnographic materials synthesized by Fernández de Oviedo (1959) came from the chronicles of minor conquistadors or their more articulate rank-and-file. Among the latter is Cieza de León (1985), who assembled the first history of the Inca from oral testimony given by Indian informants.

The most successful students of cultural phenomena are found among the ranks of the missionaries. The first of these came to the Americas with Columbus on the Second Voyage. Although working with little christianizing success on Hispaniola 1493–96, the obscure Jeronymite friar Ramon Pané (Panet) evidently listened with great care. He was able to recount the origin myth, beliefs in the hereafter, and ritual medical practices, as well as observations on ethnic and linguistic distributions of the Taíno people (as in F. Colón 1984, 205–29; see Wilson 1990 on their culture). Even by modern anthropological standards, this account is remarkably objective, and qualifies as a first effort to record the self-perspective of another people. Pané's account is complemented by the descriptive ethnography of the Sevillano physician for the expedition, Diego Alvarez Chanca (Jane 1988, I, 20–73; Gerbi 1985, 23–26). Although Las Casas (1967, II, 178) maliciously described Pané as a Catalan who spoke Castilian poorly and was a bit simpleminded, Las Casas himself fares poorly by comparison.

Las Casas (1967) assembled a massive corpus of information during the 1540s–50s on the rituals and customs of various New World peoples in order "to demonstrate the rational capacity of the Indians." The seemingly strange behaviors can be explained, he argued, by different beliefs and world views, and in this relativist context, the New World peoples did not merit the pejorative connotation of "barbaric." But his ethnographic materials are so highly selected and sanitized that they retain little value.[13] His dogmatic conclusions that human sacrifice and cannibalism once were universal traits and that this demonstrated "a higher concept of God" among "the most religious peoples" (Las Casas 1967, II, chaps. 157, 185) are particularly disturbing.

More solid contributions to understanding New World cultures were advanced by the early Franciscans in Mexico. Diego de Landa controlled missionary activities in the Yucatan 1549–79, and although he was responsible for burning countless Mayan documents (see Lovell 1991), he also assembled an invaluable account of ancient Maya ethnography, history, and religion. Based on his own experiences as well as oral and written information, this account included "the first accurate knowledge of the hieroglyphic writing" (Tozzer, in Landa 1941, vii). Toribio de Benavente Motolinía (1969, 1971), one of the "first twelve" missionaries to arrive in Mexico in 1524, also authored works which include a wealth of ethnographic description on the pre-Contact Aztecs and some of their archaeological sites. Yet unlike Pané, who slips at times into an "insider" presentation, Motolinía's mode remains that of an "outsider."

The main Dominican contribution, completed in 1581 by Diego Durán (1967), reconstructed Aztec historical annals and their ritual calendar, based on indigenous informants and manuscript sources. His writings are interlinked with those of his Jesuit relative, Juan de Tovar. A specialist in three indigenous languages, Tovar was commissioned in 1576 by the Viceroy of New Spain to write the history of the indigenous people he was to govern, "with the assistance of the native historians and their books" (Warren 1973, 80). Although this work was lost, it was used extensively in another Jesuit study (Acosta 1962) of the indigenous civilizations of the New World. These investigations, encouraged by the government, signal a period of genuine and sensitive scholarly activity devoted to Aztec social history, one which presupposes the existence of indigenous documentation which, like many of the missionary

writings, has been destroyed or "lost" in private collections.

The finest cultural research of the sixteenth century, the great Florentine Codex, was accomplished by the Franciscan friar Bernadino de Sahagún (1499–1590). Born in a small town of León, Sahagún came in 1529 to Mexico, where he occupied his next forty years with Aztec linguistic and cultural studies, materials that have attracted the attention of a century of international scholarship. Completed in final form in 1579, the thirteen-volume work (Sahagún 1950–69) constitutes an encyclopedia of Aztec culture, recorded in their Nahuatl language with abbreviated Spanish translations. Ranging across cosmology, philosophy, society, natural history, economic botany, and the artifactual realm, the materials stem from decades of in-depth interviewing of indigenous informants in several towns, whose responses to a structured questionnaire were transcribed in Nahuatl and in the cultural style of the informants. Of particular interest to geography are parts 10–12, dealing primarily with crafts and trades, markets and economy, architecture and construction methods, medicinal plants, and the Aztec perception and classification of the environment. These sections contain almost two-thirds of the 1846 indigenous illustrations (see Quiñones 1988) found in the work, but which so far have only been published as simplified sketches (Glass and Robertson 1975, 190–92).

An example best illustrates the complexity of cultural information encoded in what to European perception is merely a material object. In explaining the term *tecpancalli,* a pre-Contact palace, Aztec respondents unraveled multiple levels of meaning as they connected function with physical description:

> It means the house of the ruler, or the government house, where the ruler is, where he lives, or where the rulers of the townsmen, the householders, assemble. It is a good place, a fine place, a palace; a place of honor, a place of dignity . . . . It is a fearful place, a place of fear, of glory . . . . There is bragging, there is boasting; there are haughtiness, presumption, pride, arrogance. There is self-praise, there is a state of gaudiness . . . . It is a center of knowledge, of wisdom . . . . It is something embellished, a product of care, made with caution, a product of caution, a deliberated thing made with deliberation; well made, the product of carved stone, of sculptured stone, plastered . . . , It is a red house, an obsidian serpent house . . . , It has a deep footing, a deep foundation . . . . It has an entrance, vaulted, with cross beams, with a covering . . . (Sahagún 1969, XII, 270–71).

