Dietary Practices, Socioeconomic Status, and Social Mobility at Teotihuacan, Mexico

by

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ABSTRACT

This project investigates social mobility in premodern states through a contextualized program of isotopic research at the archaeological site of Teotihuacan, Mexico. Due to the lack of a concrete methodology that can be used to recover information concerning rates of social mobility from archaeological remains, many traditional archaeological models either ignore social mobility or assume that boundaries between socioeconomic strata within archaic states were largely impermeable. In this research, I develop a new methodological approach to the identification of socially mobile individuals in the archaeological record based on changes in the diet across the lifecourse that can be detected through isotopic paleodietary indicators. Drawing upon cross-cultural research surrounding the relationship between diet and socioeconomic status and established methodologies in the biogeochemical analysis of human remains, this methodological approach provides a basis for broader comparative studies evaluating the nature of social mobility within archaic states.

I then test the practical application of this methodology by applying it to a mortuary sample including individuals from distinctive socioeconomic groups from the pre-Hispanic city of Teotihuacan, Mexico. The study recovers and uses the dietary isotope ratios within bone and tooth samples from 81 individuals buried throughout the city 1) to define the dietary correlates of wealth and status at Teotihuacan and 2) to identify individuals displaying lifetime dietary changes consistent with changes in socioeconomic status. In addition to supplementing our current understanding of Teotihuacan foodways and processes of geographic migration into the city, I identify an adult male individual from the La Ventilla B apartment compound who displays dietary changes throughout his life that are consistent with downward socioeconomic mobility from a high status socioeconomic group in early adolescence to an intermediate status group later in adulthood. I conclude by identifying ways to move forward with the comparative archaeology of socioeconomic mobility in premodern contexts and highlight the applicability of archaeological information to our understanding of present-day processes of social mobility.

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CHAPTER 1: INTRODUCTION

The American national ideal of equality of opportunity for individuals, regardless of circumstances of birth and upbringing, relies heavily on the concept of socioeconomic mobility. Research from the Brookings Institution indicates that over two-thirds of Americans believe that the economic system in which they live functions as a meritocracy, where one's ability to be economically successful is a product of hard work, intelligence, and skill (Isaacs et al. 2008). While the "American Dream" glorifies individual achievement and social advancement, the existence of social inequalities that limit particular individuals' chances for success from the outset systematically exclude certain groups of people from this dream.

Socioeconomic mobility statistics indicate that "glass ceilings" continue to limit full equality of opportunity to members of our society. For example, children born into poverty in the United States are over twice as likely to remain there as would be expected by chance, while the mobility prospects for poor girls and for poor African-American children are even worse (Isaacs et al. 2008). In order to address the gap between national ideology and socioeconomic reality, we need to understand the social, economic, and political conditions that make social mobility possible to diverse groups.

Decades of sociological and historical research suggest that variability in small-scale social institutions (sensu Ostrom 2005), rather than large-scale differences in economic or political organization, play the largest role in explaining intersocietal differences in the patterns of social mobility among groups (Erikson and Goldthorpe 1992; Mayer 2005; Wong 1990). Due to its ability to delineate a broader range of human behaviors and social systems than exist today, archaeology can provide an important source of information that complements insights from other social science disciplines to enhance our understanding of social mobility processes. The study of social mobility processes within archaic states has the potential to broaden our comparative societal database while granting a long-term perspective on the development and sustainability of different opportunity structures.

However, the frequency of social mobility within ancient states has never been systematically evaluated using archaeological data. Since there is currently no explicit methodological framework for studying social mobility in the archaeological record (though see Rathje 1973 and Wilkinson and Norelli 1981 for creative attempts), most traditional archaeological models of archaic states either ignore the topic of social mobility or assume that boundaries between socioeconomic strata were largely impermeable (e.g., Flannery 1972; Fried 1967; Johnson and Earle 1987; Service 1971). Historical accounts of past societies do, however, reveal to us numerous stories of individuals who experienced lifetime changes in their socioeconomic status. In the Chan Kuo period of ancient China, commoners were able to obtain titles and economic rewards through military service, and some were even able to rise from obscurity to eventually become generals and royal chancellors (Hsu 1971). In the Aztec empire, both successful warriors and members of the merchant class, or *pochteca*, were able to accrue wealth and social importance, and at times may even have been able to become minor lords (Lockhart 1992). Even within the caste system of medieval India, mechanisms existed that allowed low caste Sudras to adopt Brahmanic ritual functions through participation in devotional sects and to receive endowments commensurate with their high ritual rank (Stein 1968).

These and other accounts make it clear that through time and space, different mechanisms and pathways have opened up to allow certain individuals to leave behind the social and economic groups into which they were born and to make lives for themselves in a different social context. In addition to promoting interdisciplinary links with other social sciences in understanding present-day social mobility processes, the comparative study of socioeconomic mobility within archaic states therefore dovetails well with recent trends in archaeology focusing on variability in the structure, operation, and characteristics of state-level societies (e.g., Blanton and Fargher 2008; Elson and Covey 2006; Feinman and Marcus 1998; Richards and Van Buren 2000).

Research Objectives

In this dissertation, I contribute to anthropological models of archaic states by developing an original methodological approach to the identification of social mobility within the archaeological record. This approach draws upon established research in the areas of both the anthropology of food and cuisine and the biogeochemical analysis of human remains to link dietary changes during a single individual's life with changes through time in that person's socioeconomic status. Food and cuisine are strongly linked with both the economic power relationships governing food production and consumption and the nonmaterial aspects of socioeconomic systems, such as social prestige (Gumerman 1997; Mintz and DuBois 2002). Though significant recent research has evaluated food consumption as a practice through which social distinctions are expressed and reinforced (e.g., Bray 2003a; Dietler 1996; Hastorf 1990), few researchers have explored flexibility and movement in social identity and economic standing using dietary indicators. In societies characterized by clear dietary differences between socioeconomic groups, dietary changes experienced by individuals during their lives provide one potential line of evidence concerning mobility between socioeconomic groups. However, these dietary changes must be evaluated in a contextualized manner in order to control for other social distinctions that may impact diet, such as age, gender, and ethnicity.

Biogeochemical analyses provide the technical tools necessary to identify lifetime dietary changes and to link them to a suite of archaeological and bioarchaeological lines of evidence bearing on socioeconomic status and social identities. Stable isotope analysis rests on the principle that the isotope values of the foods that individuals consume become incorporated into their skeletal tissues. After an individual's death, researchers can then reconstruct aspects of that person's diet during his or her life through inspection of the ratio of different isotopes within these tissues. Because the isotopes in tooth enamel preserve a permanent indication of childhood and early adolescent diet while somatic bone contains chemical values accrued during the last years prior to an individual's death, comparisons of the isotopic values found in the two tissues can identify dietary changes experienced during an individual's lifetime (Sealy et al. 1995). Evaluating these cases in a contextually informed manner may allow us to determine whether these dietary changes are likely due to socioeconomic mobility, to shifts in one or more social identities, or to some other factor.

The application of this approach in the case of Teotihuacan, an early Mesoamerican metropolis, allows us to understand previously unexplored aspects of the socioeconomic organization of early Mesoamerican states while providing a road map for broader comparative studies evaluating the nature of social mobility within the archaeological past. At the outset of the current era, Teotihuacan was a thriving metropolitan state whose influence was felt across large portions of Mesoamerica. Teotihuacan's multi-ethnic population resided in residential apartment compounds surrounding an extensive ceremonial core containing monumental pyramids, palaces, and administrative buildings. Clear differences in the size and quality of apartment compounds within the city leave little doubt that marked social differentiation existed among residents (see Millon 1976; Sanders 2008), while a diverse and complex mortuary program focused primarily on subfloor burial within domestic compound space allows published evidence from domestic architecture and mortuary offerings to be used to understand the economic standing and social identities of individuals at the time of their death and burial (Manzanilla and Serrano 1999; Rattray 1992; Sempowski 1994). Previous paleodietary research at Teotihuacan additionally provides preliminary indications that members of distinct socioeconomic groups within the city maintained dietary practices measurably different from one another in both carbohydrate source and animal protein intake, supporting the use of dietary change as a potential proxy for social mobility within this cultural context (Casar et al. 2017; Morales Puente et al. 2012; White et al. 2004a,b).

Through a contextualized program of isotopic research at Teotihuacan, Mexico, this dissertation project recovers and uses the dietary isotope ratios within bone and tooth samples from 81 individuals of distinctive socioeconomic statuses buried throughout the city 1) to define the dietary correlates of wealth and status at Teotihuacan, 2) to identify individuals displaying lifetime dietary changes consistent with changes in socioeconomic status, and 3) to examine patterns in the social categories (gender, ethnicity, etc.) of socially mobile individuals. The results are then used to evaluate and reflect on the utility of biogeochemical analyses of lifetime dietary change to recover information concerning rates of social mobility from archaeological remains.

Organization of this Dissertation

The following chapters expand on the basic methodological approach to the study of past socioeconomic mobility described above and apply it in the case of Teotihuacan. Chapter Two provides a theoretical background into status, class, and socioeconomic mobility, with a particular emphasis on the interrelationships between social and economic systems of inequality. I define the major theoretical terms that I use throughout the dissertation and emphasize the importance of the intersectionality of social identities to our understanding of how some individuals, but not others, are able to encounter and take advantage of opportunities to become socially mobile. After exploring the reasons why archaeological data has not previously been brought to bear on scholarly understandings of social mobility processes, I outline three dimensions along which bioarchaeological data sets can evaluate processes of social mobility within archaic states.

Chapter Three supports the use of lifetime dietary change as a proxy for socioeconomic mobility by reviewing the strong relationship between diet and socioeconomic status in Mesoamerica and beyond. I outline nutritional, economic, and symbolic theoretical approaches to understanding human dietary behavior and emphasize the need to combine these different perspectives into a holistic approach to socioeconomically-based dietary differentiation. I also review ethnographic and ethnohistoric accounts of diet and socioeconomic status among Mesoamerican societies of the past and present, accentuating both the social and economic aspects of food choice within these cultural contexts. Chapter Four provides technical background about the types of information provided by the stable carbon, nitrogen, and oxygen and stable and radiogenic strontium isotope systems before developing a general methodological approach to the study of socioeconomic mobility using paleodietary indicators. It also discusses the potential limiting factors on the use of this approach in certain archaeological contexts.

In Chapter Five, I introduce the prehispanic city of Teotihuacan and emphasize the ways in which the site is an ideal case study through which to explore socioeconomic mobility using isotopic paleodietary data. Throughout its history, Teotihuacan was home to a socially and economically diverse population, and I review our current understanding of gender, age, and ethnic identities at Teotihuacan and well as of socioeconomic status distinctions throughout the population. I then discuss the nature of the site's mortuary program and how the association of many burials with well-studied residential contexts allows some understanding of the social and economic identities of the deceased at their time of death and burial. To conclude this chapter, I review the diverse dietary resources available to the population of the site and evidence from previous research that suggests that we may expect to find dietary differentiation between members of different social and economic groups.

Chapter Six describes the way in which individuals and samples were selected for chemical analysis. I introduce each of the archaeological contexts from which samples were selected and review the archaeological information that can be brought to bear on the social and economic identity of individuals interred in each location. I then discuss the criteria that were used to select individuals for analysis and describe the osteological procedures that were used to estimate the biological sex and age of the individuals included in the analysis. The chapter continues on to present procedural details of the laboratory methodologies that were used to produce isotopic information about the paleodiet and residential history of each of these individuals.

In Chapters Seven and Eight, I present the isotope data and discuss the implications of my findings for our understanding of residential mobility and paleodiet at Teotihuacan. Results paint a picture of a highly diverse society whose residents used food resources in complex ways in order to enact differences in social identity and economic status between individuals on a daily basis and for whom it was not uncommon to spend time living nonlocally in early adolescence. My comparisons of lifetime dietary change identify a single individual, a male buried in the La Ventilla B compound, who experienced dietary shifts throughout life consistent with downward socioeconomic mobility from a high to a mid-status group. Finally, in Chapter Nine, I reflect upon the successes and limitations of this dissertation in developing a systematic approach to socioeconomic mobility in the archaeological record.

CHAPTER 2: WEALTH INEQUALITY, SOCIAL STATUS, AND SOCIOECONOMIC MOBILITY

Social inequality, or the uneven distribution of power, prestige, and material resources between different people within society, is a key aspect of the human societies of both past and present. Across the social sciences, the study of social inequality investigates how a certain configuration of hierarchichal social positions becomes established within society, how and why rewards are distributed to these different social positions, and how individuals enter or are assigned to these differently rewarded social positions (Davis and Moore 1945; Grusky 2001; Romero and Margolis 2005). The enduring appeal of this avenue of study lies in the hope that, by gaining a strong cross-cultural perspective on how inequality operates within human societies, we may become able to use this knowledge to address some of the negative effects of social inequality within our own society (cf. Stiglitz 2012; Wilkinson and Pickett 2009).

This chapter outlines the role that both material and social factors play in the systems of social inequality within state-level societies. While many different definitions have historically been advanced within archaeology to differentiate states from other forms of sociopolitical organization (e.g., Flannery 1972; Marcus and Feinman 1998; Service 1971; Smith 2003), the key feature of a state for the purposes of the discussion to follow is the existence of socioeconomic strata, or socially salient socioeconomic groupings that serve as the primary organizing principal of social relationships. These strata are ranked relative to one another based on overall differences in social prestige and wealth, though there is, of course, variation in both measures within each stratum (Trigger 2003:44).

Studies of inequality within early states must explicitly consider both the ways in which the socioeconomic milieu of these polities functioned similarly to modern states and the ways in which it may have been different. Factors such as the agrarian orientation of most premodern state economies, the social and legal salience of a hereditary nobility, and the lack of monetized wage labor all may have rendered the range of socioeconomic possibilities within archaic states different from those within industrial and postindustrial settings. While recognizing these differences, however, it is also worthwhile to keep in mind that some scholars question whether or not some of the differences between modern and premodern states are perhaps overstated due to biases derived from the theoretical legacy of western exceptionalism in the works of influential 18th and 19th century social theorists (Blanton and Fargher 2008:5-10).

The ultimate goal of the chapter is to develop a theoretical framework through which to view socioeconomic mobility in state-level societies that we know primarily from the archaeological record and to evaluate the degree to which equality or inequality of opportunity characterized different societies in the past. I describe the complex interactions between economic power and social prestige and the ways in which both factors can impact the lifetime movement of individuals between socioeconomic positions. In developing this framework, I draw upon studies and examples that span both premodern and modern complex societies. I take this approach because of the richness of detail available to us in modern settings that is unavailable in either archaeological or historical data sets and that can help us avoid, to some extent, the risk of developing overly simplistic models of human behavior by relying on incomplete sources of information. Where appropriate, I highlight areas in which scholars have suggested that wealth inequality, social status, and socioeconomic mobility may have been structured differently within premodern and modern states. However, many of the broad concepts and framework that I rely upon in developing my methodological approach to socioeconomic mobility in the archaeological record are general enough to apply to societies spanning different forms of social and economic organization. While the role of this dissertation is not to definitively answer longstanding theoretical questions about the nature of social mobility, it endeavors to demonstrate how archaeological case studies may productively contribute to the discussion, extending our understanding of how socioeconomic mobility operates to include societies long separated in time, technology, and social structure from our own.

Theoretical Conceptualizations of Economic and Social Power

Social inequality results whenever patterned interactions between groups or individuals regularly produce greater benefits to one group or individual than to the others (Tilly 2005, 2007). These benefits take the form of social or material assets that give individuals power within society. Though conceptual understanding of the nature of power is varied within the social sciences (e.g., Barnes 1988; Foucault 1970, 1977, 1980; Giddens 1979; Lenski 1966; Mann 1986; Wolf 1999), power can be broadly defined as the capacity for some individuals to exert control over the actions of others. Power is not, however, a uniform or homogeneous entity; it derives from multiple aspects of culture and manifests itself in correspondingly diverse forms, from the material to the conceptual (Earle 1997; Foucault 1970, 1977, 1980; Yoffee 2005:35). Social inequality becomes entrenched within human societies when the disproportionate access to social and economic resources that one party gains through socially structured interactions can then be used to further control their interactions with the opposite party. A diverse set of assets can give individuals power, including economic resources (Marx 1906; Marx and Engels 1970), political authority (Weber 1947, 1968), appropriate cultural knowledge (Bourdieu 1984), and social networks (Coleman 1990), among other resources.

Because of this diversity of resources, power itself can be distributed in complex ways within a particular society. While some social relationships may be structured hierarchically, such that individuals and groups are ranked relative to one another based on the overall extent of their power, others may take on a more diffuse or heterarchical organization, such that individuals and groups may be distinguished by different types, but not necessarily by different extents, of power (cf. Brumfiel and Fox 1994; Crumley 1995). These organizations are not mutually exclusive, and aspects of both hierarchy and heterarchy may be present within the same society (Crumley 1995). While social inequality refers specifically to the hierarchical relationships between individuals or groups with different overall extents of power, heterarchical relationships can be relevant to understanding who may experience social mobility between hierarchically structured positions, as will be discussed further below. Consequently, I concern myself with both hierarchical and heterarchical social relations in the discussion to follow.

It is often conceptually useful to classify certain axes of inequality as either economic or social based on the broad type of resource that underlies the relevant power differentials. As used in this research, economic power denotes any control over material resources and labor (Paynter 1989; Webster 1980), while social power or social status refers to subjective and situational prestige-based social identities dependent on emic concepts of who is superior to whom and for what reasons (Weber 1958). Economic and social power are rarely completely independent. However, the study of these two concepts within the social sciences has derived from different theoretical traditions that take fundamentally different views of the importance of each power source in producing certain societal configurations. In recognition of this history, the following sections review the economic and social components of socioeconomic status separately before discussing the dynamic feedback between material and social inequalities in complex societies.

Economic Power and Wealth Inequality

There are multiple mechanisms through which individuals or groups may maintain control over material resources, including direct control over land, access to revenues from land through taxation, and administration of economic processes such as trade (Brumfiel and Earle 1987; Cobb 1996; Wason 1994). Consequently, economic power need not be strictly hierarchically organized, but may be distributed throughout society in varied configurations depending on factors such as the types of material and labor resources available, the ability of select groups to monopolize access to particular resources, and the degree of correspondence between access to one type of resource and access to others. An economic class can be defined as a group of individuals who share a similar overall level of control over material resources (Mann 1986:25). Economic power can often be manipulated to allow individuals or groups to accumulate wealth, defined here as the possession of items of economic value (D'Altroy and Earle 1985; Earle 1997). From an archaeological perspective, the majority of the material residues that we can observe, such as residential architecture and portable objects, are indicators of wealth rather than direct indicators of economic power (M. Smith 1987).

Because of the aforementioned variation in both type and extent of sources of economic power within different societies, the optimal way in which to subdivide individuals and households within any particular society into economic classes is often a factor of the type of research question that is being asked (Hicks 1999; Nutini and Isaac 2009:19). Broad-scale perspectives argue that there are two fundamental economic classes within premodern states: a lower class, which consists of economic producers who do not control major sources of economic power, and an upper class, which consists of people who control major sources of economic power and use them to extract surplus production from primary producers (Service 1975:8; Trigger 2003:375-376). Due to the agrarian orientation of many premodern economies, the primary source of economic power controlled by the upper class was land ownership (Trigger 2003:315).

The institutionalized differential control of material resources in state-level societies allows for wealth accumulation among a privileged few (Johnson and Earle 1987; Wason 1994). Property norms that allow for the transfer of wealth to heirs, who can then build upon their inherited wealth through generations, allow wealth inequality in complex societies to grow to levels not seen in societies that do not allow the intergenerational transmission of wealth (Flannery and Marcus 2012; Mattison et al.

2016; Smith et al. 2010). Producers within state-level societies have fewer opportunities to accrue wealth and, because basic resources such as food, housing, craft materials, and other socially meaningful goods are necessary for human survival and social reproduction, must either comply with elite demands to obtain these goods or risk harsh and potentially life-threatening changes to their material situation (Earle 1997; Fried 1967; Sanders and Nichols 1988).

While the broad-scale distinction between two economic classes is useful in describing certain aspects of premodern economies, it is also possible to divide premodern state societies into finer economic groups that could be considered classes in the strict economic sense. Particularly, some scholars have argued that certain specialists, who do not directly produce surplus but who play a role in either maintaining the social hierarchy or transmitting surplus from producers to the upper class, held a fundamentally different relationship with sources of economic power than either the upper or lower classes delineated above (Hicks 1999; Sanders 1992). This group includes individuals in lower levels of the bureaucratic, religious, and military hierarchies as well as merchants and luxury artisans. While many of these individuals did not have access to the wealth extraction possibilities granted by land ownership, which was dominated primarily by the upper classes, they did have structural sources of economic power, such as the ability to extract wealth through graft or control over economic processes important to the upper classes, such as trade and luxury craft production (Hicks 1999).

Regardless of the specific number of classes that we choose to recognize in premodern states, the wealth variation that we see in the archaeological record results both from variation in overall extent of economic power between individuals and households and further variability in the degree to which individuals and households are able to transform economic power into wealth. While there is still considerable comparative research to be done, recent studies using the Gini index to quantify the degree of overall concentration of wealth based on differences in house size have shown levels of wealth inequality were variable through time and space within premodern states. In Mesoamerica alone, Gini indices have been shown to range from 0.12 in Classic-period Teotihuacan (Smith et al. 2014) to 0.71 at Late Classic-period Sayil in the southern Yucatan (Brown et al. 2014) (for reference, the Gini index ranges from 0 to 1, with the level of wealth inequality in the modern-day United States is represented by a Gini index of approximately 0.4; Milanovic et al. 2011). Brown et al. (2014) have shown that archaeological sites that produce a range of different Gini values may all still roughly follow a Pareto distribution of wealth, in which a small number of individuals control a large proportion of the available wealth while progressively greater numbers of individuals control proportionately less down the remainder of the economic hierarchy.

The overall concentration of wealth is, however, only one aspect of wealth inequality. The degree to which wealth variation is continuous, with an uninterrupted range of wealth levels, or discontinuous, with sharp differences in wealth between more homogenous bounded groups, is also relevant to our understanding of the economic landscape. The degree of discontinuity in wealth differentiation within archaic states appears to depend at least partially on what type of material indicator is being used as a proxy for wealth. For example, in the Aztec empire, variation in durable wealth, such as house size, was much more discontinuous than variation in portable wealth, such as domestic artifact assemblages.

In the Aztec-period sites of Cuexcomate and Yautepec in Morelos, Olson and Smith (2016) document that the largest residences in each site, presumably belonging to the wealthiest members of society, were over an order of magnitude larger than the next largest contemporary residences in the same site. However, despite this sharply discontinuous break in household size variation, ceramic index values reflecting differences in household artifact assemblages varied in a much more continuous fashion, with overlap in the index values seen in the houses inhabited by both the upper and lower classes. A continuous distribution of portable wealth values has also been demonstrated in other Postclassic Mesoamerican contexts, such as the urban site of Inguiteria in northern Oaxaca and the Aztec-period reoccupation of Teotihuacan (Garraty 2000; Steere and Kowalewski 2012).

These different wealth patterns perhaps suggest that disparities in standards of living within premodern states were wider within certain aspects of life than in others. However, it is also important to recognize that both the size of residential architecture and the composition of household artifact inventories can be impacted not only by household wealth levels, but also by other factors such as family size and the developmental stage of the household (M. Smith 1987; Watson 1978; Wilk 1983). It may also be the case that in certain context, sumptuary regulations that limit certain material expressions of wealth to people within privileged social categories may distort the degree to which disparities in material indicators such as house size or portable goods are representative of underlying wealth differences.

Considering the possibility of intermediate economic classes in premodern states, it seems that some archaeological indicators may allow us to identify distinctions between more than two economic groups. For example, it is interesting to note that studies of historical documents specifying the size of landholdings in postconquest sites in Morelos indicate that minor officials held land plots intermediate in size between those of lower-class individuals and those of upper-class nobles and rulers (Smith and Hicks 2016: Table 29.2). Olson and Smith (2016) were also able to identify a large residential structure that appears intermediate in both size and ceramic wealth index value as compared to the majority of lower-class residences and those of the wealthiest individuals at the site of Yautepec. The authors' suggestion that this structure may represent the residence of a minor official known as a *calpolli* head would support the idea that there was recognizable wealth differentiation in premodern states between people in structurally different economic positions that goes beyond simple two-class distinctions.

Social Power and Differential Prestige

Weberian social theory gave rise to the concept of status groupings, which contain individuals who are perceived as social equals, in addition to class groupings, which categorize individuals on the basis of their relationship to material resources. These different categorization systems coexist within the same society and have overlapping but not coterminous membership (Weber 1947, 1968). Frequently, the conceptual unity of social status groups is expressed through participation in distinct lifestyles or consumption patterns that express self-identification with a particular status level (Bourdieu 1984).

Far from being a purely ideological phenomenon, however, social status drives people to act based on their social values, often in ways that structure differential access to social resources between groups (Althusser 1969, 1970, 1984; Berreman 1981). Individuals monopolizing intrasocietal value systems define social categories of individuals who are excluded or ineligible from certain social privileges on the basis of perceived essential inferiority (Weber 1968). This process is responsible for determining who may have access to the rewards and privileges of authority and who is excluded from power, effectively curtailing the influence of some individuals with significant material power sources while opening up opportunities to manipulate alternative sources of power to individuals lacking material resources.

In many premodern states, the social distinction between commoners and hereditary nobles defined broad-scale differences in prestige and social privilege between the majority of the population and a small subset of individuals who had been born into a noble lineage. While many researchers refer to the distinction between nobles and commoners as "class", other scholars prefer the term "estate" to differentiate this prestige-based categorization scheme from the economically-based groupings discussed above that can also be referred to as "class" (e.g., Garraty 2000; Hicks 1999). For the purposes of clarity, I follow this convention in the discussion to follow.

In addition to granting an individual a certain associated level of prestige, estates are frequently bound up within a complex web of both legal rules and social conventions that specify the rights, privileges, and duties of each group (Nutini and Isaac 2009:20). While these rules can take many forms, the most important types of rules for the purposes of this discussion relate to both regulations over the type of economic resources and opportunities available to individuals in different social estates, to be discussed further in the next section, and sumptuary rules, which govern patterns of material consumption among individuals in different estates. Sumptuary rules typically limit the rights to display or use certain prestigious material goods to individuals in a noble social estate, with the result that certain items are not necessarily accessible to all individuals who may have the economic means to acquire them based purely on their economic value (Appadurai 1986:30; Levy 1979). Within the Aztec empire, for example, sumptuary rules limited the use of cotton clothing and expensive personal adornments to hereditary nobles, who were also the only individuals permitted to build two-story houses (Durán 1994:208-211).

