ZAPOTEC SCIENCE

Farming and Food in the Northern Sierra of Oaxaca

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CHAPTER I

THE CONCEPTUAL BASES OF ZAPOTEC FARMING AND FOODWAYS

> The approach to the problems of farming must be made from the field, not from the laboratory . . . In this the observant farmer and labourer, who have spent their lives in close contact with nature, can be of greatest help to the investigator.
>
> Sir Albert Howard, *An Agricultural Testament* (1940)

> The ability of these natives in cultivating the soil and making plantations would very shortly produce such abundance that great profit would accrue to the Imperial Crown . . .
>
> Hernán Cortés, October 15, 1524

The Zapotec people of Oaxaca have continuously cultivated maize, beans, squash, and other crops for more than 5,000 years. Evidence strongly indicates that their ancient Mesoamerican ancestors domesticated maize from a wild grass and that its propagation and improvement required a level of human intervention so sophisticated that it has been described as "the most remarkable plant breeding accomplishment of all time" (Galinat 1992:47). Over this period, techniques for producing, processing, preserving, and preparing maize and other crops evolved to the point that agricultural surpluses supported a series of civilizations, including those of the Olmec, Maya, Toltec, Aztec, Zapotec, and Mixtec. Maize, beans, and squash (the so-called American Trinity), when combined with small amounts of other foods and animal-based proteins, provided the nutritional base for the de-

velopment of complex societies like those of Monte Albán, Mitla, Tenochtitlán, Chichén Itzá, and others (Wolf 1959:63; Warman 1988:20).

In Talea de Castro, a Zapotec village in a region called the Rincón (literally "corner") of the Northern Sierra of Oaxaca, most households continue to depend heavily on these three subsistence crops to feed their families. In some ways the cultivation techniques have changed little since the prehispanic period, with important exceptions—notably the use of animal-driven plows and steel tools (introduced in the Spanish colonial era) and chemical fertilizers (introduced in the late 1960s). In other ways, however, agriculture and diet have changed tremendously. Specifically, two Old World crops—sugarcane and coffee—have been added to the agricultural and culinary repertoires, though both are cultivated and processed using centuries-old technologies. Talean agriculture has been invented and reinvented: it is a blend of New and Old World crops, knowledges, and techniques that farmers have creatively adapted to local conditions. The vast majority of villagers work the land on privately owned plots of less than three hectares; indeed, farming is carried out by more than three-fourths of the "economically active population," according to recent census figures (INEGI 1991:315). Knowledge about farming and food is passed down from parents to their children verbally and materially as children listen to and emulate their superiors. In this way they learn about subsistence agriculture.

Initial observations in the field led me to think about the sophistication of Zapotec farming. Shortly after arriving in Talea, I witnessed government consultants, mainly agronomists, struggling vainly to understand the complexities of local farming methods and their underlying assumptions. The visitors seemed to have a different way of talking about plants, soils, and the weather—sometimes radically different—than campesino farmers did.[1] Afterward, a few Taleans told me that such experts periodically arrived with good intentions but were handicapped because they did not understand local soils. Furthermore, they said, the consultants had much theory but little practical experience (*mucha teoría, poca práctica*). Campesinos, they implied, know more about farming on Talean soil than agronomists do because they actually do the farming. "The government programs usually don't amount to much," said an informant. "Most campesinos who show up pick up their materials [fertilizer or direct cash payments], sit silently through the meetings, and leave." Over time, it became clear to me that Zapotec farming was immensely successful—not "underdeveloped"—when seen from the perspective of its practitioners; indeed, how else could the region's villages have survived for so long?

The irony of this and similar situations sparked a curiosity about the nature of science. Specifically, I began to ask the following questions. Does Zapotec food production, preservation, and preparation constitute a science—and, if so, how? If Zapotec farming and foodways do constitute a system of local science, how is it similar to modern cosmopolitan science and how is it different? How might the two be related?[2] These questions became the focus of my research. In general, the answers seem to depend on whether one takes the view that science is characterized by universal features or by culturally specific ones—that is, a relativistic view or one that is culture bound. The anthropological debate over "rationality" ("Does the 'Other' think rationally?") might be seen as another statement of the same problem.

For now suffice it to say that Zapotec farmers, to the extent that they employ a "considerable store of knowledge, based on experience and fashioned by reason" (Malinowski 1948 [1925]:26), certainly practice science, as does any society whose members engage in subsistence activities. They hypothesize, they model problems, they experiment, they measure results, and they distribute knowledge among peers and to younger generations. But they typically proceed from markedly different premises—that is, from different conceptual bases—than their counterparts in industrialized societies. Indeed, it is striking that in spite of technological changes in the Sierra—in crops, farming techniques, and food preparation—a distinct kind of logic appears to operate, one which holds together in a coherent fashion but is inexplicable or incorrect according to the dominant paradigms of contemporary international science or theories that model human behavior after an ideal "Economic Man."[3] In this sense, Zapotec farming might be thought of as a set of activities stemming from and informing conceptual foundations that are culturally incommensurable with those predominating in industrialized societies.

In this book I attempt to unravel some of the characteristics setting apart Rincón Zapotec farming and foodways from contemporary cosmopolitan science on the one hand and the ideologies of development planners on the other. I focus on how concrete, everyday agricultural practices flow from the logical calculus, epistemologies, or key concepts underlying Zapotec food production and consumption. I also concentrate on the ways in which Rincón Zapotec agricultural concepts and practices inform each other and the ways in which some modern cosmopolitan sciences inform and are informed by agricultural concepts and practices resembling those of the Zapotec. A central theme is that Rincón Zapotec farming and foodways mixed with and were juxtaposed to agricultural systems from many other

parts of the world from the time of contact with the Spanish; consequently, the boundaries separating Zapotec knowledges and practices from those of other parts of the world have overlapped and blurred. Another theme is that crop cultivation may be viewed as a highly successful set of techniques when assessed using the criteria of Zapotec farmers and that, significantly, the fundamental concepts which inform them may bring to light a number of phenomena that lie outside the purview of cosmopolitan sciences. These concepts or categories include household and ecological maintenance, reciprocity, food quality, the personification of nonhuman and supernatural actors, the inevitability and normality of physical work, and hot/cold. Together they form a partial foundation for agricultural practices that are entirely coherent, rational, and quite effective for Rincón Zapotec farmers in the Northern Sierra.

Rationalities, Knowledges, and Sciences

In this book I attempt to build upon an emerging body of work on the anthropology of science and technology by analyzing a particular set of agricultural and dietary knowledges and practices that combine "local" and "cosmopolitan" components; "ancient" and "modern" idea systems and artifacts; and techniques and methods developed in "industrialized" and "nonindustrialized" societies. In short, this is an examination of the cultural implications of a subsistence system that might be described as a case of scientific and technological syncretism.

Increasingly, anthropologists have taken an interest in the anthropology of science and technology, and some have attempted to synthesize earlier work on science, magic, religion, and rationality. Robin Horton and Ruth Finnegan, for example, edited a collection on *Modes of Thought* (1973) a generation ago. Stanley Tambiah (1990) examines *Magic, Science, Religion, and the Scope of Rationality* in historical perspective, emphasizing their trajectory in anthropology. Laura Nader (1996), in an edited volume entitled *Naked Science*, reviews previous studies in the anthropology of science and focuses on configurations of power and the boundaries separating magic, science, and religion. This is perhaps the first major collection of anthropological essays juxtaposing cosmopolitan and local science cultures. Scholars from other disciplines, particularly philosophy and sociology, have also shown an interest in combining anthropologically informed analyses of sciences drawn from a variety of settings (Jasanoff et al. 1995; Harding 1998).