Klor (1988) regards Sahagún as "the father of modern ethnography," and he offers an insightful discussion of Sahagún's methodology and the problems of relating indigenous conceptions to European categories. Entering Aztec culture as a participant observer, Sahagún saw the native cultures as equal and, in some ways, superior to imported European cultures. He grasped what is now called cultural relativism, that each culture is rich in human information, and that the values embraced by the people who share that culture have merit. He "remained convinced that the conquest of the New World brought only one arguable gain: religion" (Nicolau and Cline 1973, 207; Nicolau 1987).

The Florentine Codex marks the close of sensitive research into Native American cultures in Hispanic America. In 1577 the Inquisition and the Council of the Indies barred or suppressed works in native languages by the missionaries. They ordered Sahagún's manuscripts to be turned over, but fortunately they were saved by the Inquisition's censor in Mexico who held different views (Nicolau and Cline 1973). This reversal of policy, directed from Rome, entailed fundamental changes in missionary strategies which the Archbishop of Mexico and the mendicant orders in New Spain strenuously but vainly resisted. From Motolinía in the 1520s to Sahagún in the 1580s, the goal had been conversion, not assimilation. When, in the 1590s, that benevolent Indian policy was set aside, particularly by the Franciscans, a steady erosion of cultural integrity ensued.

The Spanish observers of the sixteenth century had great difficulty in finding a model with which to view and understand the diversity of Native American cultures. Through the widely disseminated elaborations of Martyr (1964), Columbus's account of the Taíno of Hispaniola as generous, guileless, and backward fostered the stereotype of the American Noble Savage. In Mexico, Cortés and his soldiers stumbled upon a great civilization and created a different stereotype, a Clever and Discreet Indian gifted in art and industry (Keen 1971, 60). Las Casas blindly idealized the Indians. Motolinía accented the social inequalities and the poverty of Aztec Mexico, while Durán praised the hierarchical, class-conscious spirit of Aztec society (Keen 1971, 119–20). It remained for Sahagún to recognize the linkages between the world of appearances and the cognitive structures beneath it that influence individual and group actions, a discovery made possible by his linguistic analyses. But Sahagún himself was only rediscovered in the 1880s, and his semiotic conceptualization of culture and landscape should attract postmodern cultural geographers today (see Rowntree, et al. 1989, 213–14).

Regional and Synthetic Geography: Cieza de León

The talent to integrate environmental and cultural information in spatial and logical terms may be inborn rather than learned, at least if Pedro Cieza de León is taken as an example. Cieza (1984) was raised in Llerena, an Extremaduran town of 5000 inhabitants when he and his parents embarked at Seville for Colombia in 1535. At the time he was either thirteen or seventeen years old (his books give two versions), but within a year he was campaigning up and down the Andes as a common soldier. In describing the hardships, he complained of the exorbitant price of a piece of paper, implying that he was taking notes. His terse, informative, and evocative prose indicates an educated man; but that education must have been largely informal, acquired on his own and on-the-go. He died young, in 1554, just as his introductory volume to a four-tomed history of Peru was published. This first book, which relates a district-by-district geography of the Andean world from Panama to Bolivia (Cieza 1984), is of particular interest here.

Again and again he describes the dramatic physical environment, its diversity, and the cultural landscapes and subsistence forms of its various ecozones. In one paragraph he sweeps the reader from the mangrove coasts and rain forests of the Pacific slope into the snow-topped high ranges, describing the semiarid intermontane valleys in between. He directs attention to variations in rainfall and vegetation, windward and lee slopes, habitable and uninhabited regions, and the tortuous roads that bind them together. His superb account of the environs of Quito (Cieza 1984, chap. 40), with its descriptions of planted crops, Indian populations, livestock economy, and the surrounding network of towns, is too long to excerpt. The cogent report on Lake Titicaca is also exemplary and can be reproduced in translation:

> The region of Collao has many snow-capped wastes and mountains, as well as plains covered with good pastures that serve the domestic livestock wandering across them. In the middle is a lake, possibly the largest and widest in [South America], and most of the towns of Collao lie next to it. The cultivated land [and anything of value] is found on large islands within the lake, because these are deemed safer than the towns, which lie along the roads.
>
> This region is so cold that not only does it lack fruit orchards, but maize is not grown because it will not ripen, for the same reason. There are great numbers of birds of many kinds in the reed marshes of this lake, including large ducks and other fowl, and two or three kinds of tasty fish . . . .
>
> The lake is so large that its circumference is 330 km and its depth [according to Captain Juan Ladrillero, going out with his brigs] 25 fathoms or so, more in some parts, less in others. This size, and the waves raised when the wind blows, suggests an embayment of the ocean. It is not known why so much water is held in this lake or where that water comes from: although there are many streams and arroyos flowing into it, this seems inadequate, mainly because the lake is also drained [by a deep river that flows strongly] . . . Possibly the Deluge left this water behind because, as I see it, it should be salty rather than fresh if it had been part of the ocean, and furthermore the sea is 300 km away . . . .
>
> The great lake of Collao is called Titicaca, after the temple built on it . . . (Cieza 1984, chap. 103).