The commoner-noble distinction represents a valid, large-scale distinction in prestige and privilege between defined groups of people within many premodern states. However, within each of these groups, there can also be finer distinctions backed up by institutionalized differences in social privilege. For example, in many noble estates, there are gradations of prestige whereby different lineages are ranked relative to one another based on distance from the current royal lineage (Trigger 2003:147-154). The commoner estate may also have finer-grade prestige groups, sometimes associated with particular economic specializations. For example, in the Aztec empire, professional merchants and artisans formed hereditary guilds within the commoner estate that had distinct legal privileges from other commoners, such as the right to wear distinctive insignia and exemption from labor obligations that were required of the majority of commoners (Hassig 1988:30, Hicks 1999). Accomplished warriors also appear to have formed a distinctive social group of individuals. While all adult male members of Aztec society were potentially liable for military duty in times of warfare and were not necessarily granted special privileges, individuals who had distinguished themselves in warfare adopted a distinct series of named military ranks that governed not only their role on the battlefield but also aspects of their everyday lives, such as hairstyles, manner of dress, and the ability to serve in high civil office (Hassig 1988:39-47). Nutini and Isaac (2009) refer to finer-scale social distinctions within the noble and commoner estate as subestates, a term that I will adopt in this dissertation to refer to specialized social groupings with distinctive social privileges and lifestyles that are not strictly related to overall levels of wealth.

In addition to prestige related to social estate, there are a number of other factors that impact an individual's social status in dynamic and interconnected ways. First, in many societies, elevated social status is conferred upon individuals holding material wealth (Ames 2008; Wason 1994). While wealth does tend to correspond to a certain degree with social estate, a topic to be further discussed below, prestige derived from wealth is accessible to individuals in either commoner or noble estates, provided that they have the requisite degree of material resources. The linkage between material wealth and prestige is often mediated by the expenditure of economic resources in socially appropriate ways.

The term conspicuous consumption is sometimes used to refer to the public expediture and display of wealth in order to impress others and to build one’s own social position (Veblen 1899). While the concept was originally developed to describe consumer behavior within a 19th century cultural context, similar ostentatious displays of wealth in order to generate prestige are found in a number of nonwestern and nonindustrial societies. A well-known example is the institution of the potlatch among the native peoples of the Pacific Northwest, in which kin groups expend massive amounts of material wealth in elaborate gift-giving feasts that raise the kin group's status within their community (Jonaitis 1991; Mauss 1954). Within archaeology, the concept of prestige good economies highlights the ability of economically expensive and symbolically charged objects to legitimate claims to power among high status individuals (D'Altroy and Earle 1985; Earle 1997; Frankenstein and Rowlands 1978; Goldstein 2000).

The prestige gained from wealth can at times interact in dynamic ways with the prestige derived from social estate. Due to sumptuary rules, for example, acts of conspicuous consumption must at times be carefully balanced with legal restrictions on consumption tied to social estate. Wealthy commoner merchants within the Aztec empire negotiated these interrelationships in part by building high walls around their residences so that the ways in which they displayed their wealth through, for example, elaborate feasts that they held to impress current or prospective clients, would not provoke sanctions from certain members of the noble estate (Sahagún 1950-1982: Book 9).

Status and prestige may also be attached to any number of social attributes not themselves purely economic, including gender (e.g., Hastorf 1990; Miller 1993), age (e.g., Gowland 2006; Stoodley 2000), and ethnicity (Sandstrom 1991; Weismantel 1988), among others. Within this dissertation, I refer to these social attributes under the theoretical rubric of social identities. Broadly stated, a social identity is a social classification system through which a person self-categorizes and is categorized by others with respect to a socially meaningful personal characteristic (Díaz-Andreu and Lucy

2005; Insoll 2007; Knudson and Stojanowski 2008; Meskell 2007). By socially meaningful, I refer to those characteristics that are incorporated into shared social narratives and that form a significant basis upon which differences between people are understood within a particular cultural context. Because of this social meaning, categorization of an individual with respect to these characteristics is inseparable from the attribution to that person, both by the self and by others, of certain beliefs about his or her nature and about his or her appropriate role within society.

While there is the theoretical potential for any number of personal characteristics to underlie social identities, in practice, human societies very frequently draw distinctions between people on the basis of the characteristics of gender, age, ethnicity, race, religion, and kin or community membership. Any single individual has multiple socially salient characteristics that impact how the individual is understood and treated by both self and others; therefore, an individual can be said to have multiple social identities. Together, these social identities interact with idiosyncratic factors such as personality and personal history to produce a person's unique sense of self, or individual identity.

While some researchers have argued that the concept of identity should be decomposed into several distinct analytical categories, I contend that these distinctions are frequently neither useful nor feasible in bioarchaeological cases. Brubaker and Cooper (2000) assert that the usage of "identity" (the authors do not distinguish between social identities and individual identity) should instead be replaced by the terms "identification and categorization", to indicate the process by which people are assigned by themselves and others to different social categories, "self-understanding and social location", to describe both the sense of personal uniqueness associated with individual identities and the adoption of a personal interpretation of the social meanings and societal expectations that imbue different social categories, and "commonality, connectedness, and groupness", to refer to various types of subjective feelings of similarity with others within a particular social category.

While these individual terms are potentially useful analytical concepts for certain research questions in the modern day, their utility for bioarchaeological analysis is limited by the fact that all of the above factors work together to guide human behavior. In a bioarchaeological case, the primary data under consideration frequently represent the cumulative material consequences of behavior that occurred across relatively long periods of time. Without significant contextual information about thought processes at the individual level, which is not typically available in archaeological or bioarchaeological contexts, the researcher would be hard pressed to work backward from behavioral patterns associated with personal characteristics to any of the above individual factors that guided it. Consequently, I consider a holistic term such as "social identities" to be more useful than any of these individual analytical categories in describing the multitude of processes, meanings, and affiliations associated with personal characteristics that worked interdependently to produce an individual's behavior.

While the extensive literature on social identities is beyond the scope of this dissertation, gender, age, and ethnic identities warrant brief additional discussion, as these axes of social identity form variables of analysis in the case study to follow. Broadly speaking, gender encompasses the social roles and symbolic values differentially associated with male and female members of society. Despite varying opinions on the utility of this terminology (Butler 1990, 1993), many archaeologists draw a distinction between “sex,” as denoting the biological differences between males and females, and “gender,” as describing the cultural interpretation of this sexual difference (Walker and Cook 1998). Others have argued that the term “sex” can be deconstructed even further into sexual dimorphism, the continuous (albeit frequently bimodal) biological variation seen in multiple primary and secondary sexual characteristics, and sex categories, a fundamentally cultural categorization system that classifies people into a set number of distinct named groups based on the combination and selective weighting of these characteristics (Geller 2005, 2008).

Regardless, the relationship between sex and gender is not always straightforward, and in some cultures, individuals may be gendered in a way that does not correspond from a Western perspective to their biological sex (Hollimon 1997; Looper 2002; Nanda 1994). Additionally, despite the discontinuous nature of sex categories, individuals are frequently gendered along a continuum, such that one male individual may be considered to be either more or less masculine than another for reasons that may or may not be related to differences in physicality between the two. Gender can also vary in salience throughout the lifecourse, as certain gendered expectations may be differently enforced or relaxed for younger or older individuals (Sofaer 1997a, 1997b; Stoodley 2000). While the most nuanced bioarchaeological considerations of gender will explicitly consider both the way by which sex categories may be defined and understood and the extent of gendered variation within these sex categories, broad-scale understandings of gender-normative behavior can frequently be constructed through more simple studies of the association between artifactual and skeletal indicators of behavior and skeletons for whom a (Western) sex category has been estimated through osteological means.

The concept of age can be divided into chronological age, or the length of a person’s life measured in relevant chronological units such as years, biological age, or the stage of development and decline of a person’s physical body, and social age, or the social significance given to both biological and chronological age (Ginn and Arber 1995). Like sex and gender, these different age concepts do not necessarily correspond perfectly with one another. For example, in contemporary society, it is common for adults with severe mental handicaps to be treated in a childlike manner in contradiction to their biological and chronological age characteristics. However, these different age concepts are strongly related to one another through a dynamic feedback; while social interpretations of biology and of time work together to produce one’s social age, culturally driven behavioral patterns based on social age can in turn impact one’s physiological ageing process by, for example, speeding up degenerative changes to joint surfaces (Sofaer 2005, 2006).

At its core, age is a temporary attribute and is expected to change throughout a person’s life. Some scholars advocate the use of the term "lifecourse" to describe the way in which an individual's life is segmented into different culturally meaningful age grades and life stages (Gilchrist 2000, 2004; Meskell 1999). There is cross-cultural variation in the number and timing of different age grades or life stages that a person may move through during the course of his or her life. The sequence and social significance of these age grades can also vary depending on the gender of the individual in question, with men and women undergoing age-related rites of passage at different times in the lifecourse (Gilchrist 1999:87-88; Sofaer 2000).

Ethnicity is a form of identification with a large-scale social group based on perceived common ancestry and at least some shared cultural features (Barth 1969; Emberling 1997). Ethnic groups are rarely internally homogeneous in terms of language or culture, and the most defining aspect of ethnicity is self-ascription (Barth 1969). However, it is the practices and mechanisms which groups and individuals use to signal and reinforce group boundaries that are most visible archaeologically (Jones 1997). Ethnic consciousness typically arises in a state or higher-level of sociopolitical organization and is frequently strongest amongst individuals who are members of a politically subordinate group (Emberling 1997).

Social identities are essential to our understanding of social inequality due to the fact that the numerous social categories to which individuals belong provide others with readily named and widely recognized criteria upon which to base unequal treatment (Tilly 2005:21). Due to the fact that social identities are frequently visible in behaviors, appearance, and symbols (Butler 1990, 1993; Fisher and DiPaolo Loren 2003; Joyce 2000a), they can serve as “shorthand” to signal information to people who can then make decisions about how to treat the person based on societal or individual biases. Ideas and beliefs about one’s own social identities and the courses of action available to individuals within one’s own category can also be internalized to structure individuals’ behavioral options.

An individual’s social status is complicated by the facts that multiple parallel status hierarchies exist within a single society and that a person’s position within each of these hierarchies need not be identical. For example, a person engaged in an occupation granted with high prestige may nevertheless belong to a marginalized ethic group or gender category. These discrepancies in status position on separate status hierarchies can lead to ambiguity in a particular person's overall level of social status that can be manipulated in specific contexts. Particularly, the performative nature of social identities allows them to be played up or down and negotiated within certain (sometimes physical) limits. Ethnographies provide numerous examples of individuals working within existing symbolic structures to manipulate others' perceptions of their social identities in order to gain or contest political and economic power (e.g., Hodder 1982; McGuire 1982; Srinivas 1962).

Further complications arise from the fact that different social identities do not operate as functionally independent, stand-alone characteristics. Instead, they interact with one another to create different life experiences among individuals with different combinations of characteristics, a process that is known as intersectionality (Collins 2000; Crenshaw 1989). The concept of intersectionality recognizes that the experience of belonging to any particular social category is colored by the other social categories to which a person belongs. For example, a person's experience of femininity may be very different as a woman belonging to a wealthy economic class than as a woman belonging to an economically disadvantaged class. From an archaeological perspective, the concept of intersectionality highlights the importance of analyzing multiple dimensions of social variation simultaneously. A social identity that grants one person high prestige within one social setting may grant a different person a lesser amount of prestige within their own social milieu.

Interrelationships Between Economic and Social Power in Complex Societies

As the above discussion demonstrates, a single individual has multiple economic and social characteristics that could each form the basis for differential power or subordination within a particular society. In practice, however, economic power and wealth are not completely independent variables from social estate and other sources of prestige. In state-level societies, we often see a macro-level pattern in which economic class and social estate tend to strongly correspond with one another (Trigger 2003:46). This correspondence results in a multimodal distribution of power that approximates a series of ranked groupings, or socioeconomic strata, that crosscut society.

Throughout the discussion to follow, I use the terms “elite” and “nonelite” to distinguish between the highly-privileged top socioeconomic stratum and the remainder of society, which can itself contain multiple ranked groupings combining both social and economic aspects. I will use these terms in conjunction with references to the members of the upper, lower, and intermediate economic classes, to refer to a purely economic subdivision of individuals, and to nobles and commoners, to refer to the subdivision of individuals according to social estate. While there are certainly similarities in the way in which individuals may be sorted according to each of these categorization schemes, they do not divide society into groups in identical ways. After introducing the process of social exclusion that underlies the aforementioned correspondence between social and economic power, I then discuss how inconsistencies in levels of social and economic power can position individuals in ambiguous locations with the respect to boundaries between socioeconomic groups.

A major process that results in the strong relationship between wealth and social status in complex societies is called social exclusion. Charles Tilly (2005, 2007) defines social exclusion as the mechanism by which only some individuals are able to take advantage of a specific economic opportunity based on the social category to which they belong rather than on individual skills or merit. In societies where control over economic resources does not operate strictly along lines of kinship, economic opportunities frequently become organized around other types of social distinctions that serve as a convenient mechanism through which to reinforce the boundaries between an economic in-group and an out-group. While the economic in-group controls access to an economic resource, the economic out-group is excluded from control over the resource (Tilly 2005, 2007). By co-opting interpersonal differences with pre-existing social salience into the economic realm, less effort is needed to naturalize the social boundaries necessary to sustain unequal economic relationships between different economic groups.

Social exclusion can occur on the basis of large-scale social distinctions such as social estate as well as on the basis of multiple cross-cutting distinctions such as social identities. In at least portions of the Aztec Empire, property rules related to landholding limited full land ownership to members of the noble estate, who could collect rents from commoners who worked the land. While commoners who had been designated as minor lords based on accomplishments in warfare (the *cuauhpipiltin*) were able to hold land, they were denied other noble rights, such as the ability to have tenant farmers (Hassig 1988:29). Similarly, educational differences between noble and commoners effectively limited the degree to which even very skilled commoners were able to fill roles in the highest tiers of the political, military, and religious hierarchies. While nobles attended temple schools known as *calmecac* that gave them the knowledge and skills required to fill these posts, commoners were instead educated within the *telpochcalli*, which emphasized a different set of skills more relevant to commoner economic and military activities (Berdan 1982:88-90).

However, social exclusion by social estate was not always absolute, which did open the door for individuals who were not in the noble estate to amass wealth. Many of these exceptions nevertheless involved aspects of social exclusion along the lines of social identities. For example, a small number of commoner boys were allowed to attend temple schools alongside noble youth, an opportunity that sometimes allowed them to obtain high governmental positions (Hassig 2016:73; Nutini and Isaac 2009:23). While this mechanism allowed some individuals to transcend economic barriers based on social estate, it was still a gendered form of social exclusion, in that only male individuals were able to take advantage of this opportunity.

While forms of social exclusion existed both in the past and today, the relative importance of estate-based social exclusion as compared to other forms has changed through time. Crone (1989:101-102) argues that in premodern societies, privilege based on birth into a particular social estate was the primary determinant of access to wealth, though as we have seen above, other social factors such as gender also played a role in shaping access to economic opportunities. With the decline in the social and legal salience of a hereditary nobility in many industrialized societies, social exclusion based on legally-defined social estate has declined in importance, and processes of social exclusion instead operate more strongly along the lines of social identity. A relatively extreme example of modern-day social exclusion based on social distinctions is the job reservation policy in apartheid-era South Africa, in which particular employment opportunities were legally restricted to members of certain races (Lowenberg 1989).

However, more subtle and informal forms of social exclusion are pervasive throughout contemporary society, as shown through studies demonstrating that even minor markers of social identity such as names associated with a particular gender or racial group can introduce significant differences in economic outcomes such as hiring or academic admissions to fictitious individuals with otherwise identical resumes or application materials (Bertrand and Mullainathan 2003; Moss-Racusin et al. 2012). To these examples, we should also include the entrenched privilege granted to people of wealth, as can be seen, for example, in the relaxed standards of admission into elite universities for legacy students, typically from disproportionately wealthy families, which places these students in an advantageous position to engage in continued wealth generation through recruitment into the best-paying professional positions (Shadowen et al. 2009). While the specific characteristics upon which social exclusion operates may have changed through time, the basic mechanism of social exclusion remains relevant to both premodern and modern contexts.

While the discussion up to this point has focused on an elite-nonelite dichotomy, there is frequently a sufficient amount of economic and social variation within the elite and nonelite strata to allow us to subdivide these groups further based on salient socioeconomic divisions when analytically useful to do so. I have previously mentioned prestige-based divisions within both the hereditary nobility and commoner estates, and these finer grained distinctions also may align with economic variables. For example, in Early Dynastic Sumerian society, both social and economic inequality within the commoner estate arose from the practice of allowing commoners to hold lower-level bureaucratic positions that not only granted prestige but allowed individuals within these positions to take an extractive economic position with respect to non-official commoners through graft (Flannery and Marcus 2012:476). As we have seen earlier, merchants within the Aztec Empire not only held hereditary social privileges, but also were in an economic position that allowed them to accrue more wealth than most other commoners through control over trade.

As described above, there are a number of reasons why economic classes and prestige-based groups such as social estate should have strongly overlapping membership. However, we cannot always assume that economic control and social status are inseparable sources of power. In state-level societies, a highly socially diverse population must negotiate relationships with varied individuals wielding multiple potential sources of both social and economic power, not all of which are controlled by the same group. Despite certain tendencies for some economic and social variables to align in processes of exclusion, their intrasocietal distributions do not necessarily coincide such that individuals holding power from economic sources necessarily are the same as those holding power from status.

Indeed, evidence from archaic states suggests that nonelites can hold ambiguous socioeconomic positions whereby their position along one dimension of privilege, for example wealth, is much higher than that of another individual who may outrank the first in a different dimension, such as membership in the noble estate. Across a number of states and empires, for example, the assignment of commoners to high-ranking bureaucratic positions was not uncommon where rulers feared usurpation from others within the noble estate (Flannery and Marcus 2012). These positions were often richly rewarded and granted an individual a high degree of social power, though their occupants were nevertheless ranked lower on the criterion of social estate than nobles who may not have had as much official power. Wealthy commoners, including successful merchants, also sometimes overlapped with lesser nobles in economic standing, as suggested by the need for the *pochteca* in Postclassic Central Mexico to hide their wealth in order to avoid provoking jealousy from members of the noble estate (see also Smith and Hicks 2016:428).

To summarize, an individual's socioeconomic standing is a complex synthesis of material and ideational factors. While there are certain multimodal patterns of socioeconomic power within state-level societies that we can reasonably call ranked socioeconomic groups or social strata, these groups become blurry at the edges, particularly where some individuals have substantial economic power but less social power, and vice versa. As we shall see in the following section, various mechanisms exist that serve to allow individuals to move more fully into or out of certain socioeconomic groups. However, the ability for a person to take advantage of these mechanisms is deeply embedded in both social and economic considerations.

Socioeconomic Mobility

Social mobility can be broadly defined as a change in a person's social position over time. Sorokin (1959:7) draws a distinction between vertical social mobility, as movement between hierarchically structured socioeconomic groupings, and horizontal social mobility, which refers to movement between other social categories such as ethnic, religious, or occupational groupings that may or may not have a hierarchical relationship to one another. To avoid ambiguity in terms, here I use the term "social mobility" to refer only to either upward or downward vertical movement among socioeconomic groupings while referring to changes in other social categories as shifts in social identities. Social mobility appears to exist across a broad range of state-level societies, through its prevalence and characteristics can vary widely (Breen and Jonsson 2005; Erikson and Goldthorpe 1992; Kelley and Perlman 1971; Li et al. 2015; van Leeuwen and Maas 2010). While some discussions of social mobility in premodern states focus primarily on movement between the noble and commoner social estate (e.g., Trigger 2003:160-165), the existence of finer grained socioeconomic distinctions within both of these groups as noted previously means that it is also possible to talk about changes in socioeconomic status within each social estate under the rubric of social mobility (see also Smith et al. 2016: Appendix).

There are multiple ways in which a single individual can experience a change in his or her socioeconomic status. Sociologists draw a distinction between structural and exchange mobility as two factors impacting a person's socioeconomic experience (McClendon 1977; Schluter and Van de Gaer 2011; Yasuda 1964). Structural mobility occurs when there is a fundamental change in a society's economy, such that entire groups of people find themselves in a better or worse economic situation than they had previously experienced. Rising standards of living due to expansion of the United States economy in the twentieth century would be an example of a structural mobility process in action. In a premodern context, the collapse of a distinct aristocratic ministerial class in the Chan Kuo period of ancient China resulted in the movement of the *shih* class of stewards and warriors upward into economic roles that they had not formally been able to hold (Hsu 1971). Exchange mobility, on the other hand, occurs when a single individual moves between established socioeconomic groups that are not necessarily experiencing a change in relative position or wealth. The two processes can occur in tandem, so the amount of socioeconomic change that a single person experiences during his or her life can be a combination of both society-wide economic change and individual movement between societal groups.

Similarly, there are several ways in which sociologists and historians are able to measure and track rates of social mobility through time. Measurements of intergenerational mobility compare the socioeconomic status of an individual to that of his or her parents to discern whether or not social mobility has occurred. This approach is common in historical studies of social mobility rates in western societies, since historians are often able to locate references to the occupations of individuals and their parents in religious and secular records of births, deaths, and marriages (Miles 1999; Miles and Vincent 1993). In contrast, intragenerational mobility considers only the changes that a single individual has experienced within his own lifetime, without reference to previous generations of his family. Rates of mobility do, however, only provide a partial understanding of mobility processes within a particular society. Equally important is an understanding of how the mobility opportunities that exist within a particular society are distributed to different individuals on the basis of social and economic characteristics.

Factors Impacting the Intrasocietal Distribution of Mobility Opportunities

Social mobility is deeply embedded in other aspects of social and economic life. While early sociological and ethnographic research viewed an individual's likelihood of being social mobile as associated with personal characteristics such as charisma, work ethic, or intelligence (e.g., Lipset and Bendix 1959; Sorokin 1959; Turner 1960), more recent interpretations of inequality recognize that opportunities for social mobility are also strongly linked to the social categories and the resulting social networks to which people belong, including both economic categories such as class of origin and culturally constructed categories such as gender and ethnicity (e.g., Duncan and Hodge 1963; Tilly 2007). Much of our current theoretical understanding of social mobility comes from sociological and historical research, while archaeological lines of evidence have only rarely been brought to bear on the subject. After providing a brief review of the current state of knowledge surrounding social mobility, I discuss the reasons why archaeology has not played a larger role in scholarly understanding of mobility processes and outline how social mobility can be operationalized in a way that allows archaeological data to identify the characteristics of social mobility in ancient societies.

Given the above discussion of social and economic power, it should not be surprising that both economic circumstance and personal social characteristics are important in impacting a person's likelihood of becoming socioeconomically mobile during his or her lifetime. In the economic realm, there is evidence that the class group that a person is born into can play a strong role in how likely that person to be socially mobile, as well as how far he or she is likely to travel either up or down the social hierarchy (Mishel et al. 2012). Research in modern societies has suggested that it is particularly difficult for individuals to move out of poverty conditions into other socioeconomic groupings (Corcoran and Adams 1997). Additionally, even societies which display frequent movement between the low and intermediate class groups may contain a relatively fixed and impermeable upper class that only rarely receive socially mobile individuals from lower social groups (Lipset and Bendix 1959).

The impact of economic factors on opportunities for social mobility is also mediated by the social groups to which an individual belongs (Lanjouw and Stern 2003; Narayan and Petesch 2002). While discrimination against members of less socially valued groups is a phenomenon that occurs across all types of social categories, the previously discussed social identities of gender, age, and ethnicity can form additional barriers or openings for mobility. Both gender ideologies and the gendered division of labor can impact how likely one gender is to be socially mobile as compared to another. For example, in the contemporary highlands of Bolivia, despite the economic control of women over the income producing activity of corn beer production, male members of a family are more likely to become socially mobile. This happens because of the organization of family labor, which obligates female children to work in the brewery while their brothers are free to get an education outside the community (Perlov 2005).

Differences in ideologies concerning social and familial roles can also open up different mechanisms for social mobility for people belonging to different genders. In some contemporary societies, for example, women are more likely to become socially mobile through marriage than are men, who are more likely to either stay in their economic group of origin or experience mobility based on occupational achievement (Li and Singelmann 1998). Indeed, a similar pattern may have held in the Aztec empire, where the practice of elite polygyny meant that it was not unusual for noble men to take commoner women as secondary wives, a practice that raised both the economic and social standing of the woman in question even if she were not formally named into the noble estate (Hassig 2016:73). Interestingly, the same practice of noble polygyny may have driven downward social mobility among lesser noble men, who were not able to make the advantageous marriages necessary to maintain the kinship networks that determined access to wealth and privilege (Hassig 2016:75-79). In contrast, avenues of upward social mobility for men within the Aztec empire were instead based on achievement as priests, merchants, or warriors (Hassig 2016:74).

The age at which a person dies may impact how their economic standing at the time of death compares to their standing early in life. In modern industrial societies, an individual's income generally increases throughout the peak working years, while material well-being tends to decline for individuals past the age of economic productivity (Arber 2005; Mishel et al. 2012). In societies without wage labor, the relationship between age and economic standing may not be quite as straightforward, but it can nevertheless impact whether or not a particular person has had the chance to experience mobility within his or her lifetime. Generally, the longer a person has been alive, the greater the chance she or he may have had particular opportunities for social mobility and to have successfully taken those opportunities, other factors held constant. The relationship between age and economic standing could, however, have a gendered component if, for example, one gender's opportunities for social mobility are concentrated relatively early in life, such as is the case with marriage mobility, while another's opportunities for social mobility may be available over a greater span of the lifecourse, as with occupational achievement.

Ethnic group membership can impact one's chances of mobility above and beyond cases of discrimination such as those described above for race. For example, ethnic endogamy can result in a greater likelihood of marriages between members of different economic classes within an ethnic minority group as compared to the ethnic majority, since ethnicity can become a higher priority within the ethnic minority group than economic standing in selecting a marriage partner (Blau and Schwartz 1984). An additional potential linkage between ethnicity and mobility opportunities can occur indirectly through immigration status in ethnic diasporic groups, where ethnic communities within certain cities may contain higher proportions of immigrant individuals than the general population of the city. In modern industrial societies, recent immigrants into large cities appear to have fewer opportunities for upward social mobility than do lower class individuals born and raised within the city, perhaps due in part to the greater awareness on the part of the latter of the economic structure and occupational possibilities present within their native community (Lipset and Bendix 1959: 219-221). While geographic origin is not synonymous with ethnicity, the disproportionate representation of immigrants within ethnic communities in these cases may nevertheless structure mobility opportunities along ethnic lines.