These debates have a long history in modern anthropology. For example, the renowned social evolutionist Edward Tylor (1871) argued that magic in "civilized" European societies existed only as a "survival" from a barbarous past. He divided religion, "the belief in spiritual beings," into a number of stages, the earliest of which coincided with magic in "primitive" societies. For Tylor, science was characteristic of "civilized" peoples and "changed ideas from notions of personalized force to impersonal force . . . [and] therefore necessarily dissolved animism" (Tambiah 1990:50). He ascribed scientific thought to Europeans and magical and religious thought to their colonial subjects. James Frazer (1911–1915) argued that magic corresponded to "lower cultures," while religion and finally science corresponded to "higher cultures."

French theorists were also active participants in rationality debates. Emile Durkheim and Marcel Mauss (1963 [1903]) hypothesized a continuous development from "primitive" to "modern" thought. Lucien Lévy-Bruhl (1923), in his earlier work at least, rejected the notion that "primitive" thought was a rudimentary form of the "modern" civilized mentality, but instead argued that it was altogether different from modern rational scientific thought and that "it had its own characteristic organization, coherence, and rationality" (Tambiah 1990:86). Claude Lévi-Strauss's view can be contrasted to that of Lévy-Bruhl; in *The Savage Mind* (1966) he describes the difference between "concrete" science and "abstract" science, present in both "primitive" and "modern" societies. For Lévi-Strauss, the complex, particularistic categories deployed in "concrete" thinking are constructed in a piecemeal fashion, like that of the *bricoleur* or "tinkerer" who pragmatically assembles things from odds and ends. This differs from the more general "concepts" constructed when "abstract" science is done.

British structural functionalists engaged the French scholars, particularly Lévy-Bruhl, in different ways. Bronislaw Malinowski (1948 [1925]) promptly dismissed his views, arguing instead that magic, science, and religion coexist in all societies, though each serves a different function. In particular, he stressed the universality of scientific thought by providing examples from Trobriand gardening, fishing, and canoe-building to show how science was used to deal with the natural world (Malinowski 1948 [1925]:26). Trobrianders deployed magic and religion for influencing the sacred supernatural sphere, which served psychological and social functions, respectively. Malinowski showed that the thought processes of Trobrianders and Europeans were similar, for each practiced magic, science, and religion. He demonstrated that Trobrianders had genuine science (not

just magic and religion) and that Europeans had magic and religion (not just science).

Malinowski's work was influential and probably inspired Ludwik Fleck's critique of science (1979 [1935]). Fleck, a Polish physician, reviewed changing notions of syphilis over time and succeeded in revealing science's constructed nature, its contextuality, and its contingency. He influenced science studies by way of Thomas Kuhn's *The Structure of Scientific Revolutions* (1962); following this lead, social scientists—including anthropologists—began doing work among modern cosmopolitan scientists (Traweek 1987; Dubinskas 1988; Gusterson 1995).

In *Witchcraft, Oracles, and Magic among the Azande* E. E. Evans-Pritchard (1976 [1937]) focused upon how the Azande answered questions that modern scientists did not even attempt to ask. He found that the Azande deployed oracles and magic to explain random events—for example, a death caused by a collapsing granary. They used divination to expose otherwise inexplicable occurrences as premeditated acts carried out through witchcraft. Evans-Pritchard (1976 [1937]:16) concluded that "[t]he Zande mind is logical and inquiring within the framework of its culture and insists on the coherence of its own idiom." Tambiah (1990:92) summarizes the similarities in the approaches of Malinowski and Evans-Pritchard:

> [Both were conscious of] the danger of double selection by which ["primitive" peoples] are described entirely in terms of their mystical beliefs, ignoring much of their empirical behavior in everyday life, and by which Europeans are described entirely in terms of scientific rational-logical thought, when they too do not inhabit the mental universe all the time . . . A person can in a certain context behave mystically, and then switch in another context to a practical empirical everyday frame of mind.

The rationality debates have continued in anthropology. Robin Horton (1967), for example, has argued that "theoretical thinking" in modern cosmopolitan science has its equivalent in African thought, but that the latter is inferior since "it is not reflective or critical, is closed rather than open, it is unable to entertain alternative conceptions to its dogma, it is ignorant of the experimental method . . . and it resorts to secondary rationalizations to protect its premises, rather than face courageously the possibility of falsification" (Tambiah 1990:91). Horton fails to mention how such characteristics may also describe what Kuhn (1962) called "normal" activity among modern cosmopolitan scientists.

Max Weber's work (1946) has embedded within it a critique of rationality, not unlike Kuhn's critique of "normal science." For Weber, rationality was not a quality in and of itself, but part of a broader process, *rationalization:* the rational reorganization of production for maximizing productive efficiency. He argued that rationalization stemmed from the introduction of a new "capitalist spirit" of entrepreneurial enterprise and the subsequent "disenchantment" of the world. In this sense, Weber's rationality assumed a progressive, unilinear development. Unlike the evolutionists, however, Weber saw rationalization not as a liberating force, but as an all-enveloping ethos linked to the creation of bureaucratic, dehumanizing "iron cages" (Weber 1958:181).

Similarly, Karl Mannheim (1960:508–509) noted that rationality has at least two distinct and apparently contradictory meanings. Mannheim, like Weber, drew links between rationality and industrialization and noted that, although they may represent a particular evolutionary stage, they tend to paralyze, not liberate (Mannheim 1960:512):

> Increasing industrialization, to be sure, implies functional rationality, i.e. the organization of the activity of the members of society with reference to objective ends. It does not to the same extent promote "substantial rationality," i.e. the capacity to act intelligently in a given situation on the basis of one's own insight into the interrelations of events . . . The violent shocks of crises and revolutions have uncovered a tendency which has hitherto been working under the surface, namely the paralysing effect of functional rationalization on the capacity for rational judgement.

The work of the Frankfurt School—particularly that of Herbert Marcuse (1964) and Jürgen Habermas (1971)—might be seen as elaborations of this critique of formal rationality, so prevalent in modern bureaucratic societies.

Unresolved Issues in Studies of Local Science

Within anthropology, there is abundant evidence that local knowledge systems are internally coherent and logical. Studies of local science traditions, following Malinowski, have described, among other things, native astronomy in the Caroline Islands of Micronesia (Goodenough 1953), knowledge about marine life off the coasts of Hong Kong (Anderson 1967), navigation in the Puluwat Atoll of Micronesia (Gladwin 1970), Tzeltal Maya plant classification in Chiapas, Mexico (Berlin 1974), and "ethnoecological" knowledge (Nazarea 1999).

The interdisciplinary field of "traditional ecological knowledge" (TEK)

has become something of a growth industry in recent years. Edited TEK collections have become increasingly popular (Brokensha, Warren, and Werner 1980; Freeman and Carbyn 1988; Johannes 1989; Williams and Baines 1993), and marine biologists (Berkes 1977; Johannes 1981), geographers (Richards 1985; Wilken 1987; Nietschmann 1989), entomologists (Altieri 1987), and others have taken an interest in local environmental and resource management strategies. Such projects demonstrate that scientific thinking appears to exist everywhere, even if different societies have particular scientific styles or begin from distinct theoretical premises.

Even so, several issues remain unsolved in the TEK field. To begin with, a number of anthropologists and TEK researchers describe the benefits associated with certain local science practices, but often analyze local knowledge systems in the terms of modern cosmopolitan sciences rather than from the "native's point of view." To the extent that this research demonstrates the effectiveness of local knowledges by translating the results into cosmopolitan science terms, such analyses are laudable. But there are hazards. In the words of anthropologist Colin Scott (1996:71), "if the sharing of knowledge were to be reduced to a skimming-off by Western specialists of indigenous empirical insights, and their mere insertion into existing Western paradigms, then it would be an impoverished and failed exchange that would ultimately contribute to undermining indigenous societies and cultures." Angus Wright (1990:254) agrees: "There are major problems about how to proceed with such an effort because there are fundamental conflicts between the way Western science views the world and the systems of knowledge and practice of traditional agriculturalists." He cites Richard Norgaard (quoted in Wright 1990:254):

> In the absence of a consensus about epistemological beliefs, agroecologists have resorted to pragmatism. Western knowledge is not rejected, for the mechanical world view has given us many insights, and conventional agricultural explanations help the agroecologist understand traditional systems as well. At the same time, agroecologists are receptive to the explanations of traditional peoples . . . traditional knowledge has survived the test of time—the selective pressures of droughts, downpours, blights, and pest invasions—and usually for more centuries than Western knowledge has survived.