Cieza's account rivals the regional geographies of the nineteenth century, which is all the more remarkable because Cieza was untrained and had no mentors or role models. Although Classical geographers like Strabo provided good regional descriptions, they lacked the ability to shift the scale of vision, to gather so much hard observational data, to analyze interrelationships, or to systematically treat a large region according to a particular set of criteria.

A very different type of regional geography, embracing most of the New World, was attempted 1571–74 by López de Velasco (1971), whose similar lack of formal education is discussed below in relation to government geography. The *Geografía y descripción universal de las Indias* was assembled from reports and maps on the New World and East Indies in the office of the Council of the Indies. Dedicated to the king, and evidently intended to inform the government, Velasco tallied a total of 200 Spanish settlements in the Americas, with 32,000 Spanish households and 4000 other settlers and miners; there also were 8000 Indian

towns and 1.7 million Indian "tributaries" liable to tax or work demands as well as 40,000 African slaves, not counting people of partial black ancestry.

Velasco's is a classic regional geography, a coherent work of synthesis. First the coastlines of a region are described, much in the manner of a navigational chart, followed by an outline of the topography, a description of the environment, a summary of the main cultural phenomena, and a systematic account of towns and agricultural activities. Miscellaneous points cover topics such as climatic constraints to settlement or agriculture. Historical digressions or travelers' "tales" are few. Unlike Cieza, who wrote spontaneously on the basis of direct observation, Velasco presented a more "academic" synthesis.

The work's rigor and systematics make it a volume of lasting historical scientific interest, as is shown by Menéndez Pidal's (1944) reconstruction of a New World geography for about 1570, based primarily on Velasco. The modernity of his secular and empirical synthesis, conceived at a global level through its inclusion of oceanic navigation and East Asia (López de Velasco 1971, 29–49, 273–309), contrasts with the continuing use of an obsolete Ptolemaean framework and a theological paradigm to the end of the century for presenting new geographic information in Central Europe (Menéndez Pidal 1944, 4; see also Ptolemy 1966; Münster 1968, Büttner and Burmeister 1979). Unfortunately, Velasco's prototype for synthetic geography remained unpublished until the fourth centenary of Columbus's voyage. Although Velasco's work had no impact on geographical scholarship, it deserves to be considered as a precursor to Carl Ritter and Elisé Reclus.

This first epoch of Spanish geographical inquiry aptly concludes with another compendium of a New World regional geography, that falls a little beyond our period of examination. The Carmelite friar Antonio Vázquez de Espinosa (c. 1570–1630) traveled through most of Hispanic America for fourteen years (1608–22), perhaps to evaluate possibilities for his order to engage in missionary work. Doubtless Vázquez (1969) had important backers because he had full freedom of movement, access to privileged information (such as the salaries of high church officials), and disposition over reams of municipal and economic statistics, which he put to good use. In the course of his travel and sojourns, he compiled a wealth of papers, maps, reports, and first-hand observations.

Vázquez came from a poor, rural background in the olive-growing country just west of Sevilla. Equipped with a primarily religious education, and lacking the conceptual rigor or analytical skills of Velasco, Vázquez compensated for his shortcomings by a ready appreciation for complex landscapes and a lively interest in the rural economy. He provides, for example, unique quantitative data on wine and olive oil production in Peru; he also remains a key source for demographic data. The Compendium spans the Hispanic dominions, and his regional descriptions brim with quality, systematic information. He was unsparingly critical of what he regarded as short-sighted and abusive administration of the indigenous peoples, by both church and state; yet his own attitude was paternalistic, and unrelieved by sophistication for other cultures. At the time of his sudden death, his manuscript was in press, and like so many others, it remained unpublished.

To the works of Cieza, Velasco, and Vázquez can be added a variety of other travel reports or regional histories, with enlightening geographical introductions. Collectively they show that synthetic as well as analytical geography was an integral part of what would now be described as scientific thinking in sixteenth-century Spain. That normative geography was espoused in government circles should therefore come as no surprise.

Government Geography and Town Planning: López de Velasco

The role of Spanish government policy in urban planning is relatively well known (see Stanislawski 1947), but disagreement continues on the relation of theory and practice and the origin of the Spanish gridiron plan.

The first unambiguous government decree in regard to town location and morphology dates to November 1513 (CDI 1883, vol. 39, 284–85, 295–97); it instructed Pedrarias, the governor of Panama, to choose a town site on the coast or along a river to facilitate transport, making certain that the location was healthy, near woodland (for fuel) and good soil (to cultivate), and

not liable to flooding; once the site was selected, the streets, plaza, church, and house lots were to be laid out in an explicitly "regular" (*ordenado*) manner, from the very beginning. A geometric grid is evidently meant, but no particular arrangements are specified for the various components. Cortés (1963, 589–90) received almost identical instructions in 1523, that added the caveat to avoid locations that were excessively windy, foggy, or steep.

But the details for the gridiron format were only specified in the "laws for settlement," proclaimed in 1573 (Ordenanzas 1973, 112–25). These ordinances called for towns to be organized along four main streets running at right angles to a central plaza and opening to four external gates; eight additional streets should diverge from the cardinal directions at the corners of the plaza. Diagonal alignment of the square and axial streets was thought to avoid direct exposure to unpleasant winds. The town square was to be rectangular, with a ratio of 1:1.5, varying from 60 by 90 m to 240 by 460 m, depending on the initial and expected size of the town. One ordinance specified that, according to Mediterranean custom, the church should be on the highest point and not necessarily on the plaza, with the public buildings located between the two (Ordenanzas 1973, 124). Where possible, location on a river or coast was recommended, with sanitation dictating that craft centers be located near the water.