As indicated in the above discussion, the way in which social identities affect an individual's chances for social mobility are not always clear. While discrimination in economic opportunities is fairly common for members of less valued social categories, membership in these social groups can open up certain avenues of mobility while closing off others. The rates and structure of social mobility may also change within the same society through time, particularly during periods of political and economic upheaval (Sorokin 1959). Socioeconomic mobility is a complex process with a number of dynamic variables, and as such, the study of mobility processes benefits from well-characterized case examples that can be used to understand how these different variables interact.

Comparability of Mobility Patterns in Preindustrial and Industrialized Societies

There has been considerable debate concerning whether or not social mobility operates the same way in industrialized and nonindustrialized societies, and therefore about the applicability of the study of past societies to our understanding of modern processes of social mobility. Early sociological research suggested that the process of industrialization caused both an increase in rates of vertical social mobility as well as a convergence of rates between societies, perhaps due to the similar economic needs in all industrial contexts (Featherman et al. 1978; Form 1979; Inkeles 1960; Lipset and Bendix 1959). Subsequent studies of longitudinal historical records spanning periods immediately before and after industrialization in a range of Western countries (e.g., Fukumoto and Grusky 1993; Kaelble 1985; Lambert et al. 2007; Maas and van Leeuwen 2004; Miles 1993) have provided mixed results, but they have generally failed to support the idea that the industrialization process unquestionably or uniformly changed either the frequency or patterns of social mobility throughout the Western world. Furthermore, differences in the rates of vertical social mobility are apparent between different industrial societies and may in fact relate more strongly to local institutional and cultural factors than to large-scale changes in economic organization or governmental regime (Erikson 1990; Erikson and Goldthorpe 1992; Kaelble 1985; Wong 1990). Consequently, the study of past societies through both historical and archaeological means has the capacity to broaden the comparative database of social mobility processes and to grant a long-term perspective about how certain distributions of mobility opportunities develop.

Social mobility has not typically formed an explicit subject of investigation in archaeology, however, due in part to the fact that there is currently no established methodology for identifying socially mobile individuals in the archaeological record. Models of social mobility in archaic states are based primarily on ethnohistoric records, which often describe social and political policies aimed at limiting vertical social mobility between class groups (see Trigger 2003:160-165 for a review). Due to the biases and uncertainties that often plague historical records (see Perry 2007), it is often difficult or impossible to know how effective these policies were in enforcing class boundaries without testing these records against independent lines of archaeological evidence. While studies of architecture and material culture can provide important insights into social differentiation, they typically lack the specificity needed to track changes in a single individual's socioeconomic status during his or her lifetime. Bioarchaeology, a field that allows researchers to focus on individuals and their life experiences (e.g., Stodder and Palkovich 2014), provides one possible solution to this conundrum.

Prior to delving into the methodological details of a bioarchaeological approach to social mobility, however, it is first necessary to define which characteristics of social mobility we are interested in capturing through a comparative archaeological program concerned with social mobility in premodern states. Particularly given contemporary concerns surrounding equality of opportunity, as discussed in the previous chapter, we may like to know when and under what circumstances various economic and social factors impact the distribution of mobility opportunities. The foregoing discussion suggests thee dimensions along which to evaluate the processes of social mobility within archaic states: 1) the overall prevalence of social mobility, 2) equality of opportunity based on starting economic position, and 3) equality of opportunity based on social category. This three-dimensional framework elaborates on previous models of premodern social mobility (e.g., Brown 1988) to focus not only on the degree to which movement between socioeconomic groups was possible, but also on how it was structured. While the framework is intended as a conceptual tool to be used in future comparative work, rather than as a set of specific hypotheses to be tested within this dissertation, it does structure my general methodological approach to reconstructing mobility processes in the archaeological record as developed in the following chapters. Below, I present theoretical scenarios representing the extreme endpoints of these three dimensions, recognizing that most societies will fall between these extremes in each measure.

Dimension 1: Prevalence of Social Mobility

Closed Stratification System. In societies with a closed stratification system, few economic opportunities for changing one’s socioeconomic position exist. We should observe few or no individuals experiencing a change in socioeconomic status between early adolescence and adulthood. Society-wide shifts in socioeconomic well-being in particular time periods due to positive or negative changes in the regional economy as a whole may occur, but should impact all contemporary individuals equally rather than changing the positions of individuals or groups relative to one another.

Open Stratification System. In a society with an open stratification system, many economic opportunities for changing one's socioeconomic position exist. We may expect to observe many individuals who started life in a socioeconomic group different from that to which they belonged at the time of their death. The changes in socioeconomic well-being experienced by contemporary individuals should vary in direction and extent, indicating that the mobility is due to their changing position within the economy rather than or in addition to changes in the overall prosperity of the regional economy as a whole.

Dimension 2: Equality of Opportunity (Economic)

Inequality of Opportunity (Economic). In a society with inequality of opportunity in the economic realm, we may expect an individual's starting class to be the primary determinant not only of his or her likelihood of being socially mobile, but also of the direction and extent of mobility possible for him or her. Upwardly mobile individuals should display evidence that they originated disproportionately from certain socioeconomic groups, while other socioeconomic groupings are more strongly associated with either downward social mobility or with socioeconomic stasis (cf. Duncan and Hodge 1963; Lipset and Bendix 1959).

Equality of Opportunity (Economic). In a society with equality of opportunity in the economic realm, socially mobile individuals may originally come from widely divergent economic backgrounds and may be buried within contexts associated with any ending socioeconomic position. No clear patterns can be observed with respect to starting economic category that would allow us to predict an individual's likelihood of being upwardly or downwardly mobile.

Dimension 3: Equality of Opportunity (Social)

Inequality of Opportunity (Social). In a society with inequality of opportunity in the social realm, the social categories to which individuals belong are expected to play a defining role in facilitating access to opportunities for social mobility. We should consequently expect certain categories of individuals, whether based on gender, occupation, ethnicity, or another factor, to be disproportionately represented among the socially mobile. In a complex state society, we may expect considerable intrasocietal variation in the degree to which individuals were able to manipulate and construct their social structure, based on a number of intersecting identities such as age, gender, class, ethnicity, and household or lineage membership.

Equality of Opportunity (Social). In a society with equality of opportunity in the social realm, the prestige associated with social identities has little to no effect on economic achievement. No clear patterns may be observed with respect to the social categories of individuals experiencing upward or downward social mobility, other than perhaps those due to differences in the average starting wealth of individuals within different social categories.

To further develop these models into a concrete methodological approach to socioeconomic mobility within the archaeological record, we must be able to estimate how many and which individuals within a particular archaeological site experienced socioeconomic mobility during their lifetimes. I argue that the stable isotopes in human bone and tooth enamel can address the issue of social mobility by identifying substantial lifetime changes in an individual's diet which may serve as a proxy for shifts in socioeconomic status and group identity. As a theoretical and methodological justification for this argument, the next two chapters review the ethnographically and ethnohistorically documented relationship between diet and socioeconomic status in Mesoamerica and beyond and introduce the stable isotope systems that allow us to track any dietary changes that occurred during a single individual's lifetime.

CHAPTER 3: DIET AND SOCIOECONOMICS

Diet is intertwined both with the economic power relationships that govern food production and consumption and with many ideological aspects of social life such as religion and social identities (Bray 2003a; Goody 1982; Gumerman 1997; Mintz and DuBois 2002; Twiss 2007). Due to these interconnections, food and cuisine can be used as a lens through which to investigate socioeconomic organization in complex societies. This chapter discusses the theoretical linkage of diet with both economic and social distinctions between individuals and evaluates empirical ethnohistoric and ethnographic accounts of dietary differentiation in Mesoamerica.

Food Choice in Complex Societies

The foods that people eat are governed by a complex set of interactions between our shared nutritional needs as a species, the set of resources available to individuals based on their environment and economic position, and choices that individuals make about what to consume based both on their personal preferences and on how they view themselves and their location within a broader social landscape. Within complex societies, where the number of possible economic and social distinctions between individuals is large, it is common for these factors to converge in order to produce diversity in the dietary regimes followed by members of different social and economic categories (Goody 1982). Here, I review theoretical perspectives on the nutritional, economic, and symbolic significance of food choice, emphasizing the need to combine aspects of each perspective to understand the ways in which foodways interconnect with systems of prestige and economic power in complex societies. The applicability of these theoretical views for understanding food choice and consumption in a Mesoamerican context are illustrated through ethnohistoric, ethnographic, and archaeological examples of Mesoamerican dietary behavior.

Nutritional and Ecological Aspects of Food Choice

Traditional nutritional and ecological approaches to food choice define cross-cultural regularities in dietary practices that identify human biological predispositions shaping diet and cuisine. Nutritional perspectives view human food preferences as inherently adaptive forces that contribute to biological fitness by driving members of our species to select foods that contribute to optimal nutrition (e.g., Barker 1982; Hladik 1990, 1997; Macbeth and Lawry 1997; Rolls 1997). These perspectives emphasize evolutionarily derived, universal preferences for particular food types such as sweet foods (Beauchamp 1981; Drewnowski and Greenwood 1983; Glander 1982) and fat- and protein-rich foods (Drewnowski and Greenwood 1983) that would have guided human biological ancestors toward energy-dense resources. Particularly relevant to archaeological discussions is the idea of a universal preference for meat over plant-based foods (Harris 1985), which has underlain many assumptions regarding the status of meat as a universally high-prestige food across many cultural contexts.

Despite some innate human taste preferences that may have an evolutionary basis, empirical studies suggest the types of foods consumed to satisfy particular tastes vary cross-culturally, with individuals of differing cultural backgrounds displaying different preferences for the intensity of particular flavors and for their combination with other taste qualities, a result that is most easily explained through cultural learning rather than biological feedback (Desor et al. 1975; Harbottle 1997:182-183; Jerome 1977; Rozin and Fallon 1981; Rozin and Schiller 1980). Some evidence does, however, suggest that nutritional concerns play a larger role in food selection within marginal environments or during periods of intense food scarcity, particularly within hunter-gatherer economies (Hladik 1997; Speth 1990; Speth and Spielmann 1983). While biological factors certainly place limits on the types of diets that it is possible for humans to maintain, purely nutritional perspectives are inadequate to predict all aspects of food choice in complex societies, where many possible types of foods can be exploited to satisfy nutritional needs and biologically derived preferences.

Perspectives on diet derived from human behavioral ecology elaborate on nutritional models of food choice by embedding nutritional concerns within cost-benefit analysis and economic decision-making. According to optimal foraging theory, individuals do not necessarily select the most nutritious food sources available within a certain environment, but instead choose those food sources that provide the greatest energy or nutrient gains relative to handling time (Barlow 2002; Christenson 1980; Kaplan and Hill 1992; Pyke 1984). While typically utilized to explain aspects of hunter-gatherer subsistence systems (e.g., Bliege Bird and Bird 1997; Hawkes et al. 1982; O'Connell and Hawkes 1981; Wood and Hill 2000), models derived from human behavioral ecology do appear to receive some ethnographic support for agricultural societies during periods of extreme food scarcity, when individuals engage in behaviors akin to foraging in order to supplement their agriculturally based diets with uncommonly high levels of wild foods. In these cases, people tend to preferentially select plant foods with greatest nutritive value and lowest processing costs during the outset of food shortages and progress to less nutritive and/or more costly wild products as famine worsens (Huss-Ashmore and Johnston 1997).

Ethnohistoric and historic accounts of famine within Central Mexico suggest that not only wild plants but also non-staple agricultural goods may serve as famine foods during periods of shortage. During the Mexican Revolution, members of the Orizabita community in the Mezquital region just north of the Basin of Mexico subsisted nearly exclusively on *maguey* (*Agave americana*) and *nopal* (*Opuntia ficus-indica*) plant products for extended periods during the Mexican Revolution, when access to alternative food sources through nearby market towns was cut off (Parsons and Parsons 1990:11). Similar dietary choices also appear to have prevailed in pre-Hispanic Central Mexican contexts. During the Postclassic famine of 1 Rabbit, for example, commoners in central Mexico relied heavily on *maguey* products, on portions of agricultural plants not normally consumed such as tassels from the corn plant (*Zea mays*) and flowers from the *nopal* cactus, and only to a more limited degree on wild plant resources (Hassig 1981:174). Despite having some explanatory value for food choice during periods of scarcity, optimal foraging theory is not necessarily applicable to agricultural societies during periods of plenty, when individuals are not likely to engage in foraging behavior. Instead, a combination of economic and symbolic considerations drives food choice among individuals when agricultural yields are sufficient.

Economic Aspects of Food Choice

Economic models of food choice suggest that the relationship of individuals to the means of production impacts the quantity and diversity of food resources to which they have access (Castro et al. 1981; DeWalt 1983b; Gumerman 1997). Differences in the economic value of foods result in part from variation in the amount of labor required to produce different food items. For example, due to the additional labor investment in a prepared foods, food processing increases the economic value of prepared foodstuffs as compared to their raw ingredients (Goody 1982; Mintz 1986). Because of the economic principles of supply and demand, low yield or rare food resources within a particular ecosystem may also accrue economic value within a market economy regardless of the actual costs necessary to produce or obtain said resources (Rosello Izquierdo et al. 1994). Food imports into a region from distant ecosystems tend to disproportionately contain economically valuable foods that justify the additional labor and expense necessary to transport these foods from their place of origin to their place of consumption (Cowgill 1993; Drennan 1984).

Numerous archaeological and historic examples confirm that the economic elite within preindustrial states frequently have access to both a greater quantity and a wider variety of foods than the non-elite, due to their ability to afford foods at varied levels of economic expense (e.g., Clark and Blake 1994; Crane and Carr 1994; Dietler 2001; Emery 2003; Ervynck et al. 2003; Lentz 1991; Welch and Scarry 1995). However, specific economic systems strongly influence the degree of difference between elite and nonelite diets. Comparative examples from varied cultural contexts suggest that market systems such as those operating within many Mesoamerican contexts may reduce wealth-based variation in diet, as elites have more difficulty in monopolizing specific resources (Bowen 1992; Maltby 1985; Rothschild 1989; Zeder 1991).

Not all food procurement patterns operate through official economic channels, however, highlighting the importance of complementing economic perspectives of diet with other theoretical inputs. DeWalt (1983a, 1983b), for example, notes that food provisioning within modern Mexican households involves a number of disparate strategies, including engagement with the market economy as well as noncommercial routes such as gathering and gifting between households. An example of this process is borne out in the *mestizo* community of Xochimilco, where people with money consume hot coffee obtained through market mechansims, while those with less economic means would more commonly drink a tea made from the *amozote* plant (*Bidens aurea*), which grows wild along the canals bordering the *chinampas* (Christie 2008:200). The supplementation of market-derived foods with gathered or hunted resources may therefore occur not only during periods of resources scarcity or stress, as predicted by nutritional and ecological perspectives, but may also serve as one mechanism through which individuals of lower socioeconomic standing may be able to satisfy perceived dietary needs on a regular basis.

Symbolic and Performative Aspects of Food Choice

In addition to selecting foods based on economic considerations, people frequently imbue foods with symbolic associations that govern their use and consumption in particular cultural contexts. The classification of food resources in terms of broad cognitive schemes associated with sex, color, temperature, purity, or other characteristics is common within human societies (e.g., Anderson 1982; Beck 1969; Manderson 1981; Messer 1981), and these symbolic associations can both govern culturally specific ideas about the edibility or inedibility of potential food resources and help to define appropriate dietary differences between social categories of people (Diener and Robkin 1978; Douglas 1966, 1984; Goody 1982; O'Laughlin 1974). Food preferences are commonly linked with a person's sense of his or her own social identity as well as with his or her concepts of social "otherness," whereby people who eat unfamiliar foods are conceptualized to be fundamentally different from members of one's own social group (Graham 2003; Mintz 1986; Sandstrom 1991; Weismantel 1988). While strictly economic models suggest that individuals should select more costly foods when economic factors allow, symbolic perspectives recognize that food choice may deviate from economic expectations when particular foods are either subject to sumptuary rules or are associated with social identities such as gender, age, or ethnicity that do not correspond perfectly with economic distinctions (e.g., Goldstein et al. 2009; Hastorf 1990; Turner et al. 2007).

The form in which foods are consumed can also be imbued with social significance that extends beyond that attributed to a raw food resource. While food processing undoubtedly impacts the economic valuation of a dietary product due to the increased labor investment involved in the processing of raw ingredients, processed foods can be given additional symbolic connotations that govern their status- or identity-based usage above and beyond the impact of their altered economic value (Goode et al. 1984).

For example, despite roughly equivalent levels of labor investment in the preparation of corn tortillas and other forms of steamed or boiled corn such as tamales or *atole*, consumption of maize as tortillas rather than in steamed or boiled forms has been suggested to have had ethnic implications in pre-Hispanic Mesoamerica. Particularly, regional differences in ceramic forms related to maize processing and cooking that distinguish Maya and Central Mexican groups appear to have been maintained as one aspect of ethnic identity within the Merchants' Barrio at Teotihuacan, where the ceramic *comales* used to cook tortillas are quantitatively less frequent than in other areas of the site (Cheetham 2010; Rattray 1990).

The types of foods with prestigious associations may vary cross-culturally. While researchers working in Mesoamerican cultural contexts often assume that prestigious diets should be characterized by higher meat consumption and a lower reliance on maize than the diets of low status individuals (e.g., Hatch and Geidel 1985; Schoeninger 1979), this assumption is not applicable to all cultural contexts. For example, the symbolic associations of maize in the Andes guided its use as a high-status food through time (Cavero Carrasco 1986; Hastorf 1990; Hastorf and Johannessen 1993; Murra 1975), while meat is conceptualized as "polluting" within the Indian caste system and is not eaten by the higher castes, who instead maintain a vegetarian diet (Goody 1982).

Many social uses of prestigious foods serve to reinforce and reproduce the current social order (Fabre-Vassas 1997; Harris 1987; Tapper and Tapper 1986; Whitehead 2000). Like other symbolically charged objects, however, the use of meaning-laden food sources is capable of being manipulated to actively shape social relations. Even working within a shared semiotic system, individuals may choose to purposefully bend or ignore dietary rules in order to express dissatisfaction with established social norms (e.g., Gillette 2005; Lindenbaum 1986), a process which Appadurai (1981) terms "gastropolitics".

For example, while dietary practices can be used to reinforce socioeconomic divisions, they can also be used to mask such distinctions when socio-politically advantageous. In a Mesoamerican context, Sandstrom (1991) notes that despite very real differences in wealth between members of the Nahua community of Amatlán in Veracruz, no significant differences in dietary consumption patterns are observable between members of the community. These uniform consumption patterns serve as one defining aspect of Nahua ethnic identity as compared to rural *mestizos* within the area, an identity which grants members of the community access to governmental aid programs targeted at indigenous communities. In other cases, people of economic means may simply prefer inexpensive or low status foods over more expensive, high-status foods when these foods symbolize community identity or some other social distinction with which they identify (Bennet 1943; Bowen 1992; Reitz 1987; Singer 1985, 1987; Weismantel 1988). The symbolic associations of particular food items may operate independently of or in association with nutritional and economic aspects to alter or to strengthen patterns of socioeconomic differentiation in food types.

Toward a Comprehensive Understanding of Food Choice in Complex Societies

Because the above perspectives on food choice were developed and elaborated within differing theoretical traditions, it is rare for researchers studying cuisine and dietary differentiation to integrate all these viewpoints into a coherent explanatory framework. However, ecological, economic, and symbolic aspects of food choice may have varying salience to individuals occupying distinct positions within the social hierarchy of complex societies. Consequently, a theoretical lens that may suitably explain dietary patterns for some individuals may have considerably less explanatory value for others.

At the poorest levels of society, where sheer survival is of much greater importance to individuals than is social identity, we may expect food procurement practices to most closely approximate nutritional or ecological concerns, with individuals consuming those few resources accessible to them through economic mechanisms and potentially supplementing their diet with resources foraged or scavenged from wild or marginal agricultural sources in order to satisfy basic nutritional requirements and tastes. A number of ethnographic examples (e.g., DeGarine 1993; DeGarine and Hladik 1990; Goody 1982) suggest that it may be socially acceptable for socially marginal people to consume food sources deemed inappropriate or distasteful to economically secure individuals. Above these lowest socioeconomic levels, however, different components of dietary variability may more strongly reflect economic and symbolic concerns. Ervynck et al. (2003), for example, draws a distinction between affluent diets, characterized by access to larger quantities of foods, and luxury diets, which incorporate specific foods that are accessible only to a limited number of individuals based either on sumptuary restrictions or on extreme economic costs. Additionally, in societies in which economic resources are held and accessed at the household level, intrahousehold differences in food consumption likely reflect the differential prestige of members of the household, enacted and reinforced through daily performative food consumption practices (cf. Atalay and Hastorf 2006). Because different factors will have a stronger impact on consumption decisions in different social contexts, we may not expect to see a simple quantitative, linear trend in consumption patterns as we move up or down the social hierarchy within Mesoamerican complex societies. Instead, we may see qualitative differences in diet that appear to violate this trend.

The following section uses ethnographic and ethnohistoric accounts of food choice within contact-period, colonial, and modern Mesoamerican groups to demonstrate that multiple nutritional, economic, and symbolic considerations guide dietary differentiation between groups in Mesoamerican contexts. Due both to the potential for biases and misunderstandings in Spanish ethnohistoric documents and to the large temporal separation between Teotihuacan and the groups in question, the specific dietary practices described within these societies may differ greatly from what we see at Teotihuacan. Nevertheless, these accounts can provide a source of initial hypotheses regarding dietary differentiation in the past that can be verified or altered through the analysis of empirical bioarchaeological data.

Socioeconomic Dietary Differentiation in Mesoamerica

Ethnohistoric Accounts of Mesoamerican Diet

Our understanding of contact-period and colonial dietary practices within central Mexico comes from a number of contemporary observers, chief among them Franciscan friar Bernardino de Sahagún, whose *Florentine Codex* provides extensive accounts of daily life within the Aztec empire culled from interviews with a number of native informants (Sahagún 1950-1982). Due to the fact that the vast majority of Sahagún's informants were high-status males, however, the information that he provides is unlikely to provide a perfect understanding of diet among all segments of society. Rather, Sahagún's references to socioeconomically-based dietary differentiation are presented through the lens of the top members of indigenous society and were further interpreted by a European outsider (Coe 1994:67, 77). Nevertheless, this work, in conjunction with the writings of other contact period observers, can provide us with an understanding of the types of foods eaten by various members of Aztec society and can hint at at least some of the ways that food operated to differentiate people of different economic means and social statuses.

At the time of Spanish Conquest, the Aztecs exploited a diverse range of dietary resources either derived locally within the Basin of Mexico or brought into the region as tribute from outlying provinces. In addition to the primary carbohydrate staples of maize (*Zea mays*) and amaranth (*Amaranthus sp.*), other important cultivated plant foods incorporated into the Aztec diet included several species of beans (*Phaseolus sp.*) and squash (*Cucurbita sp.*), husk tomatoes (*Physalis philadelphica*), avocados (*Persea americana*), chiles (*Capsicum sp.*), maguey (*Agave americana*) and nopal (*Opuntia ficus-indica*) cactus, chia (*Salvia hispanica*), and mesquite (*Prosopis sp.*) (Ortiz de Montellano 1990). Complementing the domesticated turkey (*Meleagris gallopavo*) and dog (*Canis familiaris*), terrestrial animal protein sources included armadillos (Order *Cingulata*), pocket gophers (Family *Geomyidae*), weasles (*Mustela sp.*), rattlesnakes (Subfamily

Crotalinae), iguanas (*Iguana sp.*), mice (*Mus sp.*), and several species of insects, including grasshoppers (Suborder *Caelifera*), ants (Family *Formicidae*), and worms (Phylum *Annelida*) (Ortiz de Montellano 1990). The lake system in the Basin of Mexico also served as a rich source of animal foodstuffs, containing numerous species of fish (Class *Osteichthyes*) and water fowl (Family *Anatideae*) as well as frogs and tadpoles (Order *Anura*), fish eggs, water beetles (Order *Coleoptera*), and aquatic salamanders (*Ambystoma mexicanum*) (Ortiz de Montellano 1990; Parsons 2006). The water algae *Spirulina geitlerii*, known as *tecuitlatl* among the Aztecs, was also gathered and pressed into loaves that served as a high-protein and vitamin-rich food resource (Ortiz de Montellano 1990; Parsons 2006).

Due perhaps to a combination of the market-based economy of the Aztec empire and Aztec cultural prohibitions against excess and indulgence in personal behavior, elite diets within Aztec society appear not to have differed strikingly from those of commoners (Coe 1994:81-87). However, ethnohistoric documents point to some differences in the types of animal protein resources consumed by elites and commoners. Particularly, there seems to have been a distinction between terrestrial animals and lake-derived protein sources that had strong socioeconomic implications within Aztec society. Soustelle (1970:151) describes lake-based protein sources such as algae, insects, and frogs as associated with the poor, while the elite consumed game and domesticated turkey and dog as main protein sources. Furthermore, aquatic resources appear infrequently in Aztec tribute lists, perhaps suggesting little elite control over the production and redistribution of these resources (Parsons 2010:132). This association of lake resources with lower socioeconomic status appears to have been preserved into colonial times.

Writing in the sixteenth century, Francisco Hernández suggests that both lake worms and algae derived from Lake Texcoco were food sources exploited particularly by the rural poor (Hernández 1959).

An example of the importance of both economic and ideological factors governing differential food consumption within Postclassic Central Mexico involves the treatment of *pulque* (made from the sap of the *Agave americana* cactus) within the Aztec heartland. It is easy to classify *pulque* as an economically "inexpensive" drink, due to the widespread availability of *maguey* plants within the central highlands. However, symbolic factors in addition to exclusively economic criteria are important to understanding the nuances of its consumption by different social segments. In general, *pulque* was associated with lower classes (Motolinía 1903:315). While ethnohistoric accounts describe moral and legal prohibitions against alcohol consumption within Aztec society, Taylor (1987:55-58) suggests that prohibitions against *pulque* consumption applied primarily to the elite sectors of society, and that *pulque* consumption among members of the commoner social estate may be underestimated by ethnohistoric documents suggesting temperance. For example, Ixtlilxochitl (1985:140) mentions less stringent legal punishments for drunkenness among commoners than among the nobility. While the only punishment for drunkenness amongst nobles was death, commoners faced death only after their second offense.