Perhaps part of the problem is the search for a "consensus about epistemological beliefs"; indeed, such beliefs often derive much of their power from their specificity, uniqueness, and geographical exclusivity—in a word, their "localness."

The question of how magic, science, and religion might be related in all cultures is often not addressed in TEK studies or in studies conducted in "high-technology" settings. *Naked Science* (Nader 1996) begins with a discussion of these connections, and several of the essays illuminate linkages between the knowledges and practices of local and cosmopolitan scientists. A branch of cultural materialism has drawn links between symbolic structures and ecosystemic principles (see, for example, Rappaport 1968; Reichel-Dolmatoff 1976), but as Scott (1996:71) notes,

> it can appear as if the "totalizing" view of Western science has captured what remained unconscious or invisible to native subjects. The intellectual processes involved in framing practical knowledge within cosmological categories, from the actors' point of view, remain largely obscure. The adaptation of native cosmologies to their material-historical environments can then appear to be . . . the outcome of blind selective forces, rather than the outcome of theoretical work and proactive environmental management on the actors' parts.

Furthermore, there is sometimes a tendency to exaggerate cross-cultural distinctions, as if different systems of thought were not linked together: "The dominant . . . tradition of science is one among many traditions. Historians of science who describe science as a tradition originating from Europe are incorrect and ignorant of the remarkably diverse science traditions internal to Europe itself, traditions that have vied for control over knowledge production" (Nader 1996:8). Nader writes about struggles to create boundaries demarcating magic, science, and religion, how such struggles are embedded in political and economic structures, and how limits surrounding them often imply a civilizing process used to justify the imposition of an allegedly universal science and technology in regions thought to lack development. Only in this way can we understand international development projects such as the Green Revolution (Shiva 1991; Escobar 1995; Scott 1998). Such cases reveal the connections between scientists who may see their work as value-free and the political agendas of some development agents.

The Green Revolution highlights another dimension of some kinds of cosmopolitan science, especially "Big Science" projects like the Manhattan Project: an unshakable faith or belief in the necessity and goodness of the scientific process and the final product. According to Nader (1996:24), "the belief in the omnicompetence of [cosmopolitan] science has been steadily gaining ground throughout this century in this culture, and operating on a core-periphery model in the world." What is needed, she argues,

is a relativizing or "lower-casing" of a Big Science that, in Paul Feyerabend's terms (1978), has the ideological grip of a religion.

The Sociology of Local Science: Connecting Concepts to Practice

Where does this leave the anthropological endeavor, which itself emerged as a modern cosmopolitan science in the nineteenth century? Colin Scott (1996:71) suggests that "anthropology is unique in the degree to which it emphasizes the more inclusive cultural contexts of our local teachers and values ways of translating indigenous knowledge that reflect the symbolic and institutional contexts in which the knowledge is generated." His research focuses on the way in which actors model "social-environmental practices" in terms of "mythico-ritual categories."

Specifically, Scott examines the construction of hunting knowledge by the James Bay Cree in Canada, particularly the paradigms of pan-species personhood and communicative reciprocity. He shows how these categories allow Cree hunters to predict the behavior of geese in ways that are only now beginning to be understood by modern biologists. Central to his argument is the idea that all sciences—including cosmopolitan sciences—are constructed upon certain paradigms. For example, in industrialized societies the idea that nature exists apart from culture and humans (and is therefore subject to their domination) undergirds much of science and may be linked symbolically to notions of hierarchy—with serious implications for the way nature is manipulated in practice. There is no reason, argues Scott, that cosmopolitan science concepts should be accepted a priori; indeed, they should be subjected to the same scrutiny as local science concepts.

Similarly, marine biologist Robert Johannes (1981) takes an anthropological look at coral reef fishing in the Palau district of Micronesia from the "native's point of view" with impressive results. He discusses local conceptions of time used by successful fishermen, including lunar and seasonal rhythms that are often seen as superstitious by city dwellers. Johannes also devotes an entire chapter to a discussion of how seabirds are used as instruments by Palauan fishermen and another to the "traditional conservation ethic," the ideological basis for sustainable fishing practices. It includes established norms for reef and lagoon tenure, avoidance of waste, and laws restricting fishing at certain times. Johannes pays special attention to the influence of "modernization" upon local fishing practice and its

foundational concepts. In particular, he notes that the conservation ethic has declined in the wake of imported food and the dual processes of industrialization and official state education, which have drawn young Palauans away from fishing and into bureaucratic jobs. Johannes's monograph gives special attention to links between theoretical concepts and practices in subsistence activity.

Scott and Johannes suggest new directions in the analysis of local subsistence systems and address some of the shortcomings that characterize many local science studies. They both analyze their respective subject matter using the conceptual categories of local specialists. Both relativize modern cosmopolitan science by contrasting its assumptions with local assumptions about the environment, human-animal interaction, and the relationship of nature to culture. The results force us to consider the possibility that modern cosmopolitan sciences, like any knowledge system constructed upon a set of given precepts (the theory of relativity, the second law of thermodynamics, the effects of lunar patterns, pan-species personhood, etc.), might inherently filter out or exclude certain possibilities that might have a high degree of predictive value for practical application. Both Scott and Johannes examine the interrelationships between local and cosmopolitan science traditions, how each has influenced the other, and how third systems have had an impact on both. Finally, they take Cree hunting and Palauan coral reef fishing, respectively, seriously enough to probe the relationship between local concepts or theories and subsistence practices. What emerges in each case is a sociology of local science—a serious, sophisticated treatment of locally based knowledge production.

In agriculture such an approach is lacking, though important initial steps have been made by anthropologists. For example, in *Coral Gardens and Their Magic* (1935) Malinowski exhaustively describes Trobriand agriculture and links it to social organization, kinship, and the legal order. Although Malinowski alludes to the influence of European society (noting, for example, that the Trobrianders exported food surpluses for consumption in the colonial plantations of New Guinea), he minimizes outside influences. Trobriand horticulture was essentially a means for Malinowski to demonstrate functionalist theory: garden magic integrated farmers' attitudes and organized their cooperation. One reviewer claimed that *Coral Gardens* challenged ethnocentric notions of "primitive" society: Trobriand agricultural methods were "eminently fitted to their environment and tribal structure . . . there is nothing primitive about them" (Madgwick

1936:141). However, this was attributed to the Trobrianders' indigenous farming, not to their intelligent selection of foreign technologies such as steel axes.

Harold Conklin's analysis (1954) of shifting (swidden) agriculture among the Hanunóo of the Philippines is another ethnography which explicitly reviews local farming knowledge and practice. One of the central points is that swidden cultivation occurs in many forms, not all of which are destructive. In fact, the relation of the Hanunóo to their environment appears to be remarkably harmonious. This was an important point to make, for at that time many assumed that all forms of swidden agriculture were ecologically disastrous. Conklin, by contrast, argues that Hanunóo farming is integrated, self-contained, ritually sanctioned, and ecologically viable. Although a detailed list of cultivated crops is included, they are not discussed in wider contexts. One is left with the impression that Hanunóo agriculture is static, stable, and in near-perfect equilibrium with the environment. Absent from the discussion is a consideration of what kind of an impact chili peppers, maize, cacao, coffee, tobacco, and other crops might have had once they were introduced on the island.