These ordinances are remarkable in that they dictate norms for urban planning more than two centuries before the rectangular survey began to create checkerboard town plans in the U.S. The approximate grid plan for Santo Domingo (1502) was laid out without instructions to that effect (see CDI 1879, vol. 31, 17). The 1522 foundation document for Nata, Panama specified a *traza* ("trace"), implying a regular layout, and informs us that the principal streets of Nata converged on the church and public buildings "according to and because of the order and manner that the *traza* is identified [on the ground]" (Domínguez 1977, 36). Mexico City-Tenochtitlan was first rebuilt in 1523—in a location notorious for flooding and an unhealthy environment; it was then drastically remodeled according to a strict grid plan after 1538, not in response to special instructions, but according to the plan of Viceroy Mendoza (Tovar 1985). The new city of Puebla, begun in 1531, also conforms to the ideal type of grid layout (Yáñez 1991), and many other examples in various parts of Hispanic America predate 1573.

The ordinances merely articulated and legalized a system already well established and in common use (Hardoy 1978). But the prescribed model was not always followed. Most such grid towns are more or less axially oriented to the cardinal points, not at 45° to them, while the church and public buildings were always on the plaza (or on one of two plazas). Hardoy (1975) examined 292 maps for 134 Spanish Colonial towns, only 22 of which were founded before 1600; he found that only 42 percent had been planned from the outset, another 32 percent were gradually modified to conform to a regular plan, and 26 percent evolved spontaneously. In short, the ordinances were not very effective after 1600.

Some authors argue that the Hispanic American grid plan was influenced by (or even grounded in) the Roman architect Vitruvius or Classical town models, and Mendoza's remodeling of Mexico City was indeed influenced by the Italian architect and planner, Leon Battista Alberti (1404–72), who drew many ideas from Vitruvius (Tovar 1985). But most new towns in Europe founded after about 1200 already had some form of regular layout long before the delayed publication of Alberti's book in 1485 (e.g., Hardoy 1975; Kubler 1978; Benevolo 1980).[14] Considering the inordinate role of leading conquistadors or administrators in determining the actual forms of the first planned towns in the New World, it seems more reasonable to attribute urban evolution to adaptation of already familiar Spanish prototypes to new opportunities and requirements: the availability of abundant space; the need to quickly establish a few dozen initial settlers; the priority of economic over defensive strategies, favoring level terrain and the conjunction of kitchen gardens with dwellings on a single lot; and proximity to vital Colonial institutions: the government buildings, the church, and various shops (see also Hardoy 1978). Instead of an endless and inconclusive search for specific intellectualized antecedents, it seems more productive to explicate particular urban histories (e.g., Butzer 1989), and to explore the function of the city as an instrument of colonization (Hardoy 1978; Morse 1987).

The driving force behind the formulation of

the 1573 ordinances and the role of government in marshalling geographical information was Juan López de Velasco (c. 1530–99). He came from the remote village of Vinuesa (Soria), where his family owned some houses and irrigated fields; checks of student enrollments at various institutions of higher education confirm that he lacked a formal education (Pérez-Rioja 1958). According to his last will, his sister in Vinuesa lived in poverty; some of his money went to her sons that they might go to America—something that he had been unable to do. Despite such impediments, Velasco wrote respectable works on astronomy, a navigation guide to the Atlantic Ocean, and a regional geography of the New World (see above); he also became a national authority on the spelling and pronunciation of the Castilian language. Velasco probably received a rudimentary education from the parish priest in Vinuesa, and then began to work as a young government clerk in Madrid. By 1565 it appears that he was an assistant, possibly responsible for legal work at the Council of the Indies. The proverbial self-made man, Velasco had no rank in his status-conscious society nor the opportunity to travel.

His profound influence on Spanish geographical planning and policy was exerted indirectly, through the authority of his patron, Juan de Ovando y Godoy, the distinguished jurist and statesman. Appointed to revamp the Council of the Indies in 1569–71, Ovando focused his reforms on improving geographical understanding and developing a coherent body of legislation (Cline 1972; González, in López de Velasco 1971, v–xxxvi). Velasco implemented this effort and was appointed cosmographer and chronicler to the Council to that end. After Ovando's death, Velasco was removed from a position of influence in 1577 as the policies of church and state shifted.

Ovando apparently served as a "front" for Velasco's precocious initiatives, which included: (1) reorganization and codification of the legislation applicable to the Americas (by 1571); (2) formulation of the comprehensive "laws of settlement" (in 1573); (3) solicitation of local reports from parishes in the New World, through the various bishops, to provide data on the Indian population, frequently amplified by geographical information (1571) (see Paso y Troncoso 1905b, c, for the Mexican series); (4) compilation of a New World regional geography, based in part on the parish reports; (5) development of a geographic and ethnographic questionnaire dispatched to all district magistrates in the New World (in final form 1577) (Edwards 1969; Cline 1972); (6) the questionnaire produced *relaciones geográficas* for some 500 communities (mainly 1577–86), now available in fourteen published volumes, covering parts of Mexico, the Antilles, and the wider Andean region (Acuña 1984–88; Latorre 1920; Jiménez 1965; Edwards 1980); and (7) a parallel set of questions directed to towns in Spain, which generated *relaciones topográficas* for another 636 communities (Nader 1990). In addition to these diversified and substantial initiatives in government geography and policy, Ovando and Velasco seem to have provided indirect support for the ethnographic research of Durán, Tovar, and Sahagún in Mexico.