Yet, despite *pulque*'s relative lack of economic value and association with a lower socioeconomic status, the beverage simultaneously held symbolic associations that governed its consumption by a prestigious group of people. Due to the symbolic martial associations of *pulque* (Anawalt 1993; Nicholson 1991:161; Pasztory 1983:260; Seler

1960-1961:511) warriors were allowed to imbibe during ceremonial occasions. While chocolate beverages (made from the seed of the *Theobroma cacao* tree) served as a socially acceptable substitute for *pulque* among many of the Aztec social elite (Coe and Coe 1996:77-78), the elderly, it seems, were given license to drink *pulque* to excess, regardless of socioeconomic station (Anawalt 1993). Consequently, the differential consumption of *pulque* within Aztec society must be understood not only based on economic factors, but also on social and symbolic ideas about the appropriate types of foods that can be consumed by people with specific social characteristics.

Ethnographic Accounts of Mesoamerican Diet

Despite the introduction of many Old World species of plants and animals into Mesoamerica during the hundreds of years between the Spanish conquest and the present day, many indigenous groups throughout Mesoamerica maintain a diet based heavily on pre-Hispanic cultigens. Modern indigenous peasants throughout Mesoamerica consume a diet based primarily on maize and supplemented with beans and squash grown either in small house plots or on larger fields within their local communities (Anderson 2010; Friedlander 1975; González 2001; Ruvalcaba 1987; Sandstrom 1991; Vogt 1970, 1976). These staple crops are complemented by a variety of wild greens, collectively called *quelites*, that serve as a source of additional vitamins (Messer 1972) as well as with commercially available foodstuffs when economically feasible (DeWalt 1983b; O'Connor 2010:489; Vogt 1976:51).

Because many indigenous communities lack extensive social differentiation between individuals based on wealth, we do not see extreme wealth-based differences in diet within these communities. There are accounts from the Maya village of Zinacantan in modern-day Chiapas that families who have become economically successful maize farmers consume chicken (*Gallus gallus domesticus*) and beef (*Bos taurus*) more frequently than do less wealthy members of the community. However, this effect is small, and most excess wealth is channeled not into altering the diet or standard of living of the wealthier individuals, but instead into expensive ritual obligations associated with high positions in the cargo system (Vogt 1970:60). Additionally, as mentioned above, members of the Nahua community of Amatlán in Veracruz maintain fairly uniform diets in spite of wealth differences as a manner of asserting ethnic identity in opposition to rural *mestizos* (Sandstrom 1991).

Indeed, the most useful aspect of ethnographic data for understanding the economic and social aspect of food use in modern-day indigenous Mesoamerica lies in the dietary differences maintained between indigenous peasants and *mestizos*, a distinction that merges both socioeconomic and ethnic components. There are, indeed, examples of poorer individuals within colonial Mexican society attempting to emulate individuals of higher socioeconomic standing when economically feasible, for example by preferring highly processed white sugar over the unrefined brown sugar known as *panela* (Mintz 1986:83). However, these examples are swamped by accounts of indigenous peasants placing higher emic value on products that neither make purely economic sense nor correspond to the types of foods imbued with high status by the country's economic and social elite.

A major distinction maintained between indigenous groups and their *mestizo* counterparts lies in the extent to which wheat (*Triticum sp.*) rather than maize (*Zea mays*) is used as a staple grain, with middle- and upper-class *mestizos*, particularly those living in urban areas, consuming more wheat than corn and the generally poor members of indigenous groups living in both rural and urban areas subsisting primarily on corn rather than wheat (Ochoa 2000:11). The symbolic distinction between indigenous and *ladino* foods is emphasized by the timing of their consumption within ritual meals in the town of Zinacantan, where participants begin with the locally produced indigenous foods of maize tortillas and chicken cooked with chili (likely standing in for the pre-Columbian turkey) and later end the meal with coffee and wheat rolls purchased from *ladino* communities (Vogt 1976:41-42). The quantity of meat consumed also appears to play a role in distinctions between indigenous and *mestizo* diets. For example, in the town of Zinacantan in the highlands of Chiapas, individuals performing offering rituals to the Earth Lord describe this deity as a "'fat and greedy *ladino*' [who] wants meat with his tortillas" (Vogt 1976:56).

The dietary differences between indigenous and *mestizo* groups is not exclusively produced by economic factors, however. Particularly, the reliance on maize is heavily linked to the symbolic significance of the food within Mesoamerican traditions, in which maize is imbued with a soul and the consumption of maize links humans with the supernatural via an animate landscape (Arnold 1999; González 2001; Sandstrom 1991). Thus, maize represents not only a source of nutrition, but also a link with tradition and an identity as descendants of a pre-Hispanic Mesoamerican tradition. Among the Rincón Zapotec of Oaxaca, the perceived higher quality of locally grown foods over imported items leads individuals to preferentially grow or purchase locally produced maize, beans, and other products rather than imported foodstuffs, even when a variety of economic factors make the imported foodstuffs more affordable (González 2001:19, 157-158). For example, members of the community of Talea prefer to utilize locally produced *panela* despite the fact that store-bought white sugar is available at a lower cost at government subsidized stores (González 2001:189). This example suggests that perceptions of what constitutes a high-quality food source, which need not be uniform within a single society, also guide differences in food choice between groups.

While ethnographic and ethnohistoric studies of dietary behavior provide the theoretical linkage between diet and socioeconomic status, the use of lifetime dietary change as a proxy for social mobility requires a technical basis upon which to measure aspects of diet at different points within an individual's life. The next chapter provides background on the biogeochemical methods that can be used in such a manner.

CHAPTER 4: BIOGEOCHEMICAL APPROACHES TO DIET

Considering the strong relationship of diet with both economic standing and social identities, major shifts in an individual's diet throughout the lifecourse may signal changes in both economically-based access to foods and how that individual is socially categorized, both by themselves and by others. Biogeochemical analyses of human remains provide one way by which to study past consumption practices on an individual level as well as a mechanism through which to identify shifts in dietary practices during differing portions of the life course. Here, I review the chemical principles underlying variation in the stable carbon, nitrogen, oxygen, and stable and radiogenic strontium isotope compositions of human bone and tooth enamel, emphasizing the geographical or paleodietary information that each isotope system provides to bioarchaeologists. I then use this information to propose a methodological approach to socioeconomic mobility in the archaeological record based on lifetime dietary change and discuss potential limitations and methodological concerns surrounding the use of biogeochemical paleodietary data in this manner.

Paleomobility Isotopes

A clear understanding of dietary differentiation within a single society requires knowledge of the processes of immigration that brought nonlocal individuals into that society. People who were born and raised abroad may not only have been subject to environmental differences that made different types of food resources available for consumption within their region of origin but may also have been subject to different social norms regarding the types of foods that were appropriate for a person of their social characteristics and economic standing to consume. Additionally, as discussed further below, the stable carbon, nitrogen, and strontium isotope values present in certain food sources can vary between geologically or climatically dissimilar areas, such that people consuming the same diet in different geographic areas may nevertheless display different paleodietary isotope values in their bones and tooth enamel.

Biogeochemical analysis of human remains can be used to distinguish local individuals from immigrants or sojourners, information that is necessary in order to differentiate dietary changes related to nonlocal residence from those related to socioeconomic mobility within a single society. Numerous isotope analyses carried out at Teotihuacan demonstrate the presence of nonlocal individuals within Teotihuacan skeletal collections, whether within the distinct ethnic barrios located within the periphery of the city, buried as sacrificial offerings underneath large-scale public architecture, or in typical Teotihuacan apartment compounds that lack any distinct evidence for identification with a foreign ethnic group (Morales Puente et al. 2012; Price et al. 2000; Schaaf et al. 2012; Spence and White 2004; Spence et al. 2004; White et al. 1998, 2002, 2004a, 2004b, 2007). These data make it important to screen for nonlocal individuals within each skeletal collection at Teotihuacan before interpreting the paleodietary isotope values within their bones and teeth in terms of status-based variation. This project used a combination of stable oxygen and radiogenic strontium isotope data to distinguish between geographically local individuals and those who lived abroad for at least some portion of their lives. The use of both of these isotope systems jointly allows a more precise evaluation of the geographic place of residence of specific individuals than does either isotope system in isolation, as two geographic areas with the same strontium isotope signatures in their local foods may nevertheless be distinguished by different oxygen isotope signatures in their water, and vice versa (see White et al. 2007). The discussions to follow depend heavily upon the principle of isotope fractionation, or the changes in the isotopic composition of a substance that occur during chemical reactions and state changes (Eby 2004:182).

Principles of Radiogenic Strontium Isotope Analysis

Differences in radiogenic strontium isotope ratios in human remains originate in the underlying geology of the region from which people are obtaining their foods. Four stable isotopes of strontium occur within nature: ^{84}Sr, ^{86}Sr, ^{87}Sr, and ^{88}Sr (Comar et al. 1957; Faure 1986). Of these four, it is the ratio of ^{87}Sr to ^{86}Sr is that is used in isotopic studies of paleomobility. The radiogenic ^{87}Sr isotope is produced via the radioactive β-decay of ^{87}Rb within rocks over geologic time spans, while the concentration of the stable ^{86}Sr isotope remains constant through time. The concentration of ^{87}Sr and consequently the ^{87}Sr/^{86}Sr value in local bedrocks is therefore dependent on both the initial ^{87}Rb/^{86}Sr value of the rock at the time of its formation and the age of the rocks that make up the underlying geology of the region (Faure 1986; Faure and Powell 1972). Through weathering, the strontium content of local bedrock is becomes incorporated into local soils and water with minimal fractionation (Bentley 2006; Graustein 1989; Graustein and Armstrong 1983).

It is important to note that the strontium isotope ratios in soils are not necessarily expected to be the same as those of the bulk underlying bedrock, however. While the weathering process itself does not cause chemical fractionation to occur, differences in the strontium isotope composition between local bedrock and soils can be produced through non-uniform weathering of individual minerals in the bedrock, which may themselves have distinct $^{87}Sr/^{86}Sr$ values, and through the mixing of sediment sources into local soils due to geological processes such as river transport (Beard and Johnson 2000; Capo et al. 1998; Tricca et al. 1999). While a small amount of strontium incorporated into soils also derives from the atmosphere and from ground and stream waters, these sources of strontium are typically swamped by the contribution from mineral weathering (Åberg et al. 1989; Graustein 1989; Graustein and Armstrong 1983; Poszwa et al. 2000).

Strontium becomes incorporated into the food web as bioavailable strontium when groundwater leaches the element from the soil and when the dissolved strontium is subsequently absorbed into plant tissues. The $^{87}Sr/^{86}Sr$ value does not fractionate through the food web and is therefore unaffected by the trophic position of plants or animals (Blum et al. 2000; Comar et al. 1957; Elias et al. 1982). However, the range of $^{87}Sr/^{86}Sr$ values associated with a particular geographical locale does tend to narrow in succesively higher trophic levels. This range reduction occurs because the strontium isotope value incorporated into the tissues of a consumer is an average of the strontium isotope values in the mix of foods that it consumed. Consequently, the strontium values in animal tissues are less variable than those in local plants, which are in turn less variable than those in local soils and water sources (Blum et al. 2000; Burton et al. 1999; Sillen et al. 1998).

In contrast to terrestrial foodwebs, the ultimate source of strontium in marine foodwebs is ocean seawater. Globally, ocean seawater displays a homogeneous $^{87}Sr/^{86}Sr$ value of 0.7092 (Veizer 1989), and marine food resources derived from the ocean should therefore match the radiogenic strontium isotope composition of seawater. Terrestrial food sources from coastal areas may additionally display a strontium isotope value heavily weighted toward this marine value due to the introduction of marine-derived strontium into coastal soils via both sea-spray and rainfall derived from evaporated seawater (Chadwick et al. 1999; Hodell et al. 2004; Whipkey et al. 2000).

Strontium from the diet substitutes for calcium in the hydroxyapatite portion of developing bone and tooth enamel with no additional fractionation (Carr et al. 1962; Comar et al. 1957). Because of the chemical substitutability of strontium and calcium, the strontium isotope ratios in human bone will disproportionately reflect those of calcium-rich food sources, which provide a large amount of an individual's dietary strontium (Burton and Wright 1995). "Local" individuals are typically, though arbitrarily, defined as those who display radiogenic strontium isotope values that fall within two standard deviations of the average value derived from the analysis of locally raised modern fauna (Price et al. 2002). A number of previous studies have given us a reasonable idea of the strontium isotope values that we should expect to see in the bones of local individuals from the Teotihuacan Valley as opposed to immigrants from various regions of Mesoamerica (Hodell et al. 2004; Price et al. 2000, 2008; Schaaf et al. 2012). However, it is important to recognize that individuals who have resided locally their entire lives may nevertheless display "nonlocal" strontium isotope values as compared to a faunal baseline if they are regularly consuming imported foodstuffs grown or caught in areas with a different underlying geology, particularly if these imported foods are rich in calcium (Wright 2005). Conversely, individuals who have resided nonlocally may display bone chemistry that falls within the "local" baseline range if they came from a geographical area with similar underlying geology to the region in question.

As discussed in a previous chapter, tooth enamel forms early in life and does not remodel, meaning that the strontium isotope value present in tooth enamel will reflect the geographic locale in which a person lived during the time of enamel formation. Due to the fact that somatic bone remodels, however, the strontium isotope composition of an individual who had moved from one geologically dissimilar area to another during his or her life will be dependent both on the turnover rate of the bone and the amount of time that the individual has lived at the second location. Through time, the radiogenic strontium isotope ratio of the bone gradually transitions between the value characteristic of the place of origin toward the value characteristic of the new place of residence (Beard and Johnson 2000; Schweissing and Grupe 2003). However, even people who have lived in a single location for years prior to their death may not display radiogenic strontium isotope ratios in their somatic bone that perfectly match the local baseline if their skeletal tissues are still in the process of equilibrating to their new place of residence.

Principles of Oxygen Isotope Analysis

Geographic variation in the oxygen isotope values of water sources is generated through the processes of evaporation, condensation, and precipitation occurring throughout the hydrological cycle. As a general principle, water molecules containing the lighter ^{16}O isotope more readily enter the gaseous state through evaporation than do water molecules containing the heavier ^{18}O isotope, which instead preferentially enter the liquid state through condensation (Dansgaard 1964; Epstein and Mayeda 1953; Gat 1996). Rainclouds initially form through the evaporation of ocean waters and are therefore systematically depleted in ^{18}O relative to the ocean (Craig and Gordon 1965). As rainclouds travel inland from the ocean, they become increasingly depleted in the ^{18}O isotope as this heavier isotope is disproportionately lost as precipitation, also known as meteoric water ($\delta^{18}O_{mw}$). Therefore, increasing geographic distance from the coast is associated with lower $\delta^{18}O$ values in the meteoric water from these increasingly depleted clouds (Dansgaard 1964; Gat 1996).

Temperature also has an effect on the $\delta^{18}O$ value of meteoric water, as higher temperatures serve to reduce or eliminate the fractionation effect that occurs with state changes by increasing the kinetic energy of the system (Melander 1960). Consequently, $\delta^{18}O_{mw}$ values are also lower in areas with lower ambient temperatures, as well as with increasing altitude and latitude, due primarily to the association of altitude and latitude with decreased temperature (Bowen and Wilkinson 2002; Dansgaard 1964; Epstein and Mayeda 1953; Koch 1998; Yurtsever and Gat 1981). In addition to rainwater, individuals living within a single area may have access to multiple other water sources, including recycled water sources such as rivers, lakes, and groundwater, each of which may differ in their oxygen isotope composition due to the transport and mixing of meteoric water from other geographic areas and to the ongoing process of evaporation occurring in surface water sources (Craig 1961; Gat 1996; Zimmerman et al. 1967).

While some oxygen enters the body through respiration of atmospheric oxygen and through the consumption of foods, the oxygen isotope values in human bones and teeth primarily reflect the values in the water sources consumed at the time when a particular skeletal element is formed. Oxygen in body water becomes enriched relative to drinking water through the process of respiration, as the water vapor expired as one breathes removes a disproportionate amount of ^{16}O from the system (Bryant and Froelich 1995; Roberts et al. 1988). Oxygen from body water then becomes incorporated into phosphate and carbonate groups within the hydroxyapatite component of human tooth enamel and bone when the oxygen content of hydroxyapatite equilibrates with that of body water (Longinelli 1984; Luz et al. 1984). The primary water source of breastfeeding infants is breast milk, which is derived from the body water of the mother and is therefore enriched in ^{18}O relative to local atmospheric water. Consequently, skeletal elements formed before the weaning process was complete, including enamel from the majority of permanent teeth, will display oxygen isotope values that are further fractionated relative to local atmospheric water than are skeletal elements formed after the weaning process is complete, such as third molars and the somatic bone of older children and adults (Roberts et al. 1988; Wright and Schwarcz 1998).

Both the storage and processing of water prior to consumption by humans can cause the oxygen isotope values in drinking water to deviate from the oxygen isotope signatures in local precipitation or recycled water sources. For example, the boiling of water for purposes of sanitation or in the preparation of stews or beverages such as maize beers will cause a disproportionate amount of ^{16}O to evaporate, leaving the remaining water enriched in ^{18}O (Wilson et al. 2007; Wright and Schwarcz 1998). Even without preparation prior to consumption, the storage of water should also be expected to increase the δ^{18}O value of the stored water through evaporative water loss. Due to the combination of the variety of water sources available to people within a particular geographic area with variable water storage and processing practices, it is possible for there to be significant within-site variation in the oxygen isotope values found in the bones of local individuals (Knudson 2009). However, the analysis of reference samples derived from various regions of Mexico has provided us with a reasonable understanding of the range of oxygen isotope values that we should expect to see in the bones of local individuals from the Teotihuacan Valley as opposed to immigrants from various regions of Mesoamerica (White et al. 1998, 2004b, 2007).

Paleodietary Isotopes

Once the residential history of an individual has been evaluated, additional isotope systems can be brought to bear on his or her diet. Paleodietary reconstructions rely specifically on the stable isotopes of carbon, nitrogen, and strontium to infer past consumption practices, as isotopes of these elements are incorporated in to human remains in a way that reflects behaviorally meaningful differences in dietary composition.

Principles of Carbon Isotope Analysis

Carbon isotopes are integrated into the terrestrial food web through photosynthesis, which converts atmospheric CO_2 into organic carbon incorporated into plant biomass (Eby 2004:139-140). Broad categories of plants utilize different photosynthetic pathways, including the C_4, or Hatch-Slack, pathway used by maize (*Zea mays*), amaranth (*Amaranthus sp.*), and other tropical grasses, the CAM-photosynthetic pathway used by cacti and succulents, and the C_3, or Calvin, photosynthetic pathway used by most other plants (Calvin 1962; Calvin and Benson 1948; Deines 1980; Hatch et al. 1967). Because different photosynthetic mechanisms utilize slightly different chemical reactions, plants following distinct photosynthetic pathways incorporate organic carbon that has undergone differing degrees of isotopic fractionation relative to atmospheric CO_2.

The ratio of $^{13}C/^{12}C$ within a sample is expressed as a $\delta^{13}C$ value computed relative to the international standard Vienna Peedee belemnite (VPDB) according to the following equation: $\delta^{13}C=((^{13}C/^{12}C_{sample} - {}^{13}C/^{12}C_{standard})/ (^{13}C/^{12}C_{standard})) \times 1{,}000$ (Coplen 1994). Though altitude and climatic factors have been shown to have an impact on the specific carbon isotope values in a variety of food sources (Kohn 2010; Tieszen and Chapman 1992), plants employing the C_3 pathway tend to have $\delta^{13}C$ values ranging approximately from -20‰ to -35‰, while plants following the C_4 pathway have $\delta^{13}C$ values between -9‰ and -14‰ (Deines 1980; Smith and Epstein 1971). The isotopic composition of CAM plants is variable, but is often intermediate between those of C_3 and C_4 plants (Deines 1980). The analysis of modern baseline plant samples from the Teotihuacan Valley suggests a carbon isotope range of approximately -11.5 to -15.1‰ for C_4 plants such as maize (*Zea mays*), approximately -11.9 to -15.8‰ for CAM plants such as the maguey (*Agave americana*) and nopal (*Opuntia ficus-indica*) cactus, and approximately -21.8 to -30.5‰ for C_3 plants such as molle berries (*Schinus molle*) and

Mexican cherries (*Prunus salicifolia*) (Lounejeva Baturina et al. 2006; Morales Puente et al. 2012).

In contrast to terrestrial food webs, the ultimate source of carbon isotopes within marine food webs derives both from dissolved atmospheric CO_2 within bodies of water and from dissolved inorganic carbon originating from carbonate-based rocks (Eby 2004:173). This difference in the source of carbon incorporated into marine biomass translates into a roughly 7‰ enrichment of the $\delta^{13}C$ value of food sources derived from a marine ecosystem relative to terrestrial C_3 resources (Chisholm et al. 1982, 1983; Tauber 1981). Because of this enrichment, many marine foods have a carbon isotope composition similar to that of C_4 plants such as maize (Chisholm et al. 1982), though they can be distinguished on the basis on nitrogen isotope composition, as discussed below.

As carbon isotopes move through the food web, minor additional fractionation occurs in the bodies of primary consumers as carbon isotopes are incorporated into bioapatite carbonate and bone collagen (Passey et al. 2005a). Though the carbon isotope composition found within the whole body of animal consumers closely reproduces the carbon isotopic composition of their diets, the distribution of carbon isotopes throughout various tissues of the body is non-uniform, leading to different degrees of fractionation between diet and tissue for different components of the body (DeNiro and Epstein 1978). The carbon isotope ratios of foods in the diet are incorporated into human bone carbonate with a constant shift in isotope ratios of 9.7‰ (Kellner and Schoeninger 2007) and into human bone collagen with a shift of approximately 5‰ (Ambrose and Norr 1993). Carbon isotope values in tooth enamel carbonate are approximately 2.3‰ higher than the carbon isotope values in bone carbonate of individuals consuming identical diets, and consequently the shift between diet and tooth enamel carbonate is approximately 11.7‰ (Warinner and Tuross 2009).

Differing dietary information is encoded in the carbon isotope composition of the collagen and mineral portions of human bone. Early in the development of paleodietary applications of carbon isotope analysis, DeNiro and Epstein (1978) demonstrated that the $\delta^{13}C$ values of both bone collagen and bone apatite in animal skeletal remains correlate strongly with the $\delta^{13}C$ value of the diets that the animals consumed. Subsequent research on mammalian bone chemistry (e.g., Ambrose and Norr 1993; Jim et al. 2004; Krueger and Sullivan 1984; Tieszen and Fagre 1993) noted discrepancies in the carbon isotope composition found in the bone collagen and apatite of single individuals, and suggested that the $\delta^{13}C$ values in bone collagen more closely reflect the isotopic composition of dietary protein while the $\delta^{13}C$ values of bone apatite more closely reflect total diet isotopic composition. More recently, Kellner and Schoeninger (2007) have noted additional discrepancies in the relationship between $\delta^{13}C_{collagen}$ and the $\delta^{13}C$ value of dietary protein, suggesting that though the majority of carbon atoms in bone collagen may come from dietary protein, the isotopic composition of carbohydrate and lipid portions of the diet are also minimally reflected in collagen $\delta^{13}C$ values. Due to their divergent dietary sources, bivariate plots of $\delta^{13}C_{collagen}$ against $\delta^{13}C_{carbonate}$ can be used to distinguish the broad types of plant foods consumed directly by humans from the types of plants consumed by the animal species incorporated into human diets (Froehle et al. 2010; Kellner and Schoeninger 2007).

Principles of Nitrogen Isotope Analysis

The ultimate source of nitrogen isotopes within the food web is atmospheric nitrogen (N_2), which becomes incorporated into nitrogen-based compounds in the soil through nitrogen-fixing microbial activity (Eby 2004:114). A number of factors contribute to nitrogen isotope variation among plant resources. Variation results in part from the different mechanisms through which various plant species gain access to nitrogen compounds in the soil. While legumes maintain a symbiotic relationship with nitrogen-fixing bacteria living within their root structures and directly assimilate the ammonia produced by these organisms (Brill 1977; Yoneyama et al. 1986), other types of plants instead absorb nitrogen derived from decomposed organic matter within the soil, which is isotopically enriched as compared to the nitrogen compounds produced by nitrogen-fixing bacteria (DeNiro and Hastorf 1985; Letolle 1980).

Environmental, climatic, and cultural factors can also impact the nitrogen isotope composition of specific plant and animal species. In hot, arid environments, both plants and animals display higher nitrogen isotope values than do identical species living in less arid environments (Ambrose 1991; Amundson et al. 2003; Hartman 2011; Heaton et al. 1986; Pate and Anson 2008). Plants and animals living in saline environments, such as coastal areas or regions with shallow groundwater and high evapo-transpiration rates, feature nitrogen isotope values up to 10‰ higher than plants and animals from non-saline environments due to the higher $^{15}N/^{14}N$ value in soil nitrogen within these environments (Heaton 1987; Ugan and Coltrain 2011). Human intervention into the soil-plant system through agricultural practices can alter the nitrogen isotopic compositions of both soils and the plants that grow in them. For example, the application of animal dung fertilizers to agricultural soils can raise the nitrogen isotope ratios of plants grown within these soils, though the extent of this effect is quite variable depending on factors such as the species of animal utilized, the amount of dung added to the soil, and duration over which the fertilizers are applied (Kriszan et al. 2014; Szpak 2014; Szpak et al. 2012). Swidden agriculture and tilling practices can also both alter the isotopic composition of nitrogen inputs, resulting in elevated nitrogen isotope ratios in agricultural plants as compared to wild plants (Szpak 2014).

Nitrogen isotopes fractionate as they travel through the food chain, causing animal consumers in successive trophic levels to become enriched in ^{15}N relative to their main food source. Analyses of numerous animal species have suggested that different trophic levels are distinguishable isotopically by a difference of approximately 3.3‰ in nitrogen isotope values (Ambrose 1991, 2000; Caut et al. 2009; Schoeninger and DeNiro 1984). Because freshwater and marine ecosystems typically include a greater number of trophic levels than do terrestrial ecosystems, marine or freshwater fish and the mammals who feed on them will typically have much higher nitrogen isotope ratios than terrestrial animals (Katzenberg 1989; Schoeninger and DeNiro 1984).