Both *Coral Gardens* and "The Relation of Hanunóo Culture to the Plant World" are characteristic of studies which portray local knowledge systems as organic or "home grown." While providing good descriptive data and functional, linguistic, and ecological analyses, they tend to downplay cross-cultural factors. As in many other ethnographies of science,

> there is a tendency to focus too closely upon relatively isolated "villages" or communities of specialists, whether they are Nobel Prize–winning researchers at the Jonas Salk biological laboratories or "traditional" navigators sailing among the islands of Melanesia . . . Perhaps of greatest concern is the general inability of any approach to affect the self-knowledge of physical and biological scientists. (González, Nader, and Ou 1995:867)

But local knowledges are often a complex combination of ideas, artifacts, and institutions that have traveled rough temporal and cross-cultural trajectories, as world-systems theorists and others have made abundantly clear (Wallerstein 1974; Wolf 1982; Mintz 1985; Weatherford 1988).

Clifford Geertz's monograph on *Agricultural Involution* (1963) in Indonesia takes a different approach. His analysis of two agricultural systems shows how the intensive wet rice subsistence farming of Central and East Java was linked to the extensive swidden and cash-crop farming in much of the rest of the country. Specifically, as the latter system was imposed upon a greater portion of Indonesia's land, the former system became increasingly intensified and undiversified ("involuted"). Geertz's study differs from those of Malinowski and Conklin to the extent that it discusses agriculture in a historical, ecological, and geographical context. But it has shortcomings: as one reviewer noted, Geertz's ideal types ignore the important role of intermediate regions practicing both wet rice farming and cash cropping (Jaspan 1965). Nor does the study focus on the various meanings attached to agriculture by the Indonesians themselves.

Other research on local agricultural systems generally falls within three categories: (1) anthropological work describing agricultural techniques in the terms of local farmers;[4] (2) studies analyzing "agroecological" or local "resource management" techniques in terms of cosmopolitan science (Altieri 1987; Wilken 1987);[5] and (3) work reviewing local subsistence strategies in relation to development programs (Chambers 1983; Richards 1985).[6]

These studies successfully demonstrate the effectiveness of local agricultural techniques but rarely focus on how these knowledges and practices have incorporated elements from the outside world and vice versa—in short, they often rely heavily on a separation between the local and the global without considering how ideas and artifacts are borrowed cross-culturally. In this book I attempt to fill part of the void by analyzing the historical trajectory of food plants in a global context, the techniques and knowledges associated with them, and their meanings in a Rincón Zapotec village.

Fundamental Concepts Underlying Rincón Zapotec Farming and Foodways

This study analyzes some of the conceptual bases of Rincón Zapotec farming and foodways and their relationship to actual farming practices. Some are encoded in myths and rituals (as in the case of Cree hunters); others are embedded in institutions (as in the case of Palauan fishermen); still others are expressed more explicitly in informants' explanations of farming and food practices. In a study of myth and ritual among the Valley Zapotec, Fadwa El Guindi (1986:3), invoking the work of Lévi-Strauss, notes:

> Like myth, ritual has been shown to be enormously rich in symbolism and productive as a reservoir of cultural conceptualizations . . . Through ritual's repetitive statements and activities, concepts that are embedded in the collective unconscious of culture-bearers become activated, revealing to the ethnographer and analyst not only their content but their structure as well.

Institutions such as reciprocal exchange or "gift-giving," to the extent that they are "total social phenomena" (Mauss 1954 [1924]:1), may also be exceptionally revealing, as they find "simultaneous expression . . . [in] religious, legal, moral, and economic" spheres of social life. With respect to terminology, explanations, and other utterances, one of the aims "was to discover how people construe their world by the way they talk about it" (El Guindi 1986:23). Ritual, myth, institutions, and language can illuminate a group's shared underlying cognitive structures.

For the Rincón Zapotec, some of the most important concepts include *mantenimiento* (Sp., "maintenance"), reciprocity, the personification of nonhuman and supernatural beings, the normality and inevitability of physical work, food quality, and hot/cold. These six concepts are interrelated and often overlap in ordinary conversation and daily practice; even so, they may be separated for analytical purposes. They do not neatly fit any single typology, but instead might be seen as a mixed bag of interconnected ideas and postulates.[7] Some are genuine theories about the world; others define the goals of local science practice. To avoid ambiguity, I shall refer to the Zapotec ideas as concepts, precepts, and epistemological or conceptual bases.

A number of disclaimers are in order. Not all of the concepts can be mapped mechanically onto all farming and food preparation practices. Some serve as general guides, models, or prescriptions for certain aspects of food production or consumption, in much the same way that Heisenberg's Uncertainty Principle and Bernoulli's Principle dictate practical measures taken in physics experiments and fluid mechanics projects, respectively. They structure action and provide the conceptual tools for real-life activity in the minds of practitioners. Some concepts may be relatively new ideas recently introduced from the outside world. Most of them, however, have probably been deduced over the course of hundreds or even thousands of years.[8]

Nor would I suggest that these terms are used by all Talean farmers. Like fundamental concepts in cosmopolitan science, key agricultural concepts in Talea are generally consensual, but there are those at the fringes who, for various reasons, do not share the more uniform views of other campesinos—these are farmers who, in Kuhnian terms, might not adhere to "normal science." Perhaps the most obvious example is the case of farmers who have abandoned subsistence cropping completely in order to cultivate coffee. They tend to take a radically different approach to farming than their fellow villagers—most notably, bookkeeping becomes more important than householding.[9] Whether this outlook will eventually gain acceptance and replace one based on the notion of household maintenance, remain at the margins of agricultural theory, or disappear entirely in Talea is still an open question.[10]

The genesis of these ideas is a complex question. As we shall see, it is difficult enough to follow the trajectories of artifacts and crops over time, and it is an even greater challenge to track ideas. It is tempting to refer to the following concepts as indigenous, but this obscures the fact that much of what presently encompasses Rincón Zapotec farming and foodways, in both theoretical and practical terms, can probably be traced to the Spanish colonial or postcolonial eras. Because the boundaries separating local and global science traditions blur and overlap, the question of origins is often difficult or impossible to answer. Consequently, such an analysis lies outside the scope of this book.

Mantenimiento (Maintenance)

Mantenimiento, a Spanish term literally meaning "maintenance," is a concept that Talean campesinos use to guide the entire gamut of activities related to food production and consumption. In fact, one of the most significant things about Zapotec farming and foodways is that, when talking about their work and that of their families, many campesinos do not make a sharp distinction between agriculture, food preparation, and consumption. *Mantenimiento* glosses these distinct moments in the life cycles of crops by making reference to their common aim: household maintenance over the course of human lifetimes. The goals or objectives of the activities are thus more important than the setting in which they occur (in the fields versus in the home/kitchen).

This concept of household maintenance, which shares a remarkable congruence with the ancient Greek notion of *oikos* (from which the term "economy" is derived), has a number of practical ramifications for farmers. It implies that a balance must be struck between producing sufficient food so that household members have enough to eat and at the same time limiting production (by allowing land to lay fallow) so that farmland is not overtaxed. The two may be contradictory, but each is necessary to maintain the household. In the case of the former, short-term maintenance is assured by coaxing a sufficient quantity of food from the earth; in the case of the latter, long-term maintenance is guaranteed by preserving land for future generations. *Mantenimiento* spills over into other domains as well. For example, draft animals and pack animals are "maintained" so that they can assist in

the larger role of household maintenance. Children are "maintained" so that they can contribute to household maintenance through farm and domestic work.

Mantenimiento can be drawn into sharper focus by juxtaposing it to growth models that dominate the language of development planners. In growth models the objective of productive processes (including agricultural production) is not equilibrium or maintenance but rather economic growth, generally realized through profit maximization and expressed in terms of "Gross Domestic Product," "average yield," and "productivity." Furthermore, agriculture and nutrition are conceived of as separate categories corresponding to distinct sites.