The degree to which the Renaissance spirit of rationalization pervaded this effort can be judged by Velasco's thirty-eight questions (with twelve more for coastal locations) (see Cline 1972, 234–37). Question 4, for example, requested information as to whether land was plain or rough, open or forested; with many or few streams or springs, and abundant or deficient waters; fertile or lacking in pastures; abundant or sterile in crops and sustenance. Site and location of each town was to be specified; was the site high or low, level or sloping (question 10)? Other questions asked about distance to the nearest mountains; the nature of adjacent rivers and their sources; lakes or springs serving the town; volcanoes, caves, or other notable natural phenomena in the vicinity; native trees common to the district and their potential economic use; wild animals and birds; information on mineral resources, mines, or quarries; and, for coastal locations, data on shore topography, offshore reefs, tides, and storms. These biophysical questions were complemented by requests for information on crops, soils, livestock, town plans, and the like. Ethnographic questions covered Indian languages, pre-Contact government and religion, native dress, manner of warfare, and past and present means of subsistence.

The *relaciones* therefore solicited a broad corpus of information appropriate to the administrative needs of government policy. The reports submitted by the magistrates or clergy were generally quite good since their accounts were based on interviews of long-term residents in Spanish towns and native elders in Indian towns. In addition, many of the *relaciones* included local pictorial maps, many drawn by Native Americans, that illustrate sixteenth-century cultural or symbolic landscapes, and sometimes include exquisite detail on vegetation. Collectively the *relaciones* provide an inestimable resource of analytical information on landscape change and indigenous cultural geography (see Edwards 1975; Bustos 1988; E. K. Butzer 1989). But that should not let us lose sight of the fundamental fact that the *relaciones,* like other efforts of Velasco as the first government geographer, were designed to facilitate imperial administration and policy at both the meso- and macroscales. In Madrid, by the 1570s, more complex modes of geographical understanding had begun to supersede maps as a tool of government.

Velasco's influence on sixteenth-century scientific observation thus was enormous. Not only did he play a catalytic role in government, but he also challenged others to follow similar norms. Indeed, Antonio de Ciudad Real (1976), a Franciscan friar traveling through Mexico in 1584–89 as secretary to a visiting inspector, seems to have modeled his account on parts of this questionnaire, noting the environments he traversed, land use around each town, and crops grown in the various monasteries. Similarly, requests for land deeds in Mexico increasingly incorporated environmental information, so much so that the land-grant documents can be used to reconstruct the vegetation of the sixteenth century (Butzer and Butzer forthcoming). Yet Velasco was indebted to the earlier efforts of Fernando Colón: in many ways he merely implemented the initiatives of Colón's *Itinerario,* a concept that finally bore rich fruit sixty years later.[15]

A Scientific Framework: Acosta

As the intellectual ferment of the sixteenth century began to diminish with growing religious orthodoxy and censorship (Kamen 1985, chap. 5), it remained for the Jesuit scholar Joseph de Acosta (c. 1540–1600) to place the New World into a new scientific framework. The son of a merchant family in Medina del Campo, a once-prosperous town of Old Castile, Acosta studied philosophy at the university of Alcalá de Henares 1559–67. The fifteen years 1572–87 were spent in the Americas, almost exclusively in Peru, but he had close contacts with Tovar and Durán in Mexico from whom he derived most of his ethnographic information.

In his *Historia natural,* Acosta made significant original observations on physical phenomena, e.g., the latitudinal organization of world climates in which he recognized that the rainy seasons of the tropics were linked to the zenith of the sun (high-sun rains) (Acosta 1962, 2.7), contrary to the opposite argument of Aristotle. He not only reaffirmed Columbus and Gómara to the effect that the torrid zone was quite habitable, but explained that equatorial climates were moderated by relatively short days and abundant rainfall, especially where complemented by coastal breezes (Acosta 1962, 2.10–11). He conceptualized the systematic decrease of temperature with elevation in tropical mountains (Acosta 1962, 2.12) and thus anticipated the montane ecozonation of Humboldt.

But his major contribution rests in his exposition of a scientific and ontological framework for the New World. The first half of his book focuses on the natural world, and there he makes two basic points (O'Gorman, in Acosta 1962, xliii–xlvii): (1) How the Americas form an integral part of the universe, in relation to the global distribution of seas and continents, and the habitable realm; (2) How the Americas are formed of the same four physical elements (earth, water, air, fire) and the same natural orders (mineral, vegetal, animal) as the other continents. The second half of his work, on the human world, is similarly structured according to two arguments (O'Gorman, in Acosta 1962): (1) That the New World peoples are an integral part of the supernatural world as well as of humankind, that is, spiritual, physical, feeling, and rational creatures; (2) That the New World peoples have their own history (in part oral), making them part of a universal history.