Stable nitrogen isotopes are recovered from amino acids in human bone collagen. The ratio of $^{15}N/^{14}N$ within the sample expressed as a $\delta^{15}N$ value calculated relative to the international standard AIR using the equation listed above for carbon isotopes. Though environmental and climatic factors can impact the nitrogen isotope values of specific plant and animal species, individuals consuming a primarily vegetarian diet can be expected to display a $\delta^{15}N$ value within the range of 3‰ to 9‰, while individuals consuming meat derived from terrestrial herbivores will display δ^{15}N values of approximately 9‰ to 12‰ (DeNiro and Epstein 1981; Katzenberg and Kelley 1991). Humans consuming large quantities of marine and lacustrine fish can be expected to display nitrogen isotope ratios much higher than those of individuals consuming terrestrial herbivores, often in the range of 14‰ to 15‰ (DeNiro 1987; Katzenberg and Weber 1999; Schoeninger et al. 1983). Nitrogen isotopes can therefore be used both to investigate an individual's overall level of animal food consumption and to assess the relative importance of foods from terrestrial and marine or lacustrine ecosystems within an individual's diet.

Possible confounding factors in the interpretation of nitrogen isotope ratios present in human bone include the effects of water stress, protein-calorie malnutrition, and other forms of physiological stress. Ambrose and DeNiro (1986, 1987) have argued that mammalian species undergoing continuous water stress in arid environments may excrete elevated quantities of urea, which is systematically depleted in ^{15}N relative to the diet, resulting in a higher than expected δ^{15}N value in bodily tissues among stressed individuals. Evidence also exists that enrichment in the δ^{15}N value of body tissues may result from insufficient protein intake. Experimental studies on birds have observed that protein stress results in the breakdown and reuse of existing muscle proteins to allow the synthesis of new proteins governing various metabolic functions (Hobson and Clark 1992; Hobson et al. 1993). Nitrogen isotopes incorporated in this way into the newly formed proteins will undergo the same isotopic fractionation as they would if they had been derived directly from the diet, resulting in enrichment of newly formed tissues in the heavy isotope of nitrogen relative to the old body tissues. In humans, changes in the δ^{15}N value in hair have been associated with a number of biological stressors that alter normal metabolic pathways, such as pregnancy, systemic infection, and starvation (D'Ortenzio et al. 2015; Fuller et al. 2004; Mekota et al. 2006; Neuberger et al. 2013). While it may not be possible to control for some of these factors within a skeletal sample, this dissertation project avoided the selection of samples from individuals who displayed macroscopically observable pathological conditions, as described in the Chapter 6, in order to sidestep these confounding factors to the degree possible.

Principles of Stable Strontium Isotope Analysis

Stable strontium isotope analysis forms an important supplement to nitrogen isotope analysis in assessing paleodietary trophic level. While the radiogenic strontium isotope ratio of $^{87}Sr/^{86}Sr$ in human remains is used in the study of prehistoric residential mobility, as described above, studies of paleodiet utilizing strontium isotopes instead focus on changes in the stable strontium isotope ratio of $^{88}Sr/^{86}Sr$ with increased trophic level (Knudson et al. 2010). Due in large part to temperature-based variation in the degree of isotope fractionation occurring during the formation of bedrock and soils, the starting value of $\delta^{88/86}Sr$ within biological food webs is geographically variable, as are the precise differences in $\delta^{88/86}Sr$ expected between marine and terrestrial food webs in a particular region (de Souza et al. 2010; Halicz et al. 2008; Knudson et al. 2010). The mechanism for the introduction of stable strontium isotopes into the food web is similar to that described above for radiogenic strontium isotopes. However, once within the food web, stable strontium isotopes differ from the radiogenic strontium isotope system in that isotopic fractionation occurs between each successive trophic level. In this way, the stable strontium isotope system functions more similarly to nitrogen isotope system. However, rather than becoming isotopically enriched with increasing trophic level as do nitrogen isotopes, stable strontium isotopes become isotopically depleted, resulting in lower $\delta^{88/86}$Sr values at higher trophic levels (Knudson et al. 2010).

Stable strontium isotope analysis is a relatively recently developed technique within the paleodietary literature, and as such, it is likely that our understanding of this isotope system and the way in which it functions in the food web and within the human body will continue to be refined in the future. However, because nitrogen isotopes are preserved in the collagen portion of human bone and are not present within tooth enamel, stable strontium isotopes currently provide information that nitrogen isotopes cannot: namely, a way in which to assess trophic level shifts through life through direct comparison of the same isotope system within bone and tooth enamel samples.

Data Quality

Diagenetic changes to the chemical composition of human remains in the postburial environment represent one of the most intensively studied problems surrounding the use of bone chemistry for the reconstruction of paleodiet (e.g., Budd et al. 2000; Child 1995; Collins et al. 1995; Hedges 2002; Lee-Thorp 2002; Lee-Thorp and Sponheimer 2003; Nielsen-Marsh and Hedges 2000a, 2000b; Price et al. 1992; Sillen 1989; Yoder and Bartelink 2010). Biogenic chemical ratios, the isotope values produced by cultural and biological processes during life, may be obscured or destroyed by postburial processes, making the recognition of diagenetic changes and the removal of diagenetic contaminants an essential precursor to the interpretation of the chemical composition of human remains. The extent and type of diagenesis experienced by a particular sample varies due to time, tissue type, and burial environment, with greater interment periods and moist postburial environments generally producing the largest changes (Berna et al. 2004; Nielsen-Marsh and Hedges 2000a; Price et al. 1992; Tütken and Vennemann 2011). I focus here on the differing diagenetic processes and screening protocols used to detect diagenetic changes relevant to the collagen and mineral fractions of bone.

Collagen Degradation

Though collagen may survive within the bone structure for thousands of years, it will eventually degrade through a combination of microbial attack and chemical hydrolysis (Child 1995; Collins et al. 1995, 2002; Hedges 2002). Generally, however, collagen extracted from bone can be expected to preserve its bulk isotopic integrity until the vast majority (>99%) of the original collagen content of the bone has been lost (Dobberstein et al. 2009). Several criteria have been proposed to assess whether collagen extracted from archaeological bone is sufficiently preserved to retain biogenic isotope ratios and whether it has been successfully isolated from both bone mineral and organic contaminants during the sample preparation process. DeNiro (1985) suggests that the ratio of carbon to nitrogen atoms in bone collagen (C/N value) may serve as a sensitive indicator of collagen preservation, since degraded collagen will often have a reduced nitrogen content relative to modern, well-preserved bone. Building upon this work, Ambrose (1990) has also demonstrated that the percent collagen yield recovered from a bone sample and the weight percent of carbon and nitrogen atoms within the extracted collagen also serve as reliable indicators of collagen preservation.

The primary contaminants of bone collagen include carbonates, lipids, humic acids, and other particulate matter. These contaminants can be effectively removed from archaeological collagen samples through a multi-step treatment procedure including treatment with hydrochloric acid (Brown et al. 1988; Longin 1971; Schoeninger and DeNiro 1984; Sealy 1986) or ethylenediaminetetracetic acid (EDTA) (Bocherens et al. 1995; Tuross et al. 1988) to remove bone carbonates, treatment with dilute sodium hydroxide to remove humic substances, lipids, and other base-soluble contaminants (DeNiro and Epstein 1981; Liden et al. 1995), and finally collagen solubilization and centrifugation to remove particulate matter (Ambrose 1990).

Diagenetic Contamination

Diagenetic alteration of the mineral fraction of bone and enamel occurs through two primary mechanisms: the uptake of elements from the burial environment through the addition of secondary minerals such as calcite ($CaCO_3$) and barite ($BaSO_4$) in pore spaces in bone and recrystallization, in which the dissolution and re-precipitation of hydroxyapatite allows the incorporation of diagenetic elements or compounds into the mineral structure itself (Hedges 2002:323; Kohn 2008; Lee-Thorp 2002:438; Radosevich 1993; Sandford 1993; Trueman et al. 2004). While tooth enamel is relatively resistant to both of these mechanisms of diagenetic contamination due to its large crystal size and correspondingly small pore spaces (Budd et al. 1998, 2000; Heuser et al. 2011; Kohn et al. 1999), bone is much more susceptible due to its greater porosity and surface area (Hedges 2002; Lambert et al. 1982).

A primary technique for removing diagenetic contamination from human bone is the mechanical removal of the outermost surface of bone and any trabecular material on the inside surface of the bone, where the greatest concentrations of diagenetic contaminants are found (Lambert et al. 1982, 1989, 1991; Price et al. 1992; Waldron 1981, 1983). Mechanical cleaning of the surface of the bone does not, however, remove contaminants that may have penetrated more deeply into the bone (Williams 1988; Williams and Marlow 1987; Williams and Potts 1988), and the chemical cleaning of bone samples with weak acid solutions can help to dissolve and remove some of these additional substances (Koch et al. 1997; Nielsen-Marsh and Hedges 2000b; Price et al. 1992; Sillen 1989).

Following sample preparation, elemental concentration data can be used to detect remaining diagenetic alteration to bone mineral. Rare earth elements such as uranium and neodymium, which are absent or present in extremely low levels in unaltered bone, can be used to detect the uptake of contaminants during diagenesis (Kohn et al. 1999; Williams 1988; Williams and Marlow 1987; Williams and Potts 1988). Similarly, the substitution of alternative elements or compounds for calcium or phosphate groups during recrystallization may be expected to alter the Ca/P value of bone (Burton 2008:443; Lee-Thorp and Sponheimer 2003:212; Sillen 1989:218). Elevated levels of rare earth elements and Ca/P values deviating from the expected values in modern bone are strong evidence that a particular bone sample has undergone diagenetic contamination and may not preserve behaviorally informative, biogenic isotope ratios.

Multiple authors (Manzanilla et al. 2000; Morales Puente et al. 2012; Stuart-Williams et al. 1996; White et al. 2004a, 2004b) have demonstrated variable but generally good preservation of collagen in bone samples from Teotihuacan as well as generally infrequent evidence of postburial diagenetic contamination of bone. These data indicate that studies of isotope composition within human bones at Teotihuacan can provide a reliable indicator of past diets, though, of course, continued screening of bone samples for contamination is necessary in all projects at the site.

Limitations on Isotopic Paleodietary Reconstructions

In addition to preservational concerns, there are several other considerations relevant to isotopic analysis that also must be taken into account in using lifetime changes in paleodietary isotope values as a proxy for socioeconomic mobility. Key among them are 1) limitations on the types of dietary differences that can be detected using biogeochemical analysis of human remains and 2) the biological dynamics of skeletal formation and remodeling that govern which portions of an individual's lifecourse are represented in the chemical composition of human skeletal materials.

First, not all dietary differences that may take on cultural significance can be detected using paleodietary isotope data. As discussed above, dietary differences that we can detecte include the relative importance of maize (*Zea mays*), amaranth (*Amaranthus sp.*), and cactus (*Cactaceae* family) products within the diet; the extent of animal protein consumed; differences in the species of terrestrial animals consumed; and the prominence of marine or lacustrine foods within the diet. If dietary differences between economic or social groups do not fall within one of these categories of isotopically detectable differences, we will not be able to use them to study social mobility.

Diets do, however, frequently differ in multiple ways between socially and economically defined groups of people, and we only need at least one of these differences to be isotopically detectable in order to use lifetime dietary change as a proxy for socioeconomic mobility. The review of ethnohistoric and ethnographic information about diet in Mesoamerica in Chapter 3 suggests that several of the ways in which foods were used to distinguish between groups at various points in Mesoamerican history would have been isotopically detectable in the skeletal remains of people living at the time. For example, the differential consumption *pulque* amongst the elite and commoners of the Aztec empire would likely have had a measurable impact on the stable carbon isotope ratios within bone. The regular consumption of a cactus-derived beverage such as *pulque* would have a different impact on bone chemistry as compared to potential alternative beverages such as chocolate, which is derived from a C_3 plant (*Theobroma cacao*) and has been suggested to have been a socially acceptable substitute for *pulque* among the Aztec social elite (Coe and Coe 1996:77-78). Similarly, in more modern contexts, the differential usage of wheat, a C_3 plant, and maize, a C_4 plant, as a carbohydrate staple among current-day Mesoamerican ethnic groups would also be detectable in the carbon isotope composition of human remains. In both modern ethnographic and ethnohistoric contexts, the greater animal protein consumption associated with wealth would have implications for both the nitrogen and stable strontium isotope compositions of human bone.

A second important constraint on the usage of biogeochemical data to address issues of socioeconomic mobility is the time-averaging nature of skeletal tissues, which places limitations on how straightforwardly diet at a particular moment of an individual's life is represented by the paleodietary isotope data present in different skeletal tissues. The timing of when in life bone and enamel form and the rate of bone remodeling both govern how long before death changes in diet must be experienced in order to be detectable in human bone chemistry.

As mentioned above, tooth enamel forms early in life and does not undergo subsequent remodeling through life. Teeth form between the approximate ages of five months in utero to fifteen years of age, with different tooth crowns mineralizing at slightly different times within this broader range (Anderson et al. 1976; Hillson 1996). Tooth enamel forms gradually through the sequential deposition and subsequent mineralization of perikymata from the incisal tip to the base of the tooth crown, though the precise timing and pattern of mineralization is a complex and only incompletely understood process (Hillson 1996; Montgomery et al. 2010; Simmons et al. 2013). While it is possible to target distinct portions of the incrementally growing tooth structure via laser ablation or other sampling mechanisms, there appear to be limits to the time resolution that it is possible to obtain through these methods due to these complexities in the mineralization process (Balasse 2003; Montgomery et al. 2010; Passey et al. 2005b; Zazzo et al. 2012). Bulk sampling over large areas of the tooth crown, as used in this dissertation, averages diet over the entire span of time during which enamel is mineralizing, as well as potentially up to a year before the tooth has started to mineralize due to a “reservoir effect” within the body for heavier elements such as strontium (Montgomery et al. 2010). As the period of formation of a single tooth crown is rarely longer than a few years, the primary concern for studies of socioeconomic mobility of this temporal averaging is the risk of blending information from pre- and post-weaning diets into a single isotopic value through the bulk sampling of a tooth crown that formed during the weaning process. For this reason, third molar crowns provide the ideal tooth for studies of post-weaning dietary change through life, as initial calcification of the third molar crown begins at approximately eight years of age, while crown formation is completed by approximately thirteen years of age (Ash and Nelson 2003; Hillson 1996:123). Therefore, the paleodietary isotope values recovered from third molar tooth enamel should be unaffected by diet before or during weaning.

In contrast to tooth enamel, bone remodels throughout life, continuing to incorporate new isotopes from food sources in the process. Turnover rates are different for cortical bone, the dense bone located on the outer surface of skeletal tissues, as compared to trabecular bone, the honeycomb-structured bone found within the interior of many skeletal elements. Rates of bone turnover can also vary greatly between different individuals of the same species based on factors such as age, sex, health status, and activity levels (Branca and Robins 1992; Carr et al. 1962; Cooper and Eastell 1993; Mulhern 2000; Mulhern and Van Gerven 1997; Parfitt 1983).

The annual turnover rate for dense cortical bone in ribs is approximately 3-4%, meaning that the isotope values in cortical bone will average representation of diet over decades prior to an individual’s death (Carr et al. 1962; Hedges et al. 2007; Kulp and

Schulert 1962; Mulhern 2000; Parfitt 1983). The half-life of cortical bone has been estimated as approximately 23.1 years (Parfitt 1983), though sufficient interindividual variability in bone turnover rates exists to make this number problematic as a basis for estimating a precise time interval represented by the isotope data recovered from any particular individual's cortical bone (Hedges et al. 2007). Generally speaking, cortical bone turnover rates are much higher in adolescence and slow as an individual ages, meaning that the isotopic composition of bone will average diet over a greater span of time for older individuals than for younger ones (Hedges et al. 2007). Additionally, bone turnover appears to be more rapid among adult females than among adult males, meaning that the isotopic composition of the bones of males will similarly average diet over a greater span of time than that of females (Hedges et al. 2007; Mulhern and Van Gerven 1997).

In contrast, trabecular bone remodels more quickly, with turnover rates estimated at approximately 26% per year, with a half-life of only 2.9 years (Parfitt 1983). However, due to the greater susceptibility of trabecular bone to post-depositional diagenetic contamination as compared to cortical bone (Lambert et al. 1982), trabecular bone is frequently unsuitable for biogeochemical analysis, despite the greater temporal specificity that should be recorded in biogenic chemical signatures of diet. As is conventional within biogeochemical studies of human bone, this study exclusively analyzed samples of cortical bone.

While significant interindividual variation in bone remodeling makes it difficult to define a precise length of time represented by the paleodietary data recovered in this project, it is clear that bone samples will average biogeochemical inputs over a large portion of an individual’s life, meaning that we may not expect individuals who experienced dietary change during some portion of their adult lives to feature bone chemistry that perfectly matches the isotope composition of the diet maintained at the end of their life. Rather, these individuals will feature isotope values intermediate between their original and later diets as their bone composition equilibrates with the isotope composition of the new diet. The sex and age of the person at the time of his or her death are also important considerations to take into account in assessing the degree of difference that we would expect to see between the bone and tooth samples of a person who had undergone lifetime dietary change. These factors makes a contextual understanding of the burial program at a particular site and what information it may contain about a particular individual's economic and social identities an important additional line of evidence in making a convincing argument that changes in bone chemistry through life represent social mobility.

Proposing Lifetime Dietary Change as a Proxy for Social Mobility

Despite the limitations of biogeochemical data, isotopic studies are one of the only archaeological methods allowing the reconstruction of prehistoric diet on an individual level. Therefore, biogeochemical studies of human remains provide a powerful methodological tool through which to study intrasocietal differences in food choice and consumption based on characteristics such as class, gender, and ethnicity. I present here a three-step methodology that outlines at a broad level the way in which paleodietary isotopic analysis may be utilized by archaeologists as an approach to studying lifetime shifts in social identity and economic standing. This methodology draws upon the three dimensions of social mobility outlined in Chapter 2 in order to investigate not only the overall prevalence of lifetime socioeconomic change but also the degree of equality of opportunity that individuals experienced based on their economic and social characteristics.

Step 1. Define the dietary correlates of wealth and status within the local society

Diets may be expected to differ between socioeconomic groups based both on differential economic access to expensive foods and on differential social privilege to consume foods with high-status symbolic associations. The specific foods that are economically costly or prestigious are, however, likely to vary cross-culturally. The first step of addressing socioeconomic mobility in the archaeological record is to use stable isotope analysis to identify dietary patterns within the local population associated with socioeconomic status and to establish the range of dietary variability observed among adults within groups of known socioeconomic standing.

In order to control for the impact of non-local origins on dietary choices, a necessary precursor here is to establish which individuals within the sample were born and raised within the local area and which were more recent immigrants to the site or region. This objective can be accomplished through the radiogenic strontium and stable oxygen isotope analysis of tooth samples to identify individuals who spent their childhood in a region that is either geologically or meteorologically dissimilar to the site in question and of bone samples to determine whether or not an individual was resident within the local area for a significant period preceding his or her death. Individuals who display nonlocal radiogenic strontium or stable oxygen isotope values within their somatic bone should be excluded from considerations of normative adult dietary patterns within a particular site, as the paleodietary isotope values in their bones may reflect a different set of dietary norms practiced in their geographic location of origin.

Once local individuals have been identified, systematic differences in the foods consumed by local individuals within distinct socioeconomic levels can be identified by combining information from the carbon, nitrogen, and stable strontium isotope systems to characterize multiple independently varying aspects of diet among local individuals. To control for dietary differentiation due to social factors other than socioeconomic status, this stage of research must also define dietary patterns associated with social factors such as gender, age, and ethnic identity, as appropriate to the local context. Dietary patterns associated with these social identities can be defined through statistical comparisons between groups of differing biological sex and age, between groups who display evidence of body modification or mortuary accompaniments associated with ethnic group membership or between groups interred within and outside of ethnic enclaves.

Step 2. Identify lifetime dietary changes consistent with upward or downward social mobility

To accomplish this second step, the dietary isotope values preserved in tooth samples from the individuals incorporated into the first stage of research are compared with the values recovered from their rib samples to delineate the extent and types of dietary change experienced by diverse individuals throughout their lifetimes. While carbon and strontium isotopes are present in the mineral fraction of both bones and teeth, nitrogen isotopes are not preserved within tooth enamel. Therefore, assessments of lifetime dietary change will be based only on stable carbon and strontium isotopes.

While individuals who display nonlocal radiogenic strontium or stable oxygen isotope values in their teeth may have been included in the first step of the analysis provided that they displayed local isotope values within their somatic bone, they should be excluded from the analysis in the second step in order to ensure that any lifetime dietary changes identified reflects mobility between social or economic category rather than mobility between geographic locations. Dietary changes experienced by local individuals can be compared to the patterns established during the first phase of research to assess whether the observed changes are consistent with shifting socioeconomic standing or instead with changes in group or individual social identities.

Step 3. Examine patterns in the social categories represented among socially mobile individuals.

This final stage of research investigates how opportunities for social mobility were distributed among different members of society based on social factors. It can be accomplished by applying published archaeological, mortuary, and skeletal data to assess social characteristics such as the gender, ethnic identity, and age of the socially mobile and stationary individuals identified within the first two phases of research.

In order for this general, three-step approach to be successful, however, there are a few things that must be true. First, as described above, diet has to differ between socioeconomic groups in a way that is evident using isotopic analysis. Secondly, in order to define the range of paleodietary isotope values associated with particular socioeconomic groups, we must have a reasonable mechanism by which to classify individuals according to socioeconomic position at the time of their deaths. In many archaeological cases, understanding the socioeconomic status of the deceased is far from a simple matter (Babić 2005; Parker Pearson 1999; Robb et al. 2001), and consequently, a biogeochemical approach to social mobility is likely only productively applied to archaeological cases in which numerous lines of evidence can be used to categorize the deceased with respect to their economic position within society. Thirdly, because diet can differ between individuals based on a range of social factors that are unrelated to socioeconomics, the dietary patterns associated with socioeconomic differentiation must differ in important ways from the dietary patterns that are associated with other social identities. We would not want to attribute a dietary change that someone experienced during their life to vertical social mobility between socioeconomic groups when it in fact was due to a change in ethnic affiliation by an individual whose overall economic standing has not changed, for example.

The following two chapters introduce the site of Teotihuacan, Mexico, the mortuary population of which forms the subject of the current analysis. I discuss the lines of evidence available that allow us to understand the social and economic characteristics of individuals buried at the site and discuss how the sample selection procedure used in this dissertation was designed in order to maximize the amount of information that this research could produce about dietary differentiation based on both economic standing and social identites.

CHAPTER 5: TEOTIHUACAN

As discussed in the previous chapter, the ability to use isotopic paleodietary indicators as a proxy for social mobility depends on a suite of conditions that makes the selection an appropriate archaeological case study a high priority. The long and intensive history of archaeological research at Teotihuacan has provided much useful information about the city and its inhabitants, making the site an ideal case study with which to initiate the bioarchaeological study of socioeconomic mobility.

While a summary of all that is known of Teotihuacan is well beyond the scope of this dissertation, this chapter provides a brief introduction to the city and to its its importance within Mesoamerican prehistory. I then focus on those aspects of Teotihuacan that make it well-suited to the methodological aims of this dissertation by describing the extensive mortuary sample at Teotihuacan, discussing how these burials can be linked with a diversity of social and economic categories using skeletal and contextual information, and reviewing preliminary information that indicates that diet may be expected to differ between individuals belonging to different socioeconomic categories within Teotihuacan society.

Site Description and Location

The archaeological site of Teotihuacan is located within the Valley of Teotihuacan in the northeastern portion of the Basin of Mexico, approximately 45 km northeast of modern-day Mexico City (Figure 4.1). Throughout much of its history, Teotihuacan was a densely populated urban center housing an estimated 80,000 to 100,000 residents in an area of approximately 20 square kilometers (Cowgill 2008, 2015:144; Robertson 2007). Structurally, the city of Teotihuacan is laid out around an extensive ceremonial core centered along the Avenue of the Dead, a five-kilometer-long street forming the primary north-south axis of the site. This avenue houses multiple elite residences and ceremonial structures, including the monumental Sun Pyramid, Moon Pyramid, and the Ciudadela enclosure surrounding the Feathered Serpent Pyramid. Surrounding this ceremonial core lay approximately 2,300 walled compounds which served as the primary mode of residence for the Teotihuacan populace during much of the site's history, as well as filling additional roles as local temple complexes and as administrative compounds associated with intermediate elites throughout the city (R. Millon 1973).

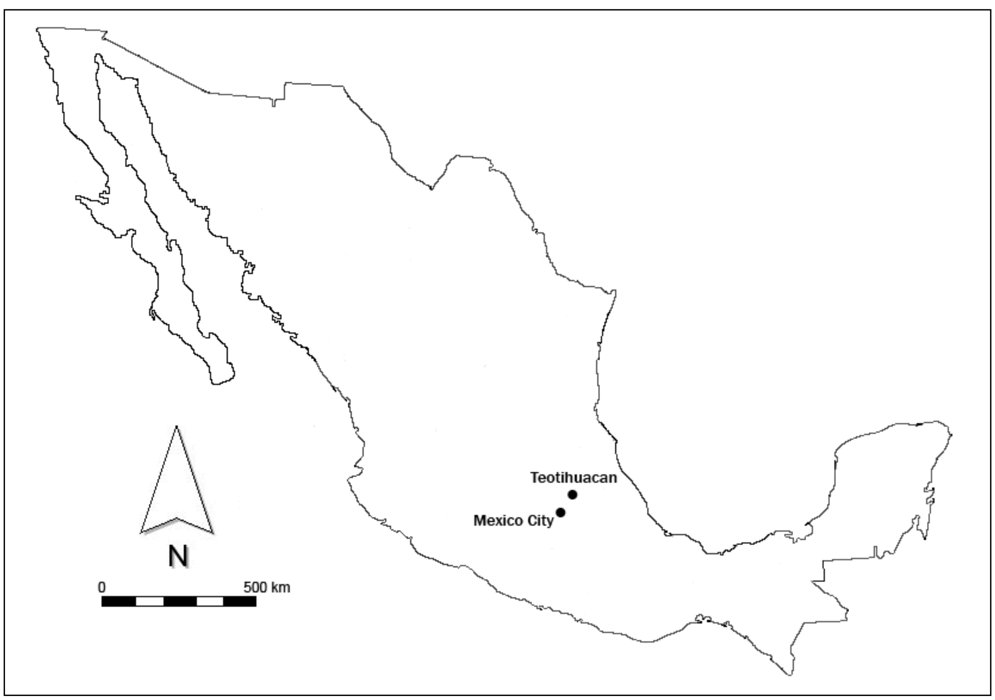

Figure 5.1 Location of Teotihuacan within Mexico

Brief Chronology

Teotihuacan thrived as an urban center for hundreds of years, ranging from approximately 150 B.C. to A.D. 600. The development and decline of the city through time is divided into six chronological phases, based largely on ceramic distinctions defined through test excavations throughout the site (Cowgill 2015:11; Rattray 2001). Most relevant for discussions of sociopolitical change during the Teotihuacan period occupation of the site are the chronological ranges of the Tzacualli, Miccaotli, and Early Tlamimilolpa periods (ca. A.D. 1-250), which witnessed the initial construction of the major pyramids in the ceremonial core of the site, and the Tlamimilolpa, Xolalpan, and Metepec phases (ca. A.D. 170-650), during which most previous structures at the site were replaced by the widespread construction of residential apartment compounds throughout the city. While both temporal ranges will be briefly summarized here, this dissertation focuses on processes of social mobility during only the Tlamimilolpa, Xolalpan, and Metepec ceramic phases, as residential contexts predating these ceramic phases are much less archaeologically well-understood.