Reciprocity

Reciprocity is most apparent in the Zapotec institution of *gozona*, a mutual aid arrangement. It is a good example of what Marcel Mauss referred to as *The Gift* (1954 [1924]:1), in which "contracts are fulfilled and exchanges are made by means of gifts. In theory such gifts are voluntary but in fact they are given and repaid under obligation . . . [they are] economic prestations between the component sections . . . [of] 'archaic' societies." *Gozona* touches many aspects of village life, but in its essential form it involves lending goods or services to be repaid at a future date. In farming this typically involves helping kin, neighbors, or friends with several days of agricultural work which are then returned upon request. In food preparation it implies food exchanges and the pooling of labor to cook food, particularly for feasts associated with life-cycle events.

Reciprocal arrangements prescribe relationships with kin, neighbors, and other campesinos, but in reality they extend even further. *Gozona* may be carried out between two villages (for example, when musical groups are exchanged for fiestas) or between families in neighboring villages (for example, when one hosts another during a fiesta). Furthermore, reciprocity in the form of successful farming and good health is expected from the earth, non-Christian spirits, Catholic saints, and the deceased in exchange for sacrifices, prayers, and other ritual offerings. Reciprocity might be related to *mantenimiento* to the extent that it involves the maintenance of social relations with supernatural actors who can help the household successfully sustain itself.

We might contrast such reciprocal exchanges with labor contracts and food purchases which are the norm in many industrialized societies. For example, at life-cycle events in the United States (such as weddings and

funerals) buildings must typically be rented, cemetery plots purchased, food catered, morticians and musicians contracted, etc. Reciprocal arrangements have, in a sense, been replaced by cash transactions. Hence Mauss's observation (1954 [1924]:74): "It is only our Western societies that quite recently turned man into an economic animal . . . *Homo economicus* is not behind us, but before . . . For a long time man was something quite different; and it is not so long now since he became a machine—a calculating machine."

Personification of Nonhuman and Supernatural Actors

The personification of nonhuman and supernatural actors is another concept employed by the Zapotec, not only in the Rincón but in other regions as well (Nader 1969; Marcus 1983). It is most clearly expressed in ritual sacrifices and myths. The earth, for example, is assumed to be a willful being who feels pain when her surface is cut open by a plow or scorched with fire or when her fruits are plucked. Farmers customarily reciprocate by offering sacrifices directly to the earth or her emissaries: stone idols buried in the ground, mountain spirits in the forest, Catholic saints with jurisdiction over farming, or all three. The earth can inflict punishment upon offensive humans by causing accidents, holding human souls hostage, or withholding harvests. Individual crops such as maize are also seen as willful actors, as are deceased humans and certain animals such as snakes and bulls.

Enchanted beings are a part of the local mythology. Perhaps the best-known is the *matelacihua* or *mal aire* (Sp., "evil air"),[11] an enchantress usually described as a beautiful woman with fair hair and skin. She appears in the evenings on footpaths between the village and farms and mesmerizes men. According to Taleans, those enchanted by the *matelacihua* wake up minutes or even hours later, miles away from the place of the encounter. The *bhni guí'a* (Zap., "man of the mountain") is another supernatural being; he dwells in the forest above the village, appearing as a well-dressed man in city clothes. He offers wealth in the form of enchanted money in exchange for one's soul. The *bhni guí'a* seems to represent the excesses of a cash economy; one could interpret his curse as a symbol of the consequences that the pursuit of cash might have for householding, reciprocity patterns, and so on.

For the Rincón Zapotec, even one's own body may express willfulness by "requesting" certain foods—"hot" foods if it feels "cold" or "cold" foods if it feels "hot." Furthermore, it may crave certain items (often without the individual being aware of it), giving startlingly explicit indicators: an

inflamed thumb or big toe may signal a craving for spicy pork sausage; a yellowish abscess on the lip, a craving for pork skin; lumps around the neck or lower jaw, a craving for eggs; parted skin behind the ear, a craving for fish.

These personified entities contrast sharply with conventional concepts among development agents and many modern cosmopolitan scientists, who view intentionality and willfulness as the exclusive domain of humans. Earth, water, forests, and, more generally, nature are considered to be inanimate objects, while for developers animals and plants are usually treated as instruments, capital, or commodities. Michael Adas (1989:213) notes that during the Enlightenment, "through scientific discoveries, the long-hidden secrets of the 'world machine' were being revealed, while a great proliferation of technological innovations was making it possible for Europeans to tap vast reservoirs of natural energy previously not even known to humans"—the earth emerged out of the Enlightenment not as a living being, but as a mechanical object. Thus the dominant post-Enlightenment view of "nature" stands quite apart from that of the Rincón Zapotec.

The Normality and Inevitability of Physical Work

Most Rincón Zapotec assume that physical work is a normal and inevitable part of life for all but a select few. In the words of an informant, "There's no rest until they lay the leaves on your belly" (a reference to the broad leaves of a plant used to cover earthen funeral mounds). Michael Kearney (1972:45) observed a similar, though more fatalistic and tragic, outlook on the part of Sierra Zapotec in the village of Ixtepeji. From a young age, Taleans learn how to do simple farming and food-processing tasks, and parents take special precautions to ensure that their children do not grow up to be lazy people. They train their children to carry out chores responsibly; to ensure that their infants will collect firewood efficiently later in life, some farmers place tiny amulets around their necks, formed from a cocoon resembling a miniature log. One of the most striking things about the fieldwork experience was the sheer physical strength of many villagers—men, women, and children. It was not unusual for a campesino to carry 130 percent of his or her own body weight using a tumpline. Many were able to stoically endure pain or physical discomfort for long periods.

Critiques of those who escape manual work are harsh. Taleans often describe the inhabitants of Villa Alta, a neighboring village that has served as the political and administrative seat of the region since its founding by the Spanish in the 1520s, as parasitic, lazy people who make an unscrupulous

living by collecting legal fees from hard-working country folk. Politicians and, in some cases, schoolteachers are criticized along similar lines. During fiestas, villagers ritualize such criticism by lampooning government bureaucrats such as the *agente del ministerio público* (Sp., a locally stationed district attorney representing the federal government), secretaries, and police in colorful Conquest plays. The officials are portrayed as overpaid people who dress in city attire and sit uselessly before typewriters, sipping sodas.

Such a view differs from a recurrent theme among many modern economists, who view physical work as distasteful and hold out the possibility of the liberation of humans from the drudgery of manual labor, expressed by theorists of both the left and the right. Karl Marx predicted that technology and automation would eventually render manual labor obsolete and ultimately lead to socialist revolution. Neoclassical economists, in a similar vein, currently tend to describe countries with many white-collar workers and "service sector" employees as more developed than countries with many people devoted to "primary sector" (agriculture, mining, logging, etc.) or "secondary sector" (blue-collar) work. Sidney Mintz (1985:35) has suggested that such a view may have predated the industrial era among New World colonists: in sixteenth-century New Spain many colonists viewed physical work as ignoble, using the Spanish term *deshonor del trabajo* to articulate this view. In short, many economists have attached a negative value and low status to physical work, and automation itself—in agriculture, in the industrial sector, and in offices—may represent an effort to minimize it as much as possible. Thus in many parts of the industrialized world manual labor is often viewed as neither normal nor inevitable.