This all may seem self-evident today, but Acosta was the first European to explicitly recognize that New World phenomena existed in their own right. Building on ideas already expressed by López de Velasco (1971, 2), he attributed the divergence of the Old and New World peoples to migration, surmising that the

continents were connected or almost connected in unexplored Arctic latitudes:

> the one (world) and the other are joined and are continuous or at least approach each other and are very close . . . because the Arctic or North Pole has not been discovered and the full extent of the land is unknown . . . .
> the first settlers travelled to the Indies . . . without reflection, progressively shifting locations and territories, some occupying those already found, others looking for new ones, so that in the course of time they came to fill the lands of the Indies with so many groups, peoples, and languages (Acosta 1962, 1.20).

Other, popular fables such as the Lost Tribes or Atlantis were rejected. As a creationist he was puzzled by the different degrees of divergence between the Old and New World faunas, and the absence of large mammals on the Caribbean islands, suggesting that

> through natural instinct and divine providence different kinds (of animals) went to different regions, doing so well in some that they remained, or if they moved on, they did not survive or died out in time (Acosta 1962, 4.36).

It can be argued that this concept of diverging migration anticipates biogeography and even geographical speciation, but without its evolutionary implications.

A more satisfactory solution to the dilemmas of natural history noted by Acosta was not forthcoming until Darwin, while the origin of New World peoples has only been unraveled during the twentieth century. Although Acosta remained entrenched in Aristotelian thinking, his synthetic, ontological framework stands midway between Medieval attempts to construct a cosmological order and more modern efforts to lay out a new, scientific counterpart. Published in 1590, his ideas were disseminated by twenty-five foreign editions during the next two centuries (López Piñero 1979, 295).

Retrospect

It is evident that Columbus's encounter with what came to be called the New World had an immense intellectual impact on thoughtful Spaniards in many walks of life, with and without formal education. These included sailors and soldiers, clerks and clergymen, and a few men of letters. They were connected less by academic links or traditions than by a spontaneous capacity to observe and describe, to compare and classify. The authors and works singled out here, together with many others, represent a wealth of original and empirical observation and analysis of new environments and unfamiliar peoples, all within a span of three generations. Separately or in tentative forms of synthetic integration, they laid out the components of a scientific, geographical understanding of that "New" World. This was a veritable Renaissance or rebirth, that easily surpassed any Classical prototypes, and the challenge to deal with all that was novel put people with rural backgrounds on an equal footing with those steeped in academic curricula.

Given the exuberant environmental descriptions of a Columbus, an Oviedo, or a Cieza, or the love of nature exhibited by Acosta (1962, 1.3), it is difficult to understand how John Elliott can claim that:

> It is as if the American landscape is seen as no more than a back cloth against which the strange and perennially fascinating people of the New World are dutifully grouped. This apparent deficiency in naturalistic observation may reflect a lack of interest among sixteenth-century Europeans, and especially those of the Mediterranean world, in landscape and in nature (1970, 20).

For an influential historian of Spain, the ethnocentric dismissal of South European interest in the natural world is inexcusable. More important, the inability of such a fine humanist to grasp the intellectual excitement of geographical observation and perception of that new world is deeply disturbing.

Unfortunately, the Spanish contributions of the sixteenth century to geography and related scientific research had minimal impact on the German revival of the field during the early nineteenth century. Humboldt (1845–47, II, 298) readily acknowledged the importance of Oviedo and Acosta, but did not know Cieza. Furthermore, Fernando Colón, Sahagún, López de Velasco, Vázquez, and the *relaciones geográficas* remained unpublished and inaccessible, primarily as a result of official xenophobia or religious censorship. The curtain that began to close in 1577 stifled free inquiry, and the quality of Spanish research declined long before the precipitous fall in Spanish scholarly publication about 1640 (see López Piñero 1979, 377–86). The geography that reemerged in Spain during the mid-1700s stood in the shadow of the French Enlightenment (see Capel 1982), and it did not regain its original vitality until well into the present century.