Chronological Phase	**Approximate Dates**
Patlachique	100 – 1 B.C.
Tzacualli	A.D. 1-100
Miccaotli	A.D. 100-170
Tlamimilolpa	A.D. 170-350
Xolalpan	A.D. 350-550
Metepec	A.D. 550-650

Table 5.1 Teotihuacan ceramic phases and their associated calendar dates

Tzacualli, Miccaotli, and Early Tlamimilolpa Phases (ca. A.D. 1 -275)

Following initial occupation at Teotihuacan during the Patlachique phase (ca. 150 B.C. – A.D. 1), about which relatively little is known archaeologically, rapid population growth occurred within the city during the Tzacualli and Miccaotli phases, potentially related in part to the relocation of peoples within the Basin of Mexico following volcanic activity impacting southern portions of the Basin (Córdova et al. 1994; Plunket and Uruñuela 1998, 2005: 99-100; Siebe 2000). Coincident with this population reorganization, massive construction efforts shaped the ceremonial core of the site. It is hypothesized that the Street of the Dead was formally established during this period, replacing earlier structures that now underlie the massive avenue (Cabrera and Soruco 1982), and large-scale construction occurred at the Sun Pyramid (Matos 1995; R. Smith 1987), the Moon Pyramid (Sugiyama and Cabrera 2007), and the Ciudadela complex (Cabrera et al. 1991). The Street of the Dead Complex, consisting of an assortment of temple complexes, residential spaces, and small adjacent rooms that may have served administrative or storage functions, was also constructed during the Early Tlamimilolpa period (Morelos 1982, 1993). Cowgill (1983, 1997:152, 2015:115) suggests that this complex likely played a complementary role with other state institutions housed in the Ciudadela, Sun Pyramid, and Moon Pyramid during the early portion of the city's history before becoming the major governmental and administrative complex during the latter part of the city's history.

The consistent use of both a standardized measurement unit in the layout of individual buildings (Drewitt 1987; Sugiyama 1993, 2005, 2010) and a uniform

“Teotihuacan North” orientation of 15.5 degrees east of north (Aveni 1980; Dow 1967; Malmstrom 1978) has been used to argue that the planning of these early monumental constructions was strongly centralized. Several researchers have speculated that early phases of occupation at Teotihuacan were associated with autocratic rule and strong, powerful rulers, perhaps due to the need for centralized leadership in order to organize the rapidly growing population at the site (Cowgill 1983, 1992b; Millon 1981, 1988a, 1993; Sugiyama 2005).

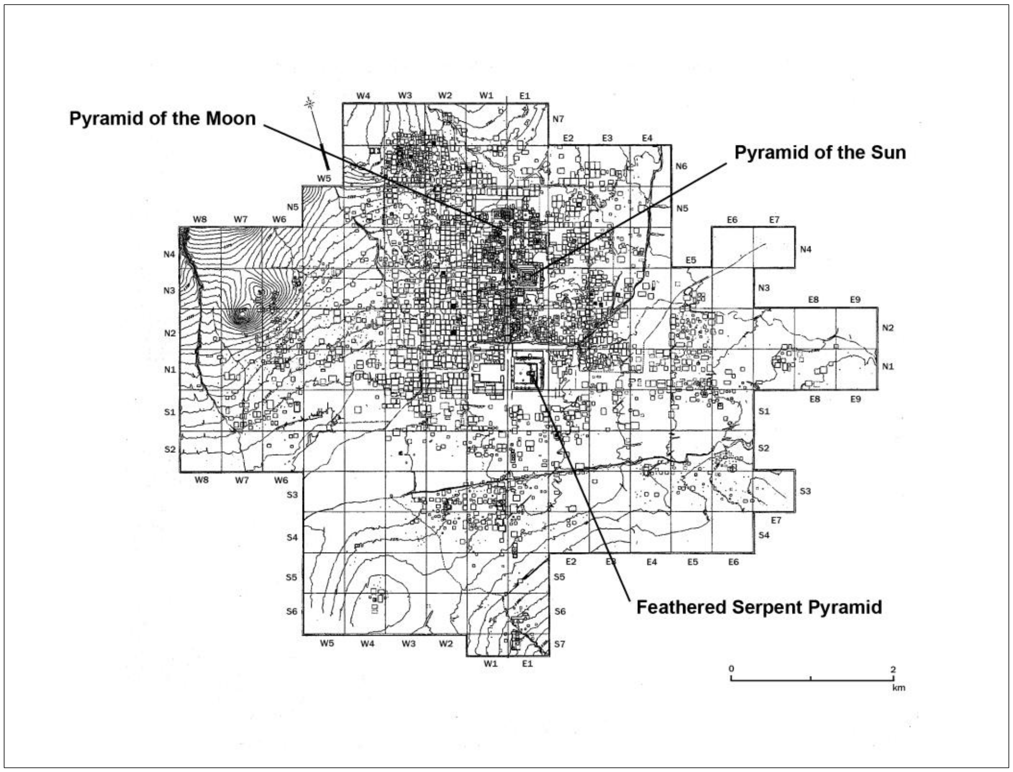

Figure 5.2 The urban layout of Teotihuacan, showing the location of select civic-ceremonial structures in the site core. Image adapted from Millon et al. (1973).

Because of the substantial project of urban renewal initiated during the later Tlamimilolpa period, few residential contexts from this period are preserved, though some evidence for small scale public architecture, including temple structures, has been discovered within the Tlachinolpan area toward the northwestern extent of the city (Blucher 1971) and at Plaza One, located to the west of the Moon Pyramid (Cook de Leonard 1957; Millon and Bennyhoff 1961).

Late Tlamimilolpa, Xolalpan, and Metepec Phases (ca. A.D. 275-650)

During the Tlamimilolpa period, the construction of roughly 2,300 apartment compounds throughout the city replaced the formerly more variable residential organization of Teotihuacan (Millon 1981). Due to the uniform orientation of these compounds to Teotihuacan North (15.5° east of true north) and to the extensive labor investments that would have been required to rebuild the entirety of the city's residential architecture within a relatively short period of time, Cowgill (1997:137) suggests that the state likely played a guiding role in this urban renewal program. However, Cowgill (2015:124) cautions that bottom-up processes of status competition and emulation may have also played a role in this urban renewal, with the common orientation of compounds serving the practical consideration of maintaining the straightness of the streets running between compounds.

While excavations on the Street of the Dead suggest that construction in the ceremonial core continued into the subsequent Xolalpan and Metepec phases (ca. A.D. 350-650) with enlargements to both the Moon Pyramid (Sugiyama and Cabrera 2007) and the Sun Pyramid (R. Smith 1987), these construction efforts were not on the same scale as earlier works and suggest a shift away from monumental construction as a focus of governmental policy (Cowgill 1997:155). Noting the neighborhood structure of the city, Manzanilla (2001, 2006, 2009) suggests that intermediate elites resident within specialized apartment compounds serving as *barrio* centers may have held considerable local power that operated outside of the official channels of the state. During the later history of the city, Manzanilla (2009:29) argues that these intermediate elites obtained increasing political and economic autonomy as evidenced by independently negotiated external trade relationships with other regions of Mesoamerica.

It is within this political and economic milieu that this project is situated. Due to the abovementioned lack of well-preserved residential and mortuary contexts predating the Tlamimilolpa phase, the majority of individuals available to be sampled for paleodietary isotopes were recovered from burials within apartment compounds spanning the Tlamimilolpa, Xolalpan, and Metepec phases of occupation. As discussed later in this chapter, multiple lines of evidence can be used to link these individuals with the social and economic groups to which they belonged, including both direct skeletal data and the broader household and neighborhood context with which they are associated through burial. First, I shall describe the axes of social and economic variation that we know to have existed in the city and the evidence that has previously been used to understand this variation.

Social and Economic Variation at Teotihuacan

Throughout its history, Teotihuacan was home to a diverse population who interacted with each other and with their surroundings in different ways based on their positions within society. In addition to variation in wealth throughout the populace of

Teotihuacan, a number of other social distinctions contributed to social diversity and complexity within the ancient state. These include gender, age, and ethnic identities as well as subestate social groups based on full or part-time economic roles. These social identities likely interacted dynamically with socioeconomic factors in order to govern dietary and culinary behavior, among other aspects of life.

Economic Diversity at Teotihuacan

Studies of residential structures, mortuary data, and iconography have revealed that important social distinctions and unequal power relationships existed within Teotihuacan society throughout its history. Evidence concerning socioeconomic distinctions in domestic settings comes from two primary sources of data: architectural and artifactual analyses of excavated apartment compounds and spatial analyses of surface collections derived from the Teotihuacan Mapping Project (R. Millon 1973; Millon et al. 1973). Inferences about social differentiation derived from excavated apartment compound data must consider the likelihood that much greater variability exists in residential remains than is represented by the few compounds for which we so far have systematic data (see Sanders 2008 for a review).

During the Tlamimilolpa, Xolalpan, and Metepec ceramic phases (ca. AD 200-600; Rattray 2001), multifamily apartment compounds formed the primary mode of residence throughout the city. Apartment compounds at Teotihuacan comprised multiple households with variable room size and construction quality, often arranged around communal courtyards featuring altars and small temple platforms apparently shared by residents of individual compounds (Cowgill 2015:153-154; Manzanilla 2002:43). These walled compounds were separated from one another by narrow alleyways. In general, the socioeconomic status of individuals residing within particular apartment compounds can be inferred based on differences in the quality of construction and mural painting characteristic of the structure itself, as well as based on the composition of household artifact assemblages. In addition to formal apartment compounds, a proportion of Teotihuacan's residents, perhaps as high as 15-20% of the population, lived in a series of insubstantial structures constructed from ephemeral materials throughout the city, believed to have housed individuals at the bottom of Teotihuacan's socioeconomic hierarchy (Cowgill 2015:159; Millon 1981:214; Robertson 2008). Though neglected archaeologically for many years, recent excavations of insubstantial structures sites by Oralia Cabrera (2006, 2011) and Ian Robertson (2008, 2016) are beginning to shed light on the everyday lives of the lowest status individuals within the Teotihuacan social fabric.

Not all apartment compounds are strictly residential in nature, and some may have served as administrative centers for distinct neighborhoods or quarters within the city (Angulo Villaseñor 1987; Manzanilla 2009). These neighborhood centers feature larger central courtyards and temple structures than those of other residential compounds in the area, and Manzanilla (2009:24) suggests that individuals resident within these centers were intermediate elites charged with the administration of neighborhood level ritual and economic activities. Excavations within the La Ventilla district have confirmed that compounds that served different functions within individual neighborhoods, including neighborhood temples, administrative centers, and both elite and commoner residential compounds have different internal layouts and artifact assemblages from one another (Cabrera and Gómez Chávez 2008).

The use of residential architecture to infer the relative wealth of individuals and social groups at Teotihuacan has focused on differences in room size, frequency of mural decoration, construction materials and quality of craftsmanship, and overall grandeur and formality in the layout of residential groups (Sanders 2008). In contrast to architectural differentiation, household artifact assemblages show less marked variability among different apartment compounds. Manzanilla (2009:36-37) suggests that most apartment compounds appear to have access to the same basic food and luxury items, though differences in the frequency of high status goods and materials such as decorated tripod vessels, theater censers, greenstone, mica, and slate do suggest quantitative differences in access to resources between compounds.

The ranking of Teotihuacan's apartment compounds against one another based on overall architectural characteristics and artifact assemblages is, however, complicated by evidence that internal variation in wealth or status existed within single apartment compounds. Socioeconomic variation within residential contexts at Teotihuacan can be categorized into two broad types. The first type involves cases in which the status variation found within an apartment compound is not so large as to exceed the amount of variation expected within a single broad socioeconomic grouping. Manzanilla (1996, 2004, 2006, 2009), for example, argues based on room size and mortuary evidence that it was not uncommon for one or more household within apartment compounds to hold a higher status than the others, even when compound residents belonged to a coherent economic group. For example, in the Conjunto Arquitectónico A of La Ventilla Frente 3, several households display evidence for greater economic and social standing than others based on larger architectural spaces and apparent control over the within-compound distribution of raw materials for craft production, though all residents of the compound could be categorized as craftspeople belonging to a broad intermediate class (Gómez Chávez and Gazzola 2011).

However, a second type of intracompound socioeconomic variation also seems to exist in which people of markedly distinct socioeconomic categories were present in the same apartment compound. Flannery (1998:30-31) argues that in some elite compounds, servants or retainers may have lived, worked, and been buried alongside the elite residents whom they served, and that such instances can be recognized archaeologically in cases where small room complexes representing the residences of servants or retainers employed within the main complex are annexed to larger "palatial" residential compounds. For example, such within-compound architectural distinctions may exist in the Tetitla apartment compound, where Séjourné (1966a) and Angulo Villaseñor (1987) have noted that a subset of apartments has smaller rooms and less solid construction than much of the rest of the compound.

Despite some wealth differences within and between apartment compounds, residences were not segregated from one another into neighborhoods based purely on these wealth differences. Millon (1976:220) made the initial suggestion that *barrio* districts within the city have a "mosaic quality", often containing residences belonging to individuals of varied socioeconomic standing. Spatial analyses of Teotihuacan Mapping Project surface collection data generally confirm Millon's initial assertion and found that wealthy residential contexts were not limited to the ceremonial core of the site, but instead were interspersed with areas of lower economic means throughout a number of distinct neighborhoods (e.g., Altschul 1987; Cowgill et al. 1984; Robertson 1999, 2005; Sload 1977, 1987). The socioeconomic uniformity of neighborhoods may, however, have changed through time to become more segregated by socioeconomic standing by the Tlamimilolpa phase as compared to earlier periods, and certain parts of the city, such as the areas surrounding the ceremonial core, may have been more homogeneous than others (Robertson 2001).

Iconography found on wall murals, ceramics, and sculpture at Teotihuacan potentially provide another avenue through which to understand wealth, status, and power within Teotihuacan society, though interpretation of these lines of evidence has proven notoriously difficult. The lack of clear portrayals of named rulers in the public art of Teotihuacan, in sharp contrast with the art styles of the contemporary Classic Maya, may communicate a different conceptual attitude toward rulership than in these other Mesoamerican societies (Cowgill 1992a:208). Numerous researchers (e.g., Cowgill 1992a, 1997; R. Millon 1988b; Pasztory 1988) have noted that portrayals of human beings within the Teotihuacan art corpus avoid depictions of rank distinction between individuals in the form of size disparities or postural cues that can be recognized by outside observers, though Cowgill (1992a:218) notes that subtle distinctions in costume may have been emically recognizable as marks of different statuses.

These aspects of Teotihuacan iconography need not mean that social relationships as experienced on the ground lacked clear ranking or stratification. Pasztory (1988) suggests that the iconographic system of Teotihuacan may have served to intentionally downplay social distinctions between members of the diverse Teotihuacan populace in order to help forge a coherent civic identity, rather than accurately portraying social relationships as they were experienced through everyday life. Additionally, the existence of notational identification codes in association with portrayed individuals may suggest that politically important individuals were at times represented iconographically, though it is unclear at this point whether these identification codes communicated personal names or instead indicated the offices or political roles of figures portrayed (Taube 2001).

Subestate Social Categories

Many people within preindustrial economies likely engaged in multiple, part-time economic activities rather than a single full-time specialization, and most were not members of a distinctive social category based on their economic activities. However, both modern sociological research and historical examples suggest that certain economic specializations can be incorporated into symbolic systems that set members apart in a social sense from others with an objectively similar level of wealth through, for example, separate social networks and privileges (Becker and Carper 1956; Davis 1986; de Vries 1997; MacKinnon and Langford 1994). I refer to these distinctions using the terminology of subestate that was introduced in Chapter 2.

A number of disparate economic activities have been documented for members of Teotihuacan society based both on artifactual and iconographic evidence. While many of the city’s residents were likely full- or part-time farmers (Cowgill 2003:49), an activity about which we unfortunately know very little from archaeological remains at the site, craft production formed an additional economic specialization for many residents. At

Teotihuacan, the major locus of craft production appears to have been the residential apartment compound, though state-controlled workshops have been identified adjacent to the Ciudadela (Munera 1985) and the Moon Pyramid (Carballo 2007). Residents of some apartment compounds appear to have shared particular craft specializations, including lapidary work (Gómez Chávez 2000; Turner 1987, 1992; Widmer 1987, 1991), stucco production and polishing (Manzanilla 1993), figurine crafting (Sullivan 2007), ceramic production (Storey and Widmer 1989; Sullivan 2006; Widmer 1987), and the manufacture of obsidian blades (Spence 1967, 1981, 1986, 1987). As noted below, in certain areas, these craft specializations may have extended beyond the apartment compound to an entire *barrio* (Spence 1986, 1987; Sullivan 2006), perhaps contributing to neighborhood-level community identity in the process. Similarities in surface collected artifact assemblages suggest that some of these neighborhood-level crafting communities maintained associated structures located directly adjacent to the proposed central marketplace for the city, the Great Compound on the Street of the Dead (Sload 1987). While the precise function of these marketplace structures is unknown, Sload (1987) suggests that they may have allowed particular local communities to play bureaucratic or economic roles within the marketplace. Due in part, perhaps, to the lack of iconographic representations of craft producers within the artistic canon of Teotihuacan, explicit consideration of the relative prestige of different craft occupations within Teotihuacan society is unfortunately lacking, and we do not have a firm basis upon which to suggest that engaging in a particular type of craft production served as a salient social identifier that extended beyond one's socioeconomic standing.

In contrast, individuals holding priestly and military roles appear to have been incorporated into broader symbolic systems expressed in art and iconography as well as likely holding significant political and economic power. Priestly figures are frequently represented within the mural paintings of Teotihuacan, as well as on ceramic vessels and in sculpture, and are often portrayed carrying out important agricultural rituals such as preparation of fields for planting and requests for water from the gods (Berrin 1988; Miller 1973). Noting that the tassel headdress used as a symbol of Teotihuacan state authority (cf. C. Millon 1973, 1988) is worn by priestly figures attending to various deities within Teotihuacan mural paintings, Manzanilla (1992) suggests that the priesthood formed the major political and economic authority within Teotihuacan society.

Numerous iconographic studies (e.g., Cabrera 1995, 2002; Headrick 2007; C. Millon 1973, 1988; Sugiyama 1993) also suggest that militarism played an important role in state ideology and may have been one avenue through which to obtain prestige, as in the later Aztec empire. Animal figures such as rattlesnakes, jaguars, coyotes, and raptorial birds may be associated with military orders analogous to later Aztec eagle and jaguar knights (Headrick 2007; C. Millon 1973, 1988), and high positions within the military seem also to be marked with a tasseled headdress symbol believed to represent state authority (C. Millon 1973, 1988). Langley (1986) additionally argues that military power and sacrifice were chief concerns of the as-yet incompletely understood Teotihuacan notational system.

The importance of the military within the Teotihuacan state through time is witnessed not only by iconographic representations of warriors and martial symbolism, but also by the interment of numerous individuals dressed in military garb in the sacrificial deposit below the Feathered Serpent Pyramid (Cabrera et al. 1991). Hassig (1992) hypothesizes, based on the types of arms and equipment portrayed in Teotihuacan art, that warfare was not necessarily the exclusive domain of the elite, but that military positions may also have been open to commoners in a meritocratic system similar to later Aztec society. A similar idea has been proposed by Spence et al. (2004:2) to explain the high proportion of nonlocal individuals included among the sacrificed soldiers at the Feathered Serpent Pyramid, who may have been attracted to the city by the opportunity that military service provided for social advancement. Therefore, while the highest ranking individuals within the Teotihuacan military likely maintained high socioeconomic standards of living, individuals within military roles likely cross-cut a large swath of the Teotihuacan socioeconomic fabric.

Gender Identity

Due in part to the lack of naturalistic depictions of individuals within the canon of Teotihuacan art, clear understandings of the gender system at Teotihuacan have largely eluded archaeological researchers. However, several studies have drawn on evidence from art and mortuary remains to reveal interesting archaeological patterns that counter traditional expectations concerning the presence of a simple gender hierarchy in complex, state-level societies.

Scholars of Teotihuacan art have debated the implications of female figures for understanding gendered aspects of the cosmological and sociopolitical systems. Pasztory (1976:161-174) presented the first systematic analysis of an apparently female deity termed the Great Goddess represented within the murals of the Tepantitla apartment compound. Later scholars built upon this work, extending the diagnostic iconographic features used to identify this goddess (Berlo 1992) and employing iconographic parallels with the Southwestern Spider Grandmother to suggest that the Teotihuacan Great Goddess may have been viewed as a major creator deity within Teotihuacan cosmology (Taube 1983). This interpretation has not been without critique, however, and some (e.g., Cowgill 1997:149-151; Paulinyi 2006) question the importance of the Great Goddess in state religion, suggesting that many of the images identified as this goddess may in fact represent a number of disparate deities. Regardless, Cowgill (2015:92) has argued that sculptural evidence from the Moon Pyramid, including the colossal "Diosa de Agua" statue, speaks to the prominence of at least some female entities within Teotihuacan cosmological systems. Interpreting three colossal statues featuring female garments as possible depictions of Teotihuacan rulers (contra Pasztory 1997:99), Headrick (2007:41) additionally suggests that females may have occasionally held positions of rulership at Teotihuacan, as among the Classic Maya.

While Teotihuacan art hints that females played an important role in state institutions and religious ideology, there is much that is still not understood both about the corpus of art itself as well as the way in which these representations articulated with the social organization of Teotihuacan's residents. Because human figures within Teotihuacan art wear elaborate costumes that obscure most physical features except small portions of the face and hands of individuals, gender is typically attributed based on the costuming of individuals (Cowgill 1997:149). The attribution of a binary gender identity to individuals and deities portrayed in Teotihuacan art based solely on their costuming ignores the possibility of cross-dressed, gender ambiguous, or alternate gender individuals, such as those which appear to be represented in contemporaneous Maya art (Joyce 1998, 2000a; Looper 2002). Consequently, interpretations concerning the gender system at Teotihuacan derived primarily from artistic representations must be tempered with additional lines of evidence pertaining to gender roles and relations within this society.

Evidence from mortuary studies provides an important alternative viewpoint on the gender system at Teotihuacan. Sempowski (1994) has investigated male and female burials from a number of apartment compounds and ritual structures within Teotihuacan by quantifying the number, diversity, and quality of associated burial offerings. While this study found that male burials scored slightly higher in terms of overall burial complexity, differences between the sexes were not statistically significant. Additionally, perhaps due to the large degree of individual variation in mortuary treatment found within the Teotihuacan burial program (Sempowski 1994:160), few mortuary goods appear to have been strongly associated with one biological sex or another, suggesting that gender may not have been a primary social identity emphasized in burial (Sempowski 1994:250).

Because the study of mortuary patterns at Teotihuacan has provided some indications that gender ideologies may not have been uniform across all apartment compound groups (Clayton 2009, 2011), it will be necessary to assess the relationship between biological sex with diet both within and between contexts in order to produce an accurate assessment of gender-based dietary patterns at Teotihuacan. A consideration of the active construction of gender in situations other than the mortuary context, such as through distinctive gendered patterns of food consumption, has the potential to provide an complementary viewpoint on how gender identities were experienced and maintained during the life of individuals that can enrich our understanding of gender identity at Teotihuacan.

Age Identity

Unlike the other social categories discussed here, age has received relatively little explicit consideration within the Teotihuacan literature. With the exception of the distinctive pattern mentioned below of infant burial within ceramic vessels, age-related differences in mortuary treatment appear to be marked primarily by differences in the quantity of funerary goods interred with an individual rather than by differences in other mortuary aspects such as grave form or body treatment. Both Clayton (2009:309) and Sempowski (1994:182, 211, 233) note that the older an individual was at the time of death, the more likely he or she was to be interred with funerary goods and the greater the average number of objects that was included within the mortuary offering. This pattern appear to hold true both when comparing subadults to adults of all ages (Sempowski 1994) and when investigating patterns within different adult age categories (Clayton 2009).

These patterns could conceivably reflect a greater prestige associated with increasing age, though it is difficult to unambiguously link the quantity of funerary objects with prestige in the absence of a consideration of the emic value of specific objects included in particular burials. Additionally, as with all mortuary patterns at

Teotihuacan, there is significant variation in the treatment of the dead of all ages that makes it difficult to generalize about patterns of mortuary treatment at different biological ages. For these reasons, as well as the lack of iconographic or other sources of evidence explicitly dealing with age in the archaeological record at Teotihuacan, the social significance of differing age-based mortuary treatments is a topic that has not been elaborated within the literature.

Ethnic Identity and Geographic Origin

Several regions of the city have been identified as ethnic neighborhoods based both on their spatial isolation from the core of the city and on evidence for the maintenance of foreign traditions among residents. Tlailotlacan, or the Oaxaca Barrio, is located toward the western margin of the city in Teotihuacan Mapping Project squares N1W6 and N2W6. This neighborhood consists of approximately ten apartment compounds, several of which have undergone extensive study by Evelyn Rattray (1987, 1993) and Michael Spence (1976, 1989, 1992, 1996) and others of which have been more recently explored through excavations by Verónica Ortega (Ortega and Archer 2014). Other than the presence of distinctive cobblestone floors not found in other areas of Teotihuacan, apartment compounds within Tlailotlacan are architecturally typical of Teotihuacan residential structures (Ortega and Archer 2014; Rattray 1987:244; Spence 1992, 2002). However, the presence of a Zapotec-style temple within the barrio and the evidence for ritual practices and mortuary traditions that fused Zapotec and Teotihuacan traditions attest to the distinctive ethnic identity of residents (Croissier 2007; Rattray

1987; Spence 2002; Spence and Gamboa 1999). Expressions of foreign identity extended beyond the ritual realm to practices such as culinary and household traditions, as Spence (2002) notes that residents of the Tlailotlacan barrio continued to manufacture and use specific temporally diagnostic styles of Oaxacan greyware pottery within Teotihuacan even after these same styles had fallen out of fashion within the Oaxaca Valley itself. This pattern potentially suggests that these ceramics served more as a conscious marker of inhabitants' ethnic differences from the surrounding Teotihuacanos than as a way to assert economic links with the Oaxaca Valley.