Food Quality

For Taleans, the food quality of crops is often more important than the quantity harvested. This means that, for many, there is a threshold below which crops become unfit for human consumption. This is frequently articulated by Taleans in conversation and in their maxims: *Somos humildes pero delicados* (We are humble [poor] but delicate [picky]), I was told by a number of informants. Others noted that "[e]ven though we only have our little beans, they are legitimate, and we can eat them with pleasure because we know they're clean." In practical terms, this is manifested by a distinct preference for locally grown maize, beans, sugarcane products, coffee, poultry, beef, and other foods over imported items. "Knowing where it comes from" is critical in assessing foods, and many people purchase imported maize and beans only in cases of extreme privation. This implicitly

forms part of a broader civilizational scheme opposed to urban models: indeed, viewed from the countryside, urban folk appear animal-like, since they eat anything, at any hour, without knowing whether it has been irrigated with sewage or drenched in pesticides—an unexpected situation in which city dwellers are classified as "brutes" or "barbarians." Food forms part of a broader scheme in which a high value—and an underlying civilizational assessment—is attached to those substances most important for the survival of humans: high-quality food, pure water, and clean air.

Among many bureaucrats in industrialized societies, quality may sometimes be a consideration, but in distinct ways. For example, in the United States, from the perspective of multinational food corporations and government bureaucrats, "food quality" often refers to the external appearance of fruits and vegetables or ritual inspections of meat and poultry processing plants by U.S. Department of Agriculture (USDA) officials. More subtle conceptions of quality such as taste, texture, or the presence of pesticides are not always taken seriously (indeed, the ability to taste quality may be effectively impaired if consumers have no sense of how foods may vary). The requirements of a long, economically rational food chain may often take precedence over other criteria (though in Chapter 8 we shall see how this may be changing as organic foods gain popularity). This may explain the justifications for the injection of hormones in cattle, the use of pesticides and herbicides on farms, and other cases in which quality may be sacrificed in order to realize greater quantities of food.[12] Across much of the United States, the quantity of food (including its year-round availability) has often taken precedence over its quality.

The Hot/Cold Concept

Nearly all Taleans describe food, drink, plants, medicine, soil, and other substances as "hot" and "cold"; to the North American observer, the deployment of the categories seems ubiquitous. Humoral theory (or the hot/cold concept) has been extensively documented across Latin America. It is described by George Foster (1994:2–3) as a system in which

> all foods, all herbal and other remedies, and many other substances as well (such as iron), have a metaphoric "quality" . . . a humoral value of "hot" or "cold" (and occasionally "temperate") that serves primarily to distinguish classes of foods and remedies . . . [Illnesses are] due to hot and cold insults (sometimes thermal, sometimes metaphoric) that upset the bodily temperature equilibrium that is believed to spell health. A hot insult produces a hot illness, while a cold insult produces a cold illness. Therapies . . . conform to what has been known since the time of Hippocrates as the "principle of opposites": a Cold remedy for a hot illness, and a Hot remedy for a cold illness.

In Talea, as in many parts of Mesoamerica, "other substances" include soil, water, certain minerals, human or animal fluids (for example, snake venom or bulls' blood), and air. Personality characteristics are often described in these terms (e.g., people from hotter regions are described as "hot-blooded").

Classificatory schemes are subject to inter- and intravillage differences, and Foster notes that even the same informant may give contradictory data. Some foods are consistently classified as hot (chiles and garlic), however, while others are consistently classified as cold, particularly plants with a high water content (for example, avocados, raw sugarcane, and cactus leaves) or game animals hunted in the ("cold") forest. Many others are classified according to criteria that are more elusive: oranges are hot, but limes are cold; beef is hot, but pork is cold; mezcal (distilled from the blue agave [*Agave* sp.]) is hot, but *aguardiente* (distilled from sugarcane juice) is cold; Coca-Cola is hot, but Alka-Seltzer and beer are cold. When I asked how hot and cold are distinguished in the latter cases, several informants told me that cold items make one ill if taken at night, while hot items do not. It may be that the effects of food items, rather than any of their intrinsic properties, serve as a guide for classification.[13]

In recent years anthropologists have "hotly" debated the origins of the Latin American humoral system. Foster (1994) claims that Spaniards—who inherited the system from the ancient Greeks—introduced the system in Latin America. Others argue that humoral theory evolved independently in the Americas (Butt Colson and de Armellada 1976; Ortiz de Montellano 1990). It now seems to have been established beyond a reasonable doubt that the American and Old World systems evolved independently before fusing in the decades following the Spanish Conquest.[14]

The Science of Zapotec Farming[15]

In a recent anthropological exploration of science, Sandra Harding (1998: 308–314) asks, "Could there be other sciences, culturally distinctive ones, that also 'work' and thus are universal in this sense?" Though the conventional view in industrialized society holds that only the "cosmopolitan" sciences deserve such a designation, a reconsideration of Harding's ques-

tion might be fruitful. We might ask: Do the knowledges and practices of Zapotec farming and foodways—or any other system of local knowledge—constitute a science? If they are so thoroughly infused with quasi-religious and other problematic premises and assumptions (viewed from the perspective of contemporary international science), how can we describe Zapotec farming and foodways as a science in their own right?

Looking at the science concept in historical perspective is helpful. The word "science" came into the English language in the fourteenth century as a term for knowledge in the general sense. This continued until the nineteenth century, when it began to refer exclusively to the physical and experimental sciences. Science became associated with experiment rather than experience, and the terms "scientific," "scientific method," and "scientific truth" were used to describe the successful methods of physics, chemistry, and biology (Williams 1985:277–279).

My position is that science, in its most essential form, is a practical quest for truths about the world—a dynamic search for effective "knowledge, based on experience and fashioned by reason" (Malinowski [1948] 1925). In order to differentiate this definition of science from others, we might contrast it with a range of competing meanings:

1. Science as a collection of certain truths that have been verified (for example, Newtonian physics).
2. Science as high technology (as portrayed, for example, in the mass-media views of space travel, cloning, etc.).
3. Science as a social enterprise (for example, activities associated with the U.S. "Big Science" establishment).
4. Science as "what scientists do" (often meaning modern cosmopolitan scientists). This includes their errors, miscalculations, life problems, worldviews, etc.
5. Science as a form of inquiry that makes use of a particular method (the scientific method).
6. Science as the achievement of Superior Western Man. This is, at its root, a form of racism posing as science and long predates modern cosmopolitan science. Note, for example, the Spaniards' use of the term *gente de razón* (people of reason) to describe Europeans, as opposed to *gente de costumbre* (people of custom) or Indians. This view of science continues to the present day.

A great deal of what is written about "science" today mixes up these and other definitions, and in practice they are often confused by the mass

media, government and non-government organization (NGO) bureaucrats, and development agents, as well as by the lay public. But by proposing a working definition of science that emphasizes the practical process by which people seek to discover truths about the world around them, I hope to create an area that is broad enough to include the activities of such diverse groups as Zapotec farmers, Chinese acupuncturists, nuclear physicists, agroecologists, and many others.

A critical part of my formulation is the notion of science as *practice*, as a practical search for knowledge to understand certain aspects of the world in which actors, while constrained by certain structures (conceptual, social, and material), can and do transform them over time, through practice (Farquhar 1994; Nyerges 1996). That is, people engaging in scientific activity begin with given frameworks, conduct practical experiments, analyze results, and modify given frameworks or invent new ones when faced with too many anomalies (Kuhn 1962). From this perspective, the search for knowledge takes the form of a dynamic accommodation that people make between experience and received wisdom.

Objectives and Themes of This Book

Here I have intentionally presented the Zapotec concepts in preliminary form so that they may be more fully developed later in the book. They take on more meaning when they guide daily activities (that is, when they are put into practice), and illuminating the way in which conceptual categories inform farming practices is an important goal. Ultimately, I shall use these concepts to examine the possibility that certain methods prescribed by the Zapotec concepts might long have eluded cosmopolitan scientists. This is closely related to one of the book's underlying themes: the legitimacy of local science. As we look at how the concepts are actually used to inform the fashioning of implements and maize, sugarcane, and coffee cultivation, it will become clear that Zapotec farming is remarkably successful when we assume the perspectives of its practitioners.