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Notes

1. Marco Polo (1958) can be cited for descriptions of "Tartar" transhumance and the spring snow melt in Armenia (chap. 22), the landscapes he passed in the Pamir Mountains (chap. 47); moving sands covering tracks in the Lop Nor (chap. 56), the bustle of life and urban layouts of Peking and Hangchow (chaps. 85 and 153), and a series of well-tended Chinese landscapes (chaps. 107–58). Even data he obtained by hearsay for Zanzibar and Madagascar (chaps. 192–93) are remarkably accurate, such as a description of giraffes. The "chapters" refer to the Bennedetto subdivisions, used by some but not all of the many available editions. On the expanding geographical horizons of Medieval Europe, see J. Phillips (1988).
2. For example, the German cartographer Münzer (1952) gave a valuable and remarkably objective eyewitness account in 1494–95 of the Muslim towns and people of recently conquered Granada, without quoting a single Classical author or historical source. By comparison, a more erudite Portuguese traveler, Barreiros (1952), traveled through Spain in 1542, to fashion a self-styled chorography that was little more than a pretext to display his familiarity with Classical literature; observations become little more than incidental.
3. The Ptolemy (1932) edition, in English translation, has been criticized, but it is one of the very few that is accessible and not written in Latin or Greek. The fifteenth-century maps it reproduces presumably go back indirectly to third-century or earlier prototypes, to illustrate the regional information available in Antiquity. By contrast, Ptolemy (1966), in Latin with commentary and maps by Sebastian Münster, is a good example of how these principles were used to redraw the same maps during the early 1500s, using contemporary information. Münster (1968), Waters (1958), Harvey (1987), Campbell (1987), Harley (1990), and Nebenzahl (1990) are recommended for those readers interested in the cartography of the period. The unexpected death of Brian Harley will undoubtedly delay preparation of volume 3 of his and David Woodward's monumental *History of Cartography*, which will treat the Age of Discovery.
4. Questions persist whether the diary of the First Voyage is heavily edited, incomplete, or even a selective summary of Columbus's original by Bishop Las Casas (see Fuson 1983; Henige 1991). These issues do not affect the materials selected here, which clearly do not stem from Las Casas, who later paraphrased the same biophysical data in a singularly lifeless and inept manner (see Las Casas 1965, I).
5. Columbus's background, prior to his appearance at the Spanish court in the late 1480s, has been in hot dispute since 1517. The idealized biographical data for before 1488 all derive from Fernando Colón (1984) and Las Casas (1965), who used the same documentation, almost all of which has disappeared and thus cannot be authenticated. If the lost correspondence with the Florentine cartographer Paolo Toscanelli (1397–1482), as claimed by Colón (1984, 66–71) and Las Casas (1965, I, 62–66), were verifiable, it would date Columbus's interest in circumnavigation and, more important, his scholarly activities, back to before 1481. Las Casas (1965, I) refers to these letters on seven different occasions, implying that he had them in hand. For a lucid but critical analysis of Columbus's career, see Phillips and Phillips 1992; the authoritative biography is by Taviani (1985).
6. Letters securely attributed to Columbus are written in the script known as *humanística cursiva* (see Arribas 1965, I, 166–67 and plate 101), characteristic of the royal court in about 1500.
7. No maps by Columbus have been authenticated, but his younger brother Bartolomé is reputed to have been the author of several nautical charts (F. Colon 1984, 85–86; Las Casas 1965, I, 153–54). "Because Columbus dominates the documentary record, we know less about the other men on the voyage, but his observations . . . can stand as a general description of their experience" (Phillips and Phillips 1992, 157). The geographical competence of contemporary cartographers becomes apparent in the case of Andres de Morales (died 1517), a ship pilot on Columbus's Third Voyage. Morales was commissioned to make a map of Hispaniola in 1508 (see color copy in Milanich and Milbrath 1989, 68), and information from his report is preserved in Martyr (1964, 349–55), subsequently evaluated by Carl Sauer (1966, 41–48). The map is remarkably detailed and accurate, showing the key mountain chains in fifteenth-century, North Italian technique (see Harvey 1987 for examples). Sauer rates highly the information on indigenous territorial organization and land use, but the abbreviated topographic descriptions preserved in Martyr are also intriguing. Morales appears to have had accurate views on the

pattern of ocean currents in the North Atlantic, and later served as Chief Pilot in the Casa de Contratación of Sevilla (Becker 1917, 81, 90–91). That institution in Sevilla was the key European center of navigational science from 1508 onwards (Broc 1980, 194–96). For insights into its curriculum for ship pilots, see Lamb (in Medina 1972).