A second ethnic enclave at the northeast periphery of the city, termed the Merchants' Barrio, was initially recognized based on discernable surface concentrations of foreign ceramics stylistically linked to the Gulf Coast and lowland Maya areas (Millon 1981). Excavations directed primarily by Evelyn Rattray (1989, 1990) uncovered a neighborhood with distinctive residential architectural patterns, including small circular and rectangular structures constructed from adobe bricks and differing in style and layout from standard Teotihuacan apartment compounds (See Sanders 2008 for an alternative interpretation of these structures). Later in the history of occupation of the neighborhood, however, the large, multiroom apartment compound of Xocotitla was constructed in a plan more similar to that of Teotihuacan compounds (Rattray 1987).

Spence (1996) argues that the Oaxacan and Merchants' Barrios utilized different mechanisms to maintain ethnic identity as well as potentially to articulate with the Teotihuacan state. In contrast to the locally produced Oaxaca-style ceramics in Tlailotlacan, a high proportion of the ceramic assemblage in the Merchants' Barrio consists of foreign wares which appear to have been continuously imported from the

Tlamimilolpa through Metepec phases (Clayton 2005; Rattray 1987:260-261). These foreign-style wares primarily consist of ceremonial or serving vessels meant for display rather than utilitarian domestic forms as found in Tlailotlacan. Though artifact assemblages recovered from the Merchants' Barrio contain much material culture typical of Teotihuacan, the lack of *comales* suggests that residents maintained differences in culinary practices as compared to many residents of Teotihuacan, likely including a lowered consumption of maize tortillas (Rattray 1990:126-127).

A high proportion of nonlocal individuals among skeletal samples analyzed for stable oxygen isotopes suggests that both the Oaxaca Barrio the Merchants' Barrio were sustained through a continuous influx of immigrants from other areas of Mesoamerica (Spence et al. 2005:176-177). While individuals living within the Merchants' Barrio may have arrived from two different regions of the Gulf Coast and stayed within the city for only a limited time for trade before returning to their homelands, people resident within the Oaxaca Barrio appear to have migrated from the central valleys of Oaxaca to settle permanently within Teotihuacan, adopting some aspects of Teotihuacan culture while maintaining other practices linked to their region of origin (Price et al. 2000).

A third ethnic neighborhood with West Mexican affiliations has been identified near the Oaxaca Barrio (Gómez Chávez 1998, 2002; Martel Begun 2013), though less published data is available concerning this neighborhood as compared to the above two. The excavation of Structure 19 in Teotihuacan Mapping Project squares S1W5 and S1W6 revealed an architecturally typical Teotihuacan apartment compound containing unusual quantities of West Mexican-style figurines, shaft tombs, and mortuary ceramics imported from areas of modern-day Michoacán, Querétaro, and Guanajuato (Gómez Chávez 2002).

Differences in mortuary and ceramic styles between the northern and southern sections of this compound suggest that it may have been shared by ethnically Zapotec and ethnically West Mexican families (Gómez Chávez 2002).

In addition to these distinctive ethnic neighborhoods, biogeochemical studies of residential mobility suggest that immigrants from other areas of Mesoamerica entered Teotihuacan and resided in established apartment compounds throughout the city (e.g., Price et al. 2000; Schaaf et al. 2012; White et al. 2004a). Despite some evidence for the maintenance of foreign traditions outside of clearly defined ethnic enclaves, such as the presence of a West Mexican shaft tomb at Tlajinga 33 (Widmer 1987) and of Maya-style mural paintings and glyphs at Tetitla (Taube 2003), many of these individuals appear to have integrated into Teotihuacan society. The way in which geographic origins and the process of cultural integration may have interacted with socioeconomic factors to govern culinary and food consumption practices remains largely unexplored, however.

Lines of Evidence Concerning the Socioeconomic Standing of the Deceased

Our understanding of the social and economic groups to which specific individuals belonged draws upon multiple sources of data, including the biological data derived directly from skeletons, mortuary remains accompanying individual and multiple burials, and the specific household or supra-household context with which an individual was associated during life. Due to the interment of many individuals within residential compounds at Teotihuacan rather than in spatially separate cemeteries, we are often able to apply all three levels of evidence to understand the social and economic groups to which single individuals would have belonged. While a discussion of skeletal data is deferred to a later chapter, here I introduce the mortuary program of Teotihuacan and how burial treatment and location can be linked with the social and economic identities of the deceased through the context of the larger residential structure of the site.

Mortuary Practices

Excavations throughout Teotihuacan have uncovered a diverse and complex mortuary program. While human remains are occasionally recovered from non-residential contexts, many human skeletons are present within subfloor burials directly associated with households within apartment compounds (Manzanilla and Serrano 1999; Rattray 1992; Sempowski and Spence 1994). While mortuary treatment is variable enough throughout the site to make it difficult to describe a single normative burial pattern, several central tendencies exist with respect to burial location, body positioning and treatment, and mortuary accompaniment that can provide a general sense of the treatment of the dead at Teotihuacan. Biological data derived from individual skeletons within these burials can be used in order to investigate social identities that cross-cut single residences, such as gender and age, while information about mortuary treatment can be used to assess relative prestige within single residential groups, as discussed below.

Most burials at Teotihuacan have been excavated from small oval fossae in the stucco floors of apartment compounds (Manzanilla and Serrano 1999; Sempowski 1994). A mix of both primary and secondary burials, as well as both single and multiple burials, are common within the mortuary program (González Miranda 2009; Manzanilla and

Serrano 1999; Sempowski 1994). The most frequent body position amongst adult primary burials is a seated flexed position probably resulting from the burial of individuals in mortuary bundles consisting of textile wrappings (González Miranda and Salas Cuesta 1990; Sempowski 1994; Serrano and Lagunas 1974). In contrast, typical burials of fetal and infant individuals consist of a skeleton located within a ceramic vessel and covered by a second ceramic plate (Linné 1934:72; Manzanilla and Serrano 1999; Sempowski 1994). A number of skeletons display evidence for exposure to fire, though the extent to which the skeletons are affected varies. Patterns in the portion of the skeleton affected as well as the occasional presence of burned textiles or artifacts within the burial pit have been used to conclude that the exposure of the mortuary bundle to a small fire located in front of the body may have been part of a common funerary ritual at Teotihuacan (Sempowski 1992:33).

It is common for at least some individuals, particularly subadults, to be recovered from the foundation of altars in internal plazas of an apartment compound. Due to the presence of cutmarks in a subset of these skeletons, some have argued that they represent individuals who were sacrificed in order to sacralize ritual altar space within the apartment compound (Cid and Torres 1997, 1999, 2004; Torres and Cid 1997), though the presence of cutmarks alone could potentially be related to other aspects of postmortem processing and mortuary ritual that are unrelated to human sacrifice. Human bone is also occasionally found outside of formal burial contexts within construction fill and trash deposits associated with residential contexts, a pattern that Storey (1987:108-109) argues may have resulted from the disturbance of formal burials within the apartment compound during remodeling of the compound through time.

There is great variation both within and between compounds in the type and quantity of funerary offerings found with individuals and within multiple burials. The work of Martha Sempowski (1987, 1992, 1994) represents the most extensive analysis of apartment compound burials to date, incorporating hundreds of burials from diverse residential contexts throughout the city to assess wealth and status differences throughout the city. Sempowski uses a complexity score derived from the number, diversity, and quality of grave goods interred within each burial to broadly compare the "social status" of different individuals and residential groups against one another through the Tlamimilolpa, Xolalpan, and Metepec phases. However, the degree to which this complexity score accurately represents aspects of wealth or social prestige among Teotihuacan residents remains unknown, as certain aspects of mortuary symbolism may not be accounted for within this type of quantitative assessment.

Burial complexity as measured through the quantity and quality of grave goods does suggest that within-compound variability in mortuary differentiation may exceed differentiation between compounds traditionally assigned to distinct socioeconomic levels, perhaps suggesting that mortuary treatment reflects prestige within one's residential group but may not be a sensitive indicator of concrete access to economic resources (Sempowski 1987). Some of this intracompound variability does appear to pattern spatially within the compounds, perhaps reflecting differences in wealth or prestige of particular subgroups or apartments within the larger compound community (Sempowski 1987:122). Particularly, the most complex burials within a single apartment compound tend to be located in public spaces, such as central plazas and compound temples (Sempowski 1999:495; Storey 1992:110-111). The emphasis on intra-compound status differentiation through mortuary treatment appears to decrease, however, during later periods of the city's history (Sempowski 1987), while differences between compounds increase, perhaps reflecting greater social stratification in the Xolalpan period.

While the relative impacts of social status and wealth on mortuary treatment require further exploration, large intracompound disparities in mortuary treatment provide one avenue through which to identify the relative prestige of individuals within the same residential group. Several researchers have noted that that even relatively "poor" apartment compounds, such as Tlamimilolpa and Tlajinga 33, include one or a few burials containing a number of high quality grave goods far exceeding what would be expected, given the economic standing of the apartment compound as a whole (see Linné 1942; Widmer 1987). Cowgill (1992a:216) suggests that these isolated burials may represent individuals of particular social importance within the compound, for whom other individuals within the compound were willing to expend disproportionate amounts of resources in order to commemorate.

Some caution is, however, necessary in interpreting mortuary remains from Teotihuacan. Apartment compound burials appear to represent a highly selective mortuary program in that burials recovered from completely excavated apartment compounds represent only a small fraction of the individuals estimated to have lived within these compounds over their roughly 400 year period of occupation (Sempowski 1999:473). As mentioned above, Storey (1987:108-109) suggests that one possible explanation for the under-enumeration of burials within excavated apartment compounds may be that burials were disturbed during the remodeling of apartment compounds through time, leading to the deposition of human bone within fill and trash deposits. An alternative explanation is that only certain individuals were selected for burial within compound space throughout time, with the remainder of individuals interred or disposed of elsewhere. Consequently, while apartment compound subfloor burials are the best source of data that we have to understand individuals and social groups at Teotihuacan, caution is nevertheless warranted in assessing the degree to which the individuals buried within a specific compound are representative of the entire population of that apartment compound group.

Apartment Compounds and Neighborhood Organization

The consistent burial of individuals within domestic compound space allows the use of residential architecture and household artifact assemblages to infer the broad social groups to which specific individuals likely belonged at Teotihuacan (see Sanders 2008). The social categories most strongly linked with specific architectural compounds and neighborhoods include socioeconomic and ethnic groupings.

The link between residential architecture and artifact assemblages and the socioeconomic standing of residents has been reviewed above. Additional information about an individual's social networks can in certain cases be derived from the larger neighborhood grouping within which the apartment compound is found. Neighborhoods within preindustrial cities are frequently unified socially by day-to-day interactions between members as well as by shared economic activities and ritual practices, among other features (Smith and Novic 2012). R. Millon (1973, 1974, 1976, 1981) originally hypothesized that Teotihuacan's apartment compounds were spatially divided into neighborhoods, or *barrios*, that served as administrative units in the Teotihuacan political organization. While the city's ethnic enclaves stand out as clear examples of spatial regions of the city distinguished by clear differences in material culture (Spence et al. 2005), additional neighborhoods have been recognized throughout the city based on the spatial positioning of compounds around neighborhood temples and administrative compounds, as well as on slight differences in ceramic assemblages (Altschul 1987; Cowgill 2007; Robertson 2001, 2005). Spatial clusters of artifacts used in craft production within specific neighborhoods suggest that neighborhoods may have formed supra-household economically specialized groupings, often unified by a common craft specialization (Spence 1986; Turner 1992), though residents of many compounds may have also engaged in alternative craft activities in addition to the neighborhood craft specialization (Manzanilla 2009; Widmer and Storey 2012)

Our understanding of the organization of Teotihuacan neighborhoods has been immensely aided by the excavations in the La Ventilla barrio carried out by the Proyecto Arqueológico La Ventilla 1992-1994 (Cabrera 1996, 1998, 2000; Gómez Chávez 1996, 2000; Serrano Sánchez 2003). In addition to an open plaza that may have been used by residents for markets, social activities, and ritual performances, the La Ventilla neighborhood contains a neighborhood temple, an administrative building known as the Compound of the Glyphs, several residential compounds each housing individuals of differing socioeconomic status, and a series of wells and drainage systems for common use (Gómez Chávez 2012). Variation in neighborhood form has, however, been found throughout the city, with some craft neighborhoods in the northwest sector of the city nucleated around open three-temple plazas (Manzanilla 1997:120), and others surrounding a single noble house or neighborhood center such as Teopancazco that combines multiple administrative, religious, and residential functions (Manzanilla 2007, 2009, 2012).

To summarize, while skeletal data and information about mortuary treatment allow us to infer the age and gender identities of individuals and their relative prestige within their own residential group, the integration of these burials into larger compound and neighborhood-level archaeological contexts provides us with further information about their socioeconomic status, occupation, and ethnic identity. In order to understand the dietary choices that individuals in these different social and economic groups made, we must understand the environment, food production practices, and opportunities to obtain foodstuffs through trade that faced the people of Teotihuacan. Research on faunal and plant remains and on isotopic evidence does indeed suggest that people differently incorporated the available resources into their diet based at least partially on social and economic grounds.

Sources of Food at Teotihuacan

Ecology and Natural Resources of the Basin of Mexico

The Basin of Mexico is a semiarid environment with variable mean annual precipitation ranging from over 1200 mm in portions of the southwestern Basin to under 400 mm in the northeastern portion, where Teotihuacan is located (Nichols 1987:133).

Studies of pollen, phytoliths, and charcoal (e.g., Adriano-Morán and McClung de Tapia 2008; McClung de Tapia et al. 2003) suggest that natural vegetation in the Teotihuacan Valley consisted of temperate forest species such as pine (*Pinus sp.*), oak (*Quercus sp.*), and alder (*Alnus sp.*) at high elevations, xerophytic scrub such as agave (*Agave sp*.) in valley bottomlands, and riparian vegetation such as ash (*Fraxinus sp.*), willow (*Salix sp.*), and dogwood (*Cornus sp.*) near lakes and rivers. The Basin is a closed hydrological unit, with the main sources of water deriving from a series of springs throughout the Basin, snowmelt from the mountain ranges surrounding the region on three sides, and rainwater runoff from the summer rainy season (Sanders 1976a:59). These independent sources of water drain into a system of permanent and seasonal streams that lead to a series of contiguous lakes located in the center of the Basin (Sanders 1976a:60). These five interconnected lakes provided a richness and diversity of lacustrine resources to residents of the Basin, including salt, reeds, fish, algae, and water-fowl (Parsons 2006). The hydrology of the Teotihuacan Valley centers on the San Juan, San Lorenzo, and Huixulco rivers, the waters from which would have ultimately drained into Lake Texcoco.

Nonagricultural resources within the Basin likely played a role in the diet of Teotihuacan's residents. As mentioned above, the lake system within the center of the Basin of Mexico would have provided a rich source of plant and animal resources. Though fish remains are often recovered in small quantities within residential excavations, Widmer (1987) suggests that they may be underrepresented in faunal assemblages due to the often small size of fish remains, which would be disproportionately lost or overlooked during recovery. Opinions concerning the importance of fish and other lacustrine resources are varied; some individuals consider fish as a protein resource of secondary value (Sanders et al. 1979; Starbuck 1987), while others argue that they may have played a significant role in Teotihuacan subsistence (Valadez 1993; Widmer 1987).

Due to the relatively cold mean temperatures and early frosts experienced in the *tierra fria* of Central Mexico, agriculturalists can expect only one growing season per year in the central highlands rather than the two or more growing seasons available in some other areas of Mesoamerica (Parsons 2010:109). Parsons (2010:109) argues that this agricultural schedule may necessitate the exploitation of a wider range of non-agricultural resources than areas with more frequent yields from seed-based agriculture. In addition to the rich lacustrine resources mentioned above, the *maguey* plant (*Agave americana*) provides a nonseasonal resource that can successfully grow on agricultural land too marginal for the successful cultivation of seed crops such as maize (*Zea mays*) (Parsons and Parsons 1990:4).

Agricultural Practices and Field Systems

While overall precipitation levels in the Basin of Mexico may be sufficient for maize agriculture without the use of extensive irrigation systems (Sanders 1965), high geographic and temporal variability in rainfall patterns makes irrigation a useful risk management strategy to avoid crop failure during periods of moisture deficit, particularly in the northern Basin (Nichols 1987). Despite difficulties in precisely dating the remnants of prehistoric irrigation systems (see Nichols 1987:135-136), individuals living within the

Basin of Mexico apparently utilized a variety of water management systems to intensify agricultural production during the Terminal Formative and Classic periods.

Though not the only agricultural strategy utilized, permanent canal systems within the Teotihuacan Valley likely formed a major component of the city's agricultural efforts. A series of 80 to 100 springs located in and around the modern town of San Juan Teotihuacán provided a nonseasonal source of water that was likely used during the Classic period to irrigate the alluvial plain to the west of the city within the Teotihuacan Valley (Sanders 1976b:103-104). The high water table near these springs today permits *chinampa*-like raised fields by modern-day residents of the region. Sanders (1976b:117) notes that depictions of rectangular gardens in mural paintings from the Tepantitla apartment compound within Classic period Teotihuacan strongly resemble these inland *chinampa*-like fields, suggesting that a similar agricultural strategy may have prevailed in the past, as well.

Canal systems also brought water for irrigation from both permanent and ephemeral streams throughout the area. Nichols (1982, 1987), for example, has located the remnants of probable Classic period irrigation canals branching off the Barranca de San Mateo, located just to the southeast of the Tlajinga district of the ancient city. Canal systems dating to the Terminal Formative period in the Otumba area, northeast of Teotihuacan, suggest that irrigation systems were also designed to use seasonally flowing streams throughout the area (Charlton 1977, 1978, cited in Doolittle 1990:50). As the city spread to areas that had been previously used for cultivation, former irrigation channels were eliminated and covered by apartment compounds or other construction (Gómez Chávez and Gazzola 2004; Nichols 1987; Nichols et al. 1991). Gómez Chávez and

Gazzola (2004) interpret this closure of portions of the canal system as part of a larger economic shift away from farming towards an urban economy consisting primarily of urban workers and craft specialists supported by foods imported from other areas of the Basin of Mexico. As one additional minor source of agricultural production, Cowgill (2007:278-279) suggests that open spaces between some apartment compounds within the city may have served as garden plots to produce supplementary foods for nearby households, though this suggestion is difficult to confirm archaeologically.

In addition to irrigation agriculture within the valley bottom, it appears likely that cultivation within the Teotihuacan Valley extended past the alluvial plain into the hilly piedmont area, where extensive evidence for ancient terrace systems exists (Sanders 1976b:130). Areas of the lower piedmont within the Valley receive abundant runoff from the flanking hills, which may render extensive irrigation of these areas unnecessary (Sanders 1976b:155). Excavations at a rural settlement site in the lower piedmont of the Teotihuacan Valley suggest that some rural settlements in the area may have been involved in specialized *maguey* and *pulque* production, using the marginal higher altitude agricultural areas of the Valley (Sanders 1967).

Long-Distance Trade and Exotic Food Resources

Calculating probable agricultural yields for irrigable land within the Teotihuacan Valley, Sanders et al. (1976) suggest that only between one and two thirds of the city's residents could have subsisted off of resources produced within the immediate surroundings of the site during its period of maximum population density. It is likely, therefore, that residents of the city obtained agricultural products from further afield to supplement their diets. Though many of these resources may have been obtained from small rural sites throughout the Basin of Mexico, Hirth (1978; Hirth and Angulo Villasenor 1981) suggests that the Teotihuacan state may also have reorganized portions of Morelos to the south of the Basin in order to increase agricultural production for both food products and non-subsistence agricultural resources such as cotton.

Other food products may have been imported over greater distances. McClung de Tapia (1987) suggests that some plant species found with low frequency within residential archaeological deposits at Teotihuacan, such as avocado (*Persea americana*), may have been imported from lowland regions outside of the Basin. Iconographic representations of the cacao plant (*Theobroma cacao*) on Teotihuacan ceramics and murals also suggest at least some familiarity with this plant among residents, if not its importation over long distances and consumption at the site (Coe and Coe 1996:54; Millon 1981). Additionally, the presence of marine crustaceans and fish within the faunal assemblage from the Teopancazco compound indicates that at least some residents obtained food resources from coastal areas (Rodríguez Galicia and Valadez Azúa 2013). The potential consumption of foodstuffs imported from different areas of Mesoamerica is a factor that must be considered in evaluating strontium isotope values from human skeletal remains at Teotihuacan, particularly among the elite individuals who would have had access to luxury foodstuffs such as cacao that would have been imported over long distances.

Paleodiet at Teotihuacan

Studies of plant and animal remains, food processing artifacts, and human skeletons have all contributed to our understanding of the broad varieties of wild and agricultural resources exploited by different groups within the city.

Faunal and Botanical Evidence

Research on faunal and botanical remains suggests that a wide variety of resources were exploited by households within Teotihuacan. The same broad types of plant resources were recovered from all systematically excavated apartment compounds , including maize (*Zea mays*), amaranth (*Amaranthus sp.*), beans (*Phaseolus vulgaris*), squash (*Cucurbita sp.*), chili peppers (*Capsicum sp.*), tomato (*Solanum lycopersicum*), maguey (*Agave americana*), *huahzontle* (*Chenopodium nuttalliae*), purslane (*Portulaca oleracea*), Mexican hawthorn (*Crataegus Mexicana*), and Mexican cherries (*Prunus salicifolia*) (Casales and Tavera 1995; González 1993, McClung de Tapia 1987; McClung de Tapia and Martinez-Yrizar 2017). Residue analysis of ceramic vessels also suggests that *pulque*, fermented from the sap of the *maguey* cactus, was a dietary input for at least some of Teotihuacan's population (Correa-Ascenscio et al. 2014; Robertson and Cabrera 2017). Due in part to the long history of excavations at the site, intercompound comparisons of paleobotanical remains in order to understand social differentiation in diet are complicated by both the differing archaeological recovery techniques used through time and the frequent lack of the contextual information needed to distinguish plants used in activities such as ritual practices from those used as food resources (McClung de Tapia and Martinez-Yrizar 2017). However, some research indicates that the proportions of food products found within the paleobotanical assemblages from different compounds do vary. For example, McClung de Tapia (1987) notes differences in plant exploitation between the Yayahuala and Tetitla apartment compounds, with a greater variety of plant species and a higher proportion of maize utilized in the Tetitla compound during the Xolalpan phase of occupation. While McClung de Tapia (1987) attributes this difference to the higher status of Tetitla residents as compared to those of Yayahuala, large differences in the layout of these two compounds leaves open the possibility that these differences may have been due to functional differences in compound usage, rather than to socioeconomic status.

Studies of faunal remains at the apartment compound level suggest that the primary animal species consumed included several species of rabbits (Family *Leporidae*), white-tailed deer (*Odocoileus virginianus*), dog (*Canis familiaris*), waterbirds (Family *Anatideae*), fish (Class *Osteichthyes*), and smaller quantities of rodents (Order *Rodentia*), quail (Family *Phasianidae*), turkey (*Meleagris gallopavo*) dove (Family *Columbidae*), and turtle (Order *Chelonia*) among other species (McClung de Tapia 1987; Quiroz 1995; Rodríguez Galicia and Valadez Azúa 2013; Starbuck 1987; Sugiyama et al. 2017; Valadez 1993). Widmer (1987:347; Widmer and Storey 2017) notes that numerous egg shell fragments were recovered from fine screening at Tlajinga 33, indicating that eggs from domesticated turkeys or quail may have been an additional source of animal protein in the Teotihuacan diet. While Starbuck (1987) postulates a heavy reliance for all residents on deer meat, suggesting a strong emphasis on hunting rather than the consumption of domesticated animals, Widmer (1987:344; Widmer and Storey 2017) argues that small animals such as wild birds, domesticated or wild rabbit, and fish species likely formed the bulk of the Teotihuacan diet. Due to the sheer number of Teotihuacan's residents, particularly at its peak of population density, it seems likely that residents of the city exploited a diversity of animal resources, both hunted and domestically managed, rather than focusing on a single food source such as wild deer. Indeed, a recent synthesis of faunal evidence by Sugiyama et al. (2017) emphasizes the likelihood that animal food acquisition included local husbandry of animals such as turkeys and dogs, opportunistic garden-hunting of several species including deer, rabbits, and rodents, as well as intentional hunting of animals farther afield.

Some intercompound differences in faunal consumption do appear within the archaeological record, including a greater diversity of bird species found at Tetitla, higher quantities of marine mollusks at Yayahuala, greater consumption of turkey eggs and freshwater fish at Tlajinga 33, higher quantities of domestic dog within the Merchants' Barrio and Tlailotlacan, and greater reliance on rabbit species at Oztoyahualco 15B:N6W3 (Manzanilla 2004:132; McClung de Tapia 1987; Starbuck 1975; Valadez 1993; Valadez and Manzanilla 1988; Widmer 1987:347). While some of these differences may be due to factors such as ethnic identification, others are likely related to socioeconomic differences between compounds. For example, Rodríguez Galicia (2006, 2010) notes that the barrio center of Teopancazco contained imported fauna such as fish and birds from the Gulf Coast to supplement other locally available resources, possibly due to the higher status of the intermediate elite resident in the compound and their ability to procure resources from further afield than most Teotihuacanos. In contrast, nonelite residents may have relied more on locally obtained animal foods. For example, archaeological evidence from the Oztoyahualco compound suggests that the high representation of rabbit species within this domestic setting were due to active breeding of rabbits for consumption and market exchange (Somerville et al. 2016; Valadez 1993).

Evidence from Food Processing Materials

Evidence from food processing artifacts also suggests intercompound differences in diet. Manzanilla (2004:132) notes differences in the size of projectile points recovered from different compounds, which may relate to differences in the species of animal hunted by members of different compound groups. In a study of *manos* and *metates* from the Teotihuacan Mapping Project collection, Biskowski (1997:326-336) demonstrates that households of lower socioeconomic standing relied on *metate* technology more suited for the fine grinding and lime treatment of maize, both of which increase the nutritional value of maize, than the food processing tools belonging to households of higher socioeconomic status, which presumably had greater access to meat or other foods (though not all metates may have been used for the processing of food items; see Manzanilla et al. 2006). Clustered spatial distributions of both maize grinding tools and the *comales* upon which maize tortillas would have been cooked raises the possibility that yet other households may have relied on specialized market production of tortillas to supplement or replace their own household preparation of maize (Biskowski 2017). Additionally, as mentioned above, the lack of *comales* in artifact assemblages from the

Merchants' *barrio* may also point to differences in dietary practices between members of different ethnic groups within the city.