Another theme is the interconnectedness of Zapotec agricultural science and cosmopolitan science. Specifically, this book illustrates that the boundaries demarcating Zapotec farming and cosmopolitan science may be artificial because of the constant diffusion of crops, implements, and techniques across continents—what Alfred Crosby (1972) refers to as "the Columbian exchange." This theme illustrates the complexity of farming systems worldwide following centuries-old exchanges of plants, tech-

niques, and knowledges. In short, local agricultural sciences have become "cosmopolitan" even as "cosmopolitan" sciences have become "localized" because of the multidirectional movement of crops and technologies.

Globalization is another theme. Analyses of local knowledge systems, particularly in the field of agriculture, could potentially enrich globalization studies by exposing possible connections between international political and economic policies and specific regions or communities. I have situated Zapotec farming within a global context to show how international institutions—as well as more general globalization processes—form a critical part of the reality, history, and local science of the Rincón Zapotec. I do this by focusing on three "world" crops grown in Talea, with distinct histories and complex trajectories over space and time: maize, a New World crop that diffused across Europe and Asia rapidly after 1492; sugarcane, an Old World crop thought to be native to New Guinea and introduced in the Americas shortly after the Conquest; and coffee, an Old World crop discovered in Ethiopia, popularized in the Middle East, and brought to Mexico (by way of Europe) relatively recently. Conventional notions of Eurocentric diffusionism—that the "West" developed the "rest"—are highly problematic if we trace the paths of crops in the era of empire (Kloppenburg 1988; Blaut 1993). Globalization also enters into my analysis of imposed development—from obligatory mining, cotton, and cochineal production organized by the Spanish in the colonial era, to the massive Papaloapan River basin development project of the mid-twentieth century (modeled after the Tennessee Valley Authority), to the U.S.-led Green Revolution and Mexican factory farming.

A number of issues in the concluding chapter also concern the theme of contemporary globalization. Specifically, I discuss the interrelated problems of global food security, environmental deterioration, the rapid diffusion of genetically modified crops, and the loss of genetic diversity—issues affecting small farmers across the world in the wake of the North American Free Trade Agreement (NAFTA), the General Agreement on Tariffs and Trade (GATT), and other "free" trade regimes that have radically extended the reach of multinational agribusiness firms (Nash 1992, 1994).

I suggest that as grain yields stagnate, as world population continues increasing, and as usable farmland around the globe decreases, possible solutions to the problems of twenty-first-century agriculture might be found among the Zapotec. They are extraordinarily efficient consumers of food who derive the vast majority of their nutrition from maize while consuming few meat products. They enjoy a high level of food security because nearly

all their food is grown locally, using little fertilizer and virtually no pesticide. In essence, I argue that subsistence and semisubsistence agricultural systems are becoming more important because of, not in spite of, global integration. Unlike conventional factory farming, local farming systems often use tried and true techniques for controlling pests without chemicals, for managing droughts without irrigation, for feeding people without poisoning them, and for preserving high levels of biodiversity in and around farms. Cutting-edge scientific work by agroecologists, botanists, mycologists, entomologists, and others researching local ecological knowledge is testimony to an interest in producing nutritious food in a sustainable fashion—an activity that the Zapotec have successfully engaged in for more than 5,000 years.

This study should contribute to at least three growing fields. Literature on local knowledge systems is expanding rapidly, but appears to be marginalized within the anthropology of science and technology. Part of the problem may be the low status attached to local science studies in the United States; some of the best collections have been published by Australian, Swiss, and Canadian institutions (Williams and Baines 1993; Johannes 1989; Freeman and Carbyn 1988). With respect to local agricultural systems, the works of Robert Chambers (1983), Paul Richards (1985), and Gene Wilken (1987) are especially noteworthy. In Latin America a small but growing number of researchers are building a core body of work on local farming systems, resource management, and sustainability (Hernández Xolocotzl 1977; Toledo et al. 1985; Altieri 1987; Trujillo Arriaga 1987; Tyrtania 1992; Toledo 1995).

As an anthropological critique of development, this book should supplement previous work, including analyses of the depoliticizing effects of development projects in Lesotho (Ferguson 1990); of development as discourse (Escobar 1995); of development as an enterprise that often ignores local knowledges (Richards 1985); and of development as the product of high-modernist, authoritarian state planning (Scott 1998). In the field of Mexican rural development this book should complement analyses of recent land-tenure reforms (DeWalt and Rees 1994), the effects of and possibilities for rural development programs among the Maya (Faust 1998), and the impact of Latin American development on indigenous peoples and the environment (Wright 1990; Nigh and Rodríguez 1995).

Finally, this study updates the still modest ethnographic record of the Northern Sierra. Apart from a handful of ethnographies based on research conducted in the Rincón and surrounding villages (Nader 1964, 1990; Par-

nell 1989; Tyrtania 1992; Hirabayashi 1993), relatively few monographs on the Zapotec of the Northern Sierra have been published (Schmieder 1930; de la Fuente 1949; Mendieta y Núñez 1949; Pérez García 1956; Berg 1968; Kearney 1972; Young 1976; Ríos Morales 1994).

Methodological Approaches

Anthropologists enjoy a host of methodological approaches, and it is important that the fieldworker select analytical units and methods appropriate for specific research questions. Because my study is about local science in a global context, I focus on a particular place—a village community.

Community studies have a long tradition in Latin American anthropology, from the work of Robert Redfield (1930), Elsie Clews Parsons (1936), George Foster (1948), and Julio de la Fuente (1949) to the more recent work of such anthropologists as Lynn Stephen (1991), Frank Cancian (1992), and Jeffrey Cohen (1999). For most of the twentieth century, however, many ethnographers did not explore links connecting villages, regions, nations, and the world system. After the 1960s Mexican anthropologists in particular critiqued these mostly functionalist ethnographies (some of which were used to guide projects in applied anthropology) on the grounds that they negated the need for structural change in Mexico by limiting the scope of analysis to village affairs rather than national or global politics (Bonfil Batalla 1962; Warman 1970; Stavenhagen 1971). More recently, some U.S. anthropologists have attacked community-based ethnographies as inadequate for capturing the complexity of the multi-sited world in which we live. In this book I attempt to combine both local and global approaches by maintaining a strong focus on one village while exploring global events through history and prehistory. In other words, I have tried to view global changes from a local vantage point.

In terms of field methods, the most valuable was "learning by working," a variant of participant observation in which the researcher accompanies informants to their work sites and toils with them in order to learn through firsthand experience. This method has been suggested mainly by people in the international development field looking for creative research methods for solving practical problems (Chambers 1983; Richards 1985). In practice, it has been carried out in only a surprisingly small number of cases (Hatch 1974; Devitt 1977; Richards 1979; Johannes 1981). To collect the data for this book, approximately thirteen months (out of a total of eighteen) were spent doing fieldwork—literally in the fields—an average of five days each

week on farms and in forests and ranch houses more than an hour's hike from the village. During this time, I learned to use and maintain machetes, axes, hoes, plows, coffee depulpers, sugarcane mills, and other implements; to select and cut firewood; to cook beans, stews, and other foods; in short, to do most of the things that a young Talean campesino might be called upon to do in the course of the agricultural season. My education was put in the hands of a man described by several people as Talea's most dedicated campesino, highly recommended for his profound knowledge of plants and animals, his unremitting patience, his household's economic situation (he had no sons old enough to accompany him to the fields), and, not least of all, his thoughtfulness and sobriety. He and the farmers located near his ranch house became informants, neighbors, and close friends.