8. An early appreciation of Columbus's observations is given by Humboldt (1845–47, I, 296–97, 335; II, 55–57, 277, 299–304, 325; IV, 233, 250, 253, 261), who lauds his poetic descriptions, and interprets his observations on botany, wind patterns, and magnetic declination; but at times, I suspect, he reads too much into the statements of Columbus. For a humanistic evaluation, see Gerbi (1985, chap. 2), who also emphasizes the Genoan navigator's feeling for nature, as well as his focus on differences or affinities between the biota of the Indies and the Old World. It is surprising to read in Sale (1990, 102) that Columbus's language is "opaque and lifeless"; I can only infer that Sale did not sample the evocative original language, in favor of a "flat" English translation. Sale (1990, 101) laments the absence of an exultant description of "old-growth tropical forest" from the Bahamas, a curious gaffe for a professed ecologist, both in view of the subclimax woodlands of these low, hurricane-lashed islands and of their considerable indigenous population in 1492. When Sale (1990, 101) further faults Columbus for not writing about melodious bird songs with due excitement, I can only conclude that Sale did not read the journal carefully after the entry for October 28 (a scant ten of his forty references are subsequent to that date). Only a superficial reader or an ideologue could conclude that Columbus "cares little about the features of nature" (Sale 1990, 102).
9. There is some ambiguity in Fernando Colón (1908–15, 1) about the initial entry that the Itinerary was "begun" August 3, 1517, as to whether this meant the project or the writing (see De la Rosa 1906 vs. Ponsot and Drain 1966). Since Fernando had only returned from Rome in October 1516 and was in Spain without interruption until late in 1519 (when he began his peregrinations throughout western Europe in search of books [see Arranz, in F. Colón 1984, 31–37]), his major role in this effort appears to date from 1517–19.
10. O'Gorman (1946) believes that Oviedo's conversion to science began with his trip to the court of Charles V in Brussels (1516–17), where he delivered a formal complaint against the injustices of Pedrarias Dávila, Panama's notorious governor. In Belgium, Oviedo was exposed to Erasmian thought, if not seminars by Erasmus (c. 1466–1536) himself, who taught at Louvain from 1517–21. This Renaissance philosopher, a close friend of Thomas More, emphasized a humanistic rather than a dogmatic Christianity, based on the New rather than Old Testament. According to O'Gorman (1946), Oviedo began to see the European enterprise in the New World as a providential mission that it was his vocation to describe. I have trouble discerning a utopian thread in Oviedo's history, and the only obvious trait he shares with Erasmus is his frequent use of satire to criticize Spaniards in general and churchmen in particular. The Spanish Erasmian movement, especially as represented by Juan Luís Vives (1492–1540), may, however, be pertinent, with its emphasis on inductive argument.
11. Ideal scientific procedure, according to Humboldt (1845–47, I, 65–70) proceeds from accurate observation and description to understanding, via analogy and induction, a view worth remembering in a time when empirical and inductive research are denigrated by some social scientists. In praising Oviedo's "incredible virtuosity in botany," J. D. Sauer (1976, n. 16) states that he "was far ahead of his only model, Pliny, in accuracy and originality." Also in regard to accuracy, Ferrando (1957) emphasizes that Oviedo's data on the Pacific Ocean were extracted with great care from trustworthy sources, providing a realistic picture of exactly what was known to Europeans about its coastlines and islands c. 1550. There were no imaginary islands on Oviedo's mental map.
12. That Oviedo did not know the work of Aristotle, Theophrastus, or Dioscorides on plants (Butzer forthcoming [b]), nor the late Medieval herbal literature, is readily explained by the fact that these were only used in the medical curriculum of the time (Alvarez 1957). He was also unaware of the agricultural treatise of Gabriel Alonso de Herrera (1970), published in 1513. Far more orthodox as a botanist was Francisco Hernández, Philip II's personal physician, who was sent to the New World to collect medicinal plants (Goodman 1988, 234–37). He spent six years (1571–77) collecting, drawing, and describing thousands of species on Hispaniola and Cuba, and especially in Mexico (Somolinos 1960–84), but died shortly after his return. López Piñero (1991) shows that Fernández's illustrations were probably drawn by indigenous artists.
13. To make his case, Las Casas (1967) gleaned an endless litany of bestial customs from the Classical authors and early church fathers, to show that Old World peoples were more depraved than those of the New World. But all too many of his Old World comparative "data" are no more than ethnocentric hearsay about foreign peoples or practitioners of other religions. For a more sympathetic presentation of this complex personality, see Friede and Keen (1971). In regard to ritual cannibalism in the New World, it is appropriate to cite Phillips and Phillips (1992, 295, n. 22): "To deny that cannibalism existed, one needs to assume that a wide range of European commentators simply made up the stories, an interpretation that defies reason, logic, and the available evidence."
14. There is an extensive literature on urban planning in Colonial Latin America, and several of the above references help identify larger collections of papers, mostly in English. A wealth of translated documents related to the Spanish colonial enterprise, including many of the ordinances or decrees cited here, can be found in Parry and Keith (1984), a treasure trove for students interested in exploring the possibilities of historical geographical research in the region.
15. The link between Velasco and Colón appears to be the noted cartographer Alonso de Santa Cruz (1505–67), who was appointed cosmographer to the Casa de Contratación in Sevilla 1536 (see Carriazo 1951). He worked in Sevilla until 1564, when he moved to Madrid at the king's request. Although there is no documentation to prove the point, Ovando's reliance on Velasco after 1569 offers a plausible scenario that Velasco had already acquired astronomic and geographic experience while working for Santa Cruz in Madrid. In 1572, Santa Cruz's great map collection was transferred from his old residence in Sevilla into the possession of Velasco, as the new royal cosmographer. In his *Libro de las longitudes* (completed ca. 1557), Santa Cruz notes that he planned to write a geography, while in his *Islario general* (completed ca. 1560), he implies that he was working on a *General geografía e historia* (Carriazo 1951, clxv). Velasco would have been aware of these plans and have had access to whatever notes that had been compiled, although no such materials are separately inventoried for Santa Cruz's estate (see Carriazo 1951). Although Velasco's geography would not have been possible without Santa Cruz's maps, there is no reason to doubt that his scientific organization was his own. In 1556 or 1557 Santa Cruz prepared a set of instructions for explorers in the New World, consisting of seventeen points (Jiménez 1965, 272–77; Carriazo 1951, clxix–clxxiii), evidently a direct antecedent to the questionnaire of Ovando and Velasco, in terms of inventorying environmental features and ethnographic data. Item three instructs the responsible officials to clarify the situation of new lands, "if they are mountainous or level, or if they are swampy or full of lakes, or if they are unhealthy for the natives or for foreigners" (Jiménez 1965, 274). Items twelve and sixteen inquire whether the native peoples have learned men and books, suggesting that indigenous histories be obtained in order to translate them into Spanish (Jiménez 1965, 276)—a remarkable perspective not found in Velasco's questionnaire. These instructions of Santa Cruz, much like the *ordenanzas* for town planning, form part of a chain of ideas, as can be seen from the instruction of Viceroy Mendoza, given in Mexico City in 1538 to Fray Marcos for his exploration of Cibola; he was instructed to make observations on the people as well as of "the climate of the land; the trees and plants and domesticated and wild animals they have; the nature of the land, if it is rough (*aspera*) or flat (*llana*); the rivers, if they are large or small . . ." (Jiménez 1965, 20). Perhaps Mendoza even influenced the scope of the Suma de Visitas in 1547 (see above). It is interesting that Santa Cruz uses *monte* and *montuosa* not for woodland/wooded, as in prevailing Spanish usage, but like F. Colón, for mountain/mountainous—a tantalizing hint for a possible connection with Colón, who would have known Santa Cruz, as a fellow Sevillano with shared interests.

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