Evidence from Skeletal Pathology

Two types of skeletal data have historically been applied to the question of dietary differentiation within Teotihuacan: oral pathologies that can be straightforwardly - though not always exclusively - linked to dietary factors and nonspecific stress indicators that have a complex multifactorial etiology but which may nevertheless include some nutritional information. Despite expectations that the heavily maize-based diet characteristic of Mesoamerican cultures should result in high levels of dental caries, researchers have noted relatively low caries rates amongst the residents of Teotihuacan (e.g., Archer 2012; Civera 1993; Huicochea and Márquez 2006; Rattray and Civera 1999; Torres Sanders and Cid Beziez 2011; though see Serrano and Lagunas 1974). These researchers attribute low levels of dental pathology to a low intake of fermentable carbohydrates such as maize, though it remains unclear how to reconcile this suggestion with paleoethnobotanical and initial isotopic data that indicate a strong role for maize or other C_4 plant products within the diet of Teotihuacanos. One possibility may be that the low caries rates are due not necessarily to a low intake of maize, but instead to good dental hygiene practices or intrinsic host factors that served to prevent dental pathology. Nevertheless, the slightly higher incidence of caries found among individuals in Frente 2 as compared to Frente 3 of the La Ventilla neighborhood may suggest some class-based differences in fermentable carbohydrate consumption, with a slightly higher intake of fermentable carbohydrates taking place amongst the higher status individuals interred in Frente 2 (Huicochea and Márquez 2006).

Several researchers have also noted that advanced levels of dental attrition are common within Teotihuacan skeletal collections and are the most common oral pathology among adults, likely due to the incorporation of grit into the diet from the processing of edible grains on a *metate* or to the consumption of high quantities of fibrous materials or abrasive foods (e.g., Civera 1993, 1997; Serrano and Lagunas 1974; Torres Sanders and Cid Beziez 2011:93, 99-102). However, in the absence of studies drawing explicit and quantitative comparisons between dental attrition levels between members of different socioeconomic classes, it is difficult to apply these data to the question of class-based dietary variability at Teotihuacan.

The use of nonspecific indicators of stress to infer the nutritional status of individuals belonging to different socioeconomic groups at Teotihuacan is complicated both by the range of non-nutritional factors that are implicated in the development of many of these pathologies (see Goodman and Rose 1990; Lewis and Roberts 1997; Walker et al. 2009) and by the phenomena of selective morality and heterogeneity in frailty, which make it difficult, if not impossible, to directly infer the health status of past populations from lesion frequencies within a skeletal sample (Wood et al. 1992). Nevertheless, studies of skeletal pathology and nutritional status have formed a historical emphasis within the bioarchaeological literature at Teotihuacan. Low frequencies of cribra orbitalia and porotic hyperostosis among residents of apartment compounds spanning multiple socioeconomic status levels have been used to argue that certain nutritional deficiencies such as iron or vitamin B_{12} deficiency were uncommon at

Teotihuacan, regardless of social class (Archer 2012; Huicochea and Márquez 2006; Storey 1992; Storey et al. 2012; Torres Sanders and Cid Beziez 2011:88; Widmer and Storey 2017). While the frequencies of other nonspecific stress indicators such as linear enamel hypoplasias and periostitis also seem to be generally low within Teotihuacan skeletal collections (e.g., Archer 2012; Civera 1993; Huicochea and Márquez 2006; Torres Sanders and Cid Beziez 2011:88, though see Storey 1992), some researchers suggest that they may vary with socioeconomic status. For example, Storey et al. (2012) attribute the lower incidence of dental hypoplasias and periostitis in the La Ventilla neighborhood as compared to the Tlajinga 33 compound to the higher socioeconomic status of individuals resident in La Ventilla, which may have corresponded with improved health and nutritional conditions. It is conceivable that, taken together, these data may indicate that the diet of the Teotihuacanos, while generally sufficient in certain specific nutrients such as iron or vitamin B_{12}, nevertheless varied enough between socioeconomic groups to have tangible health consequences visible in differing rates of dental hypoplasia and periostitis between groups

Evidence from the Biogeochemical Analysis of Human Remains

Isotopic studies of food consumption and analyses of major, minor, and trace elemental concentrations in bone have provided interesting initial results concerning wealth or status-based variation in diet at Teotihuacan but have been limited in both the extent and comparability of analyses used. Analyses of major, minor, and trace elemental concentrations in human remains have been carried out at the La Ventilla, Oztoyahualco

15B, and Teopancazco apartment compounds. Using the strontium-calcium ratio of the bones of individuals interred within several of the La Ventilla apartment compounds, Ochoa Ocaña (2003) suggests that greater quantities of meat were consumed by individuals living in higher-status compounds than by those in lower status residences within this neighborhood. Interestingly, however, Manzanilla et al. (2000) document the opposite pattern in elemental ratios derived from individuals buried in the Oztoyahualco and Teopancazco compounds. Despite the presumed higher status of individuals interred in the neighborhood center of Teopancazco, residents of Oztoyahualco feature lower strontium-calcium ratios. While the above authors interpret lower strontium-calcium ratios as indicative of higher levels of animal protein consumption, the correlation between animal protein consumption and strontium-calcium ratios in bone is frequently weak due to the numerous factors that influence strontium-calcium ratios in bone, including multiple aspects of diet as well as place of geographic origin and methods of food preparation (Burton and Wright 1995; Burton et al. 1999, 2003). While the data discussed above likely indicate that dietary differences existed between members of different socioeconomic status groups, they are not specific enough to determine whether these differences pertain to levels of animal food consumption or instead to one or more alternative aspects of diet or food preparation.

Several studies using carbon and nitrogen isotopes to understand the diet of the Teotihuacan population provide additional lines of evidence that both plant and animal consumption may have differed between members of different socioeconomic classes. Carbon isotope data from bone collagen exists from Tlajinga 33 (White et al. 2004a), from the barrio center of Teopancazco (Casar et al. 2017; Morales Puente et al. 2012), and from structure TL6 in the Oaxaca barrio (White et al. 2004b). Residents of all of the above residential contexts display relatively homogenous carbon isotope values that speak to similar high dependence on C_4-based protein sources such as maize-fed animals among most residents, with the exception of several individuals interred in the relatively high status site of Teopancazco who display evidence of consuming at least some proportion of C_3-based protein sources. It is possible that the exploitation of different types of protein sources may have been a marker of elevated status in barrio centers such as Teopancazco, though evidence from additional intermediate elite structures could help to test this hypothesis. Nitrogen isotope data also provide initial suggestions that levels of animal protein consumption varied according to socioeconomic class. Published nitrogen isotope data from the intermediate status artisan compound of TL6 in Tlailotlacan (White et al. 2004b) and from the barrio center of Teopancazco (Morales Puente et al. 2012) demonstrate individuals resident in Teopancazco consumed more animal protein than the medium status artisans interred in Tlailotlacan.

To summarize, it seems that dietary differences between socioeconomic groups existed in Teotihuacan society and involve the types of food resources that allow these differences to be detected using the chemical data present in human bone. Current isotopic data do derive from relatively few residential contexts within the city, however, and a comprehensive understanding of dietary differentiation throughout the entire social hierarchy at Teotihuacan consequently requires additional research incorporating a wider range of residential contexts. The next chapter discusses how this dissertation was designed to supplement our current understanding of socioeconomically-based dietary variation throughout the population of Teotihuacan by systematically sampling residential contexts with broadly different positions within the socioeconomic hierarchy.

CHAPTER 6: MATERIALS AND METHODS

Prior chapters have demonstrated 1) the importance of socioeconomic mobility to our understanding of the social and economic organization of archaic states, 2) the linkages between socioeconomic status and diet that allows lifetime dietary change to be used as a proxy for social mobility, and 3) the rich contextual data that render the city of Teotihuacan an ideal case study through which to investigate socioeconomic mobility in archaic states. Here, I explain how the archaeological contexts, individuals, and samples were selected to address the research questions that lie at the core of this dissertation. I then describe the laboratory procedures that were used to prepare and analyze samples at Arizona State University to produce biogeochemical data.

Introduction to Archaeological Contexts Sampled

The ten contexts incorporated into this study were selected to represent multiple socioeconomic levels and social groupings within Teotihuacan. The availability of detailed published information concerning the mortuary practices, occupation, and ethnic identity of the individuals interred in these structures also allows the diet of residents to be appropriately contextualized with respect to both their social and economic identities.

Socioeconomic differentiation is distributed as a roughly continuous variable throughout Teotihuacan society (Manzanilla 1996, 2004, 2009). Nevertheless, analytically useful distinctions can be drawn between (1) elites living within palatial compounds near the ceremonial core of the site and in specialized apartment compounds serving as neighborhood centers, (2) middle- to lower-class individuals resident within the vast majority of the city's apartment compounds, and (3) the urban poor living within insubstantial structures distributed throughout the city between and around formal apartment compounds (cf. Millon 1976, 1981). Eight residential contexts incorporated into this dissertation research were assigned to one of the above three socioeconomic levels on the basis of architectural quality and finishes, artifact assemblages, and mortuary data pertaining to each compound, as elaborated below. These general residential contexts are analyzed in conjunction with two other specialized contexts that can shed light on additional aspects of foodways at Teotihuacan: the Oaxaca Barrio, an ethnic enclave consisting of intermediate status individuals that can provide some insight into the effects of ethnic affiliation on diet, and the Feathered Serpent Pyramid, selected to represent a possible specialized subestate grouping interred in one of the major monuments on the Street of the Dead.

As discussed in the previous chapter, a single residential compound at Teotihuacan may include individuals of differing socioeconomic status, a fact that needs to be considered when evaluating the socioeconomic status of the individuals incorporated into this project. Particularly important is the likely presence of support staff in both elite residential compounds and barrio centers. Certain spatial locations associated with support personnel within elite compounds, such as craft workshops or residential areas, can frequently be distinguished from areas associated with the elite based on architectural characteristics, such as lower quality construction materials and lack of mural paintings (Angulo 1987:304-307), or based on the distinct artifacts represented within room fill (Manzanilla et al. 2011). Additionally, burials of support staff would be expected to feature mortuary offerings of much lower richness and complexity than those attributable to members of the intermediate elite (Sempowski 1994).

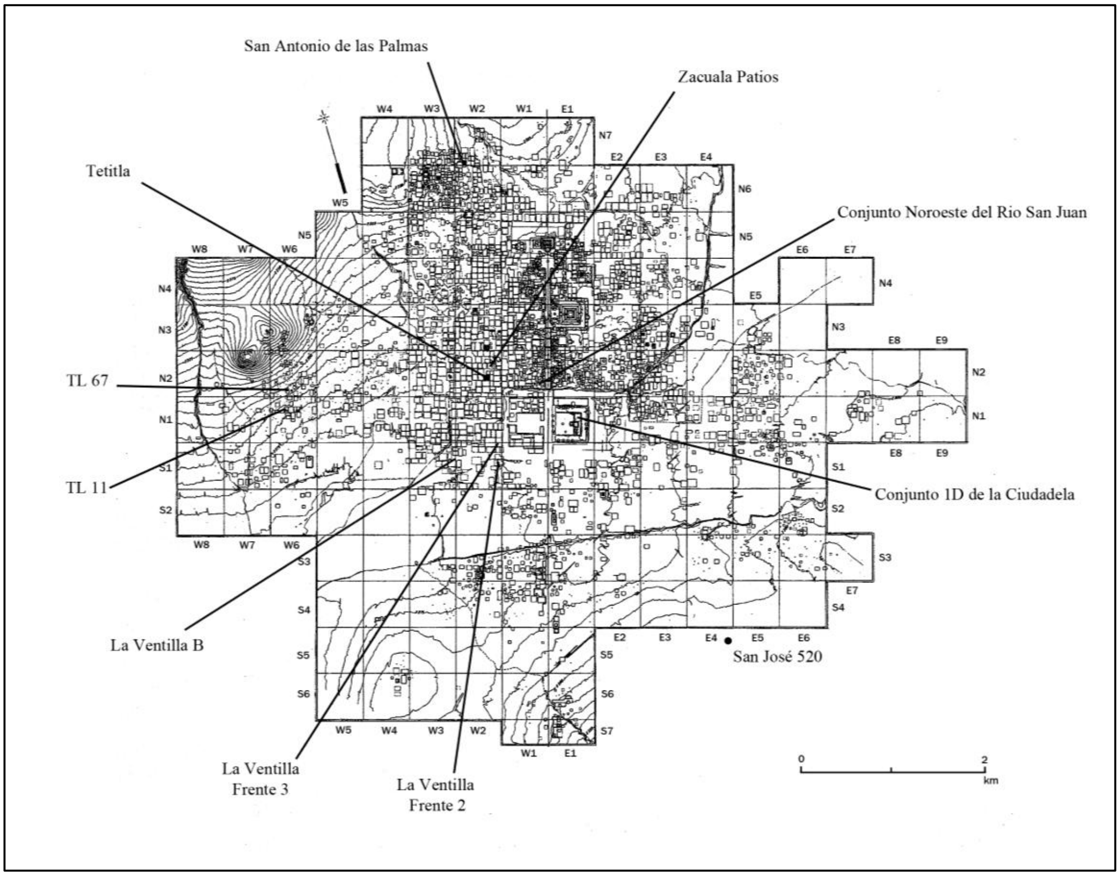

Figure 6.1 The approximate location of archaeological contexts from which samples were selected for analysis. Image adapted from Millon et al. (1976).

Because the skeletal collections from elite residential compounds and barrio centers are being used in the current project as a source of dietary information concerning elite individuals at Teotihuacan, hypothesized non-elite individuals buried within the above-mentioned distinct spatial locations of elite compounds were excluded from sampling. Here, I describe each of the archaeological contexts from which samples were selected and existing archaeological evidence for the social and economic identities of residents.

High Socioeconomic Status

Despite Teotihuacan's long history of research, no consensus exists regarding the nature of power and rulership within the Teotihuacan state, though the some of the elite likely played administrative, priestly, and military roles. Factors such as the presence of individual rulers or ruling bodies, the number of ruling elites in power at any one time, and the relationship between political rulers and leaders of both the military and priestly organizations within Teotihuacan society are largely unknown (see Cowgill 1997; Headrick 2007; Manzanilla 2006; Sugiyama 2005, for varying interpretations). A number of palatial compounds likely serving both residential and administrative functions existed near the ceremonial core of the site (Sanders and Evans 2006). While excavations at palaces such as Xalla have unfortunately recovered few to no burials dating to the Teotihuacan period, a reasonable number of burials have been recovered from excavations at likely administrative buildings lining the Street of the Dead. These compounds would not have housed the paramount rulers of the site; instead, they would have been associated with intermediate elite administrators or members of the priestly class who played a role in running the central state apparatus.

Intermediate elites also likely played an important role as intermediaries between the residents of each neighborhood and the ruling elites governing the central institutions of the state (Manzanilla 2009). Burials of intermediate elites can be found both in the barrio center compounds that served as the locus of administrative and ritual functions for residential neighborhoods and in the upper-class residential compounds distributed throughout the city. Both of these compound types are distinguished from other residential compounds based on the quality of construction and the quality of mural painting. Barrio center compounds contain spaces for administrative and ritual functions as well as residential areas in which intermediate elites would have lived on at least a part-time basis. In addition, barrio centers may contain kitchen areas, workshops employing artisans to produce sumptuary goods for the intermediate elite, and areas housing neighborhood guards or other support staff (Manzanilla 2007, 2009; Torres and Cid 2011:36).

Conjunto Noroeste del Rio San Juan. The Conjunto Noroeste del Rio San Juan is located at the northwestern corner of the intersection between the Street of the Dead and the Rio San Juan. The compound contains a total of five temple structures as well as multiple large and spacious rooms surrounding the central three-temple plaza. The compound was excavated by the Proyecto Arqueólogico Teotihuacan 80-82 and has been hypothesized to have served an elite public or ceremonial function during the majority of its history, due to the relatively large number of temples that it contains as well as to the spaciousness of the associated room complexes (Sánchez 1982a, 1982b).

Early in its history, this compound formed part of the structures known as los Edificios Superpuestos until it was divided from the Complejo de la Calle de los Muertos at the end of the Early Tlamimilolpa period by the construction of the large perimeter wall around the latter complex (Sánchez 1982a:75). Following the Late Xolalpan period, access to this compound from the Street of the Dead was closed, and the formerly spacious room complexes were subdivided into smaller residential rooms associated with a lower class of citizen (Sánchez 1982a:80).

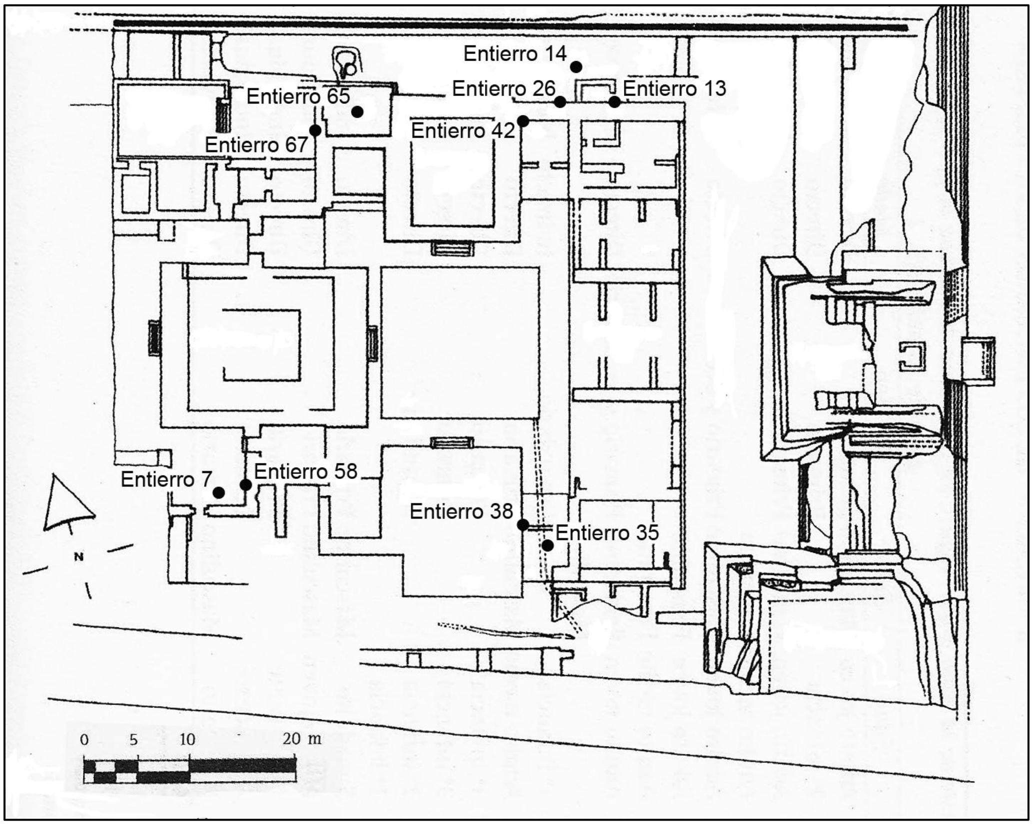

Figure 6.2 Plan view of the Conjunto Noroeste del Rio San Juan showing the location of burials selected for sampling. Image adapted from González (2009).

Most skeletons interred within the compound are associated with the Tlamimilolpa and Xolalpan phases, when this compound would have been used for elite public functions. The osteological analysis of burials encountered during the excavation of each of these compounds was carried out by Luis Alfonso González Miranda and David Fuentes González (González and Fuentes 1982). Details concerning the sex, age, pathology, state of conservation, burial positioning, mortuary goods, and cranial and dental modification of each burial have been previously published (González 2009). Studies of activity-related skeletal pathology among skeletons interred in the Conjunto Noroeste del Rio San Juan (Chilcote 2010) have been used to argue for relatively low levels of physical exertion among females buried within this compound, consistent with the idea of elite status and freedom from physical labor of individuals buried in this location.

Tetitla. The Tetitla compound is located in the northwest quadrant of Teotihuacan, in spatial proximity to the Zacuala and Yayahuala apartment compounds. Though multiple excavations projects have been carried out at Tetitla, the most extensive excavation was undertaken by Séjourné in 1963 and 1964 (Séjourné 1966a). Originally interpreted by Séjourné as a convent or school (Séjourné 1966a:217), the compound has subsequently been reinterpreted as a probable barrio center combining both residential and administrative functions (Angulo 1987:310-311). Due to its elaborate murals and spacious rooms, Millon (1976:227-228) argues that Tetitla housed individuals only slightly below members of the priestly and administrative hierarchy associated directly with state governmental institutions. Sempowski (1987, 1994, 1999) additionally notes that burial richness and complexity of individuals interred in Tetitla exceeds that of contemporary individuals in Zacuala Patios and La Ventilla B, particularly during later phases of occupation, supporting the placement of members this compound in a relatively high-status category.

However, certain portions of the Tetitla compound may be associated with a lower class of citizen, perhaps serving as staff or service personnel. The northern portions of the apartment compound, designated Sectors C and D (Angulo 1987), were built using lower quality construction materials, and they lack the elaborate murals characteristic of the remainder of the compound. Sempowski (1999:499) additionally notes slight differences in mortuary practices between individuals interred in the northern side of the compound from those interred in the southern half, further supporting the idea that individuals buried in Sectors C and D may not belong to the intermediate elite. Burials from these portions of the compound were excluded from analysis during the current project, as the intermediate elite residents of the compound are the focus of the research.

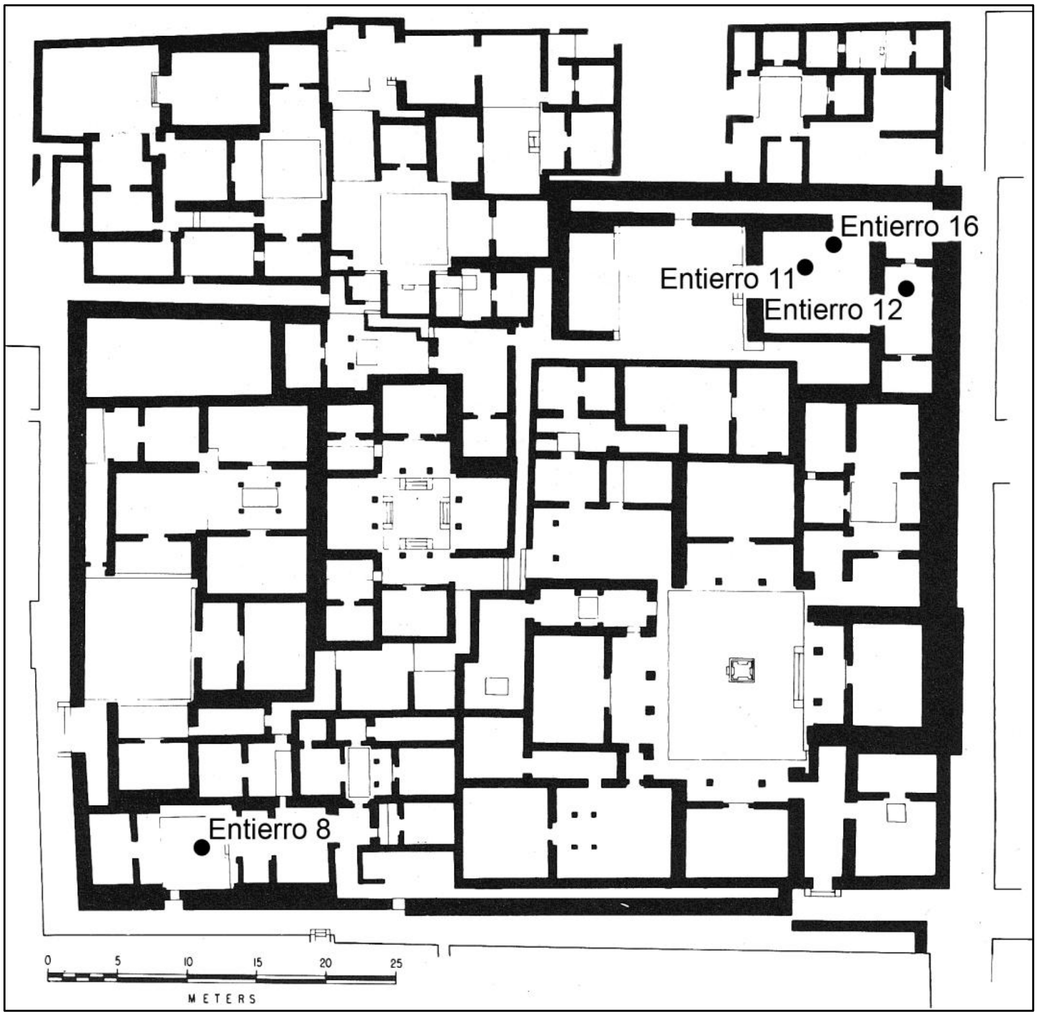

Figure 6.3 Plan view of the Tetitla compound showing the location of burials selected for sampling. Image adapted from Séjourné (1966a).

Séjourné's excavations uncovered 33 human burials in Tetitla, most of which date to the Xolalpan and Metepec ceramic phases (Sempowski 1994). Séjourné (1966b) describes the spatial location of each burial within the compound, while Sempowski

(1994, 1999) and Rattray (1992) provide detailed information regarding the mortuary offerings present in each burial. Spence (1971, 1994) has analyzed the skeletons for age and sex information, as well as for nonmetric variation pertaining to the biological relationships of members of this compound. No previous isotope analyses have been carried out with the skeletal material from Tetitla, though mural paintings and Maya glyphs found within this compound suggest that some residents may have been nonlocal or had an ethnic affiliation with the Maya (Taube 2003).

Zacuala Patios. The compound of Zacuala Patios is located just to the south of the Zacuala Palace apartment compound. The primary excavation of Zacuala Patios was undertaken by Séjourné between 1955 and 1958 (Séjourné 1959), though only the northeastern portion of the compound was uncovered. As in the Tetitla compound, the murals and high quality architectural finishes at Zacuala Patios speak to the high status of resident individuals (Millon 1976:227-228).

Despite the relatively small area of the compound that was excavated, Séjourné uncovered a total of 26 human burials containing a minimum of 34 individuals, the majority of whom date to the Tlamimilolpa and Xolalpan phases of occupation (Sempowski 1994). Santiago Genovés (cited in Sejourne 1959) performed the initial osteological analysis of the remains, documenting the age and sex of the deceased. Subsequent analyses of the skeletal remains by Spence (1971, 1994) reevaluated these age and sex estimates and documented nonmetric variation pertaining to the biological relationships of members of the compound. Descriptions and illustrations of the mortuary offerings accompanying some of the burials were published by Séjourné (1959), while