In spite of initial hardships, this approach offered advantages that would have been difficult, if not impossible, to realize in any other way. As farmers patiently taught me how to work without unduly punishing myself, they inculcated me with the frameworks that guided their own agricultural practices and elaborately explained the logic underlying their actions. They were occasionally bewildered at my inability to grasp some of their most basic, taken-for-granted concepts; but over time, as I unraveled the structures underlying everyday conversations, the assumptions became much clearer. Through their spoken words, they also fleshed out intricate links between their work and their lives, between agriculture and personal history. Perhaps just as importantly, I think that learning by working gave me a level of rapport—what the campesinos call *confianza* (Sp., literally "confidence")—that cannot easily be described. Suffice it to say that working alongside others in the most fundamental set of activities that constitute subsistence farming, day in and day out, quickly earns one a kind of respect that may be impossible to duplicate by other means.

Learning by working was supplemented with participant observation in the village. I gained a great deal of insight by participating in Talea's band and orchestra (where I played the trumpet) through most of the fieldwork period. Because one of the two musical groups was typically asked to play at fiestas, funerals, weddings, and other functions, I was automatically invited to many critical life-cycle events and village celebrations by virtue of being a musician; many Taleans greatly appreciated my services, judging from their favorable comments and encouragement. (The tradition of village bands is strong throughout much of Oaxaca. Most rural communities, even those with fewer than 300 inhabitants, have at least one musical group and take great pride in it.) It would be difficult to over-

estimate the significance of music in the Sierra; indeed, musical groups are important organizations with political implications at the village level (Nader 1990), and participation in the groups has customarily been less a pastime or diversion than a serious obligation. The musicians themselves, who are seen as role models by younger villagers, became an important pool of informants, since the vast majority were campesinos ranging in age from twelve to about seventy-five. The camaraderie among musicians is strong, perhaps because of the collective nature of making music and the shared sacrifice that long hours of practice and performance entail, and I gained many insights through close rapport with group members. Because membership in the musical groups drove home the obligatory and burdensome nature of reciprocity, it was profoundly educational. I learned that although musicians take pride in their musical abilities, they must meet rigorous demands and high expectations: participation inevitably means long, sleepless nights spent playing in the cold; the occasional neglect of farm work, animals, and families; and, in general, fatigue. For me, being a musician meant striking a physically exhausting (and sometimes impossible) balance between musical responsibilities, agricultural work, and note-taking. Nevertheless, to the extent that I was drawn into networks of reciprocity and obligation—and expected to participate in organizational matters (official meetings regarding appointment of group officials, negotiating sessions with municipal officials, festival committees, and church representatives)—music was an invaluable source of education about village politics and small-scale democracy.

I conducted a village census with the help of four research assistants, which included questions about agricultural production, household self-provisioning, and migration. I also interviewed members of campesinos' families, merchants' families, and other villagers. In addition, I consulted physicians, teachers, and other government employees in formal and informal settings as well as representatives of civil and religious organizations with a strong presence in the region, such as Catholic missionary groups and NGOs. I spoke with others interested in the region, including biologists, anthropologists, and government officials in Oaxaca City. Finally, aerial photographs provided the basis for an analysis of village land-use patterns.

Organization of This Book

To understand Rincón Zapotec farming and foodways, we must know something about the historical contexts in which they developed. In Chapter 2, I outline the geography and history of the region. First I focus on the Rincón and Talea, particularly its geographic features and its fields and forests. I continue by reconstructing Sierra society on the eve of the Conquest and then by describing colonial-era political, economic, and social structures. The chapter includes a discussion of farming practices in the wake of post-Conquest plagues, pestilence, and tribute payments to Spanish administrators as well as more recent changes in village history. It concludes with a description of the village's economic, cultural, religious, and political landscapes, including an analysis of its regional, national, and "transnational" contexts. This clears the way for a detailed look at Zapotec farming.

In Chapter 3, I review weights, measures, farming implements, and other artifacts essential to successful food production. For campesinos who do not resist the idea that physical work is an inevitable part of life, the importance of custom-made tools should not be underestimated. Crafting implements requires complex calculations—all of which are retained mentally—and a degree of control over bodily coordination to ensure accuracy in the construction process. The chapter concludes by discussing the creative uses of scrap materials, the role of the campesino as an artisan who produces tools for his or her own use, and the implications of changes which threaten the survival of Zapotec farming.

In Chapter 4, I analyze maize, a New World crop dating far back to prehispanic times, with special reference to how the crop fits into distinctly Zapotec notions of living matter. The chapter begins with a review of several legends, myths, and rituals in which the crop and its bearer, the earth, are personified. From these accounts, certain key concepts come to light, including the personification of nonhuman and supernatural actors and the importance of reciprocity. This review is followed by a brief social history of the crop, particularly the role it played in the demographic expansion of the Old World and other "agricultural revolutions."

In Chapter 5, I take a closer look at maize farming practices and food preparation in Talea. This is followed by a discussion of distinctive methods (intercropping, the construction of earth mounds, and techniques based on lunar rhythms) that are of special interest because they have only recently been recognized as effective practices by some cosmopolitan scientists. The chapter concludes by looking at the issue of food quality as a dominant concept among the Zapotec.

Another important staple food in Talea is sugarcane, the topic of Chapter 6. As an Old World crop it differs from maize in important respects,

but observers are correct in noting that "most species introduced [by the Spanish] have been totally integrated [into indigenous schemes] and are conceived of as 'creoles' " (Katz 1992:766). After a brief historical profile of the crop, I review farming techniques and the role that reciprocity plays in sugarcane production. Throughout, I focus on two questions. Why is it that sugarcane production has remained a smallholder activity in Talea? And why do Taleans prefer locally produced *panela* (unrefined brown sugar) over white sugar imported from outside the region, even when the latter is much cheaper? I conclude with a discussion of the symbolic aspects of sugar.

Coffee is a more recent crop. Since its introduction in the Sierra approximately 100 years ago, it has become integrated into Zapotec farming and social life. One of the main points of Chapter 7 is that coffee has become a part of the very identity of Taleans and that it has supplemented, not replaced, subsistence farming. Coffee forms part of a long-term strategy for household maintenance for the vast majority of campesinos. It is generally grown on parcels of land smaller than four hectares; unlike other parts of Mesoamerica, the Rincón has no large plantations (greater than ten hectares). At the same time, coffee has presented a number of contradictions because the crop is produced primarily for distant overseas markets, sometimes with severe price fluctuations. As a result, most campesinos have been unwilling to give up subsistence crops. The section ends with an account of the shifting political economic realities of coffee in the region.

In the final chapter, I examine the broader implications of Zapotec farming and foodways and the status of Zapotec agriculture vis-à-vis cosmopolitan science. This opens up a long-standing set of issues in the anthropology of science and technology. What constitutes science, and who is qualified to carry it out? In what ways is cosmopolitan science more successful than local science and vice versa? Is cosmopolitan science subject to ideological blinders that filter out new ways of constructing knowledge? These questions are addressed by examining the rise of new cosmopolitan sciences such as ecology, agroecology, alternative medicine, and others that have been informed by local science traditions. Specifically, I examine certain elements in campesino food production and consumption that were once considered superstitious, illogical, or prescientific by "normal scientists" but are now being taken more seriously by innovative cosmopolitan scientists. (By no means are all cosmopolitan scientists cut from the same cloth.) In short, the recent rapid rise of cosmopolitan science

concepts that closely resemble those of some local science systems—including sustainability, ecology, alternative medicine, organic farming, and others—is probably part of a corrective trend in modern cosmopolitan sciences. Finally, I look at Zapotec farming and foodways in the context of international development initiatives and transnational firms and conclude with a discussion of the boundaries of science and technology.

Throughout, I follow three threads that constitute the fabric of Talean farming: campesino conceptions of living matter or what we might call "nature"; science (specialized knowledge about farming that campesinos bring to bear on their work); and technology (implements and techniques used in crop cultivation). Viewing these intertwined elements as part of a dynamic agricultural system (with disjunctures and contradictions as well as continuities) is a central part of my story and might serve as a framework for integrating Zapotec farming and foodways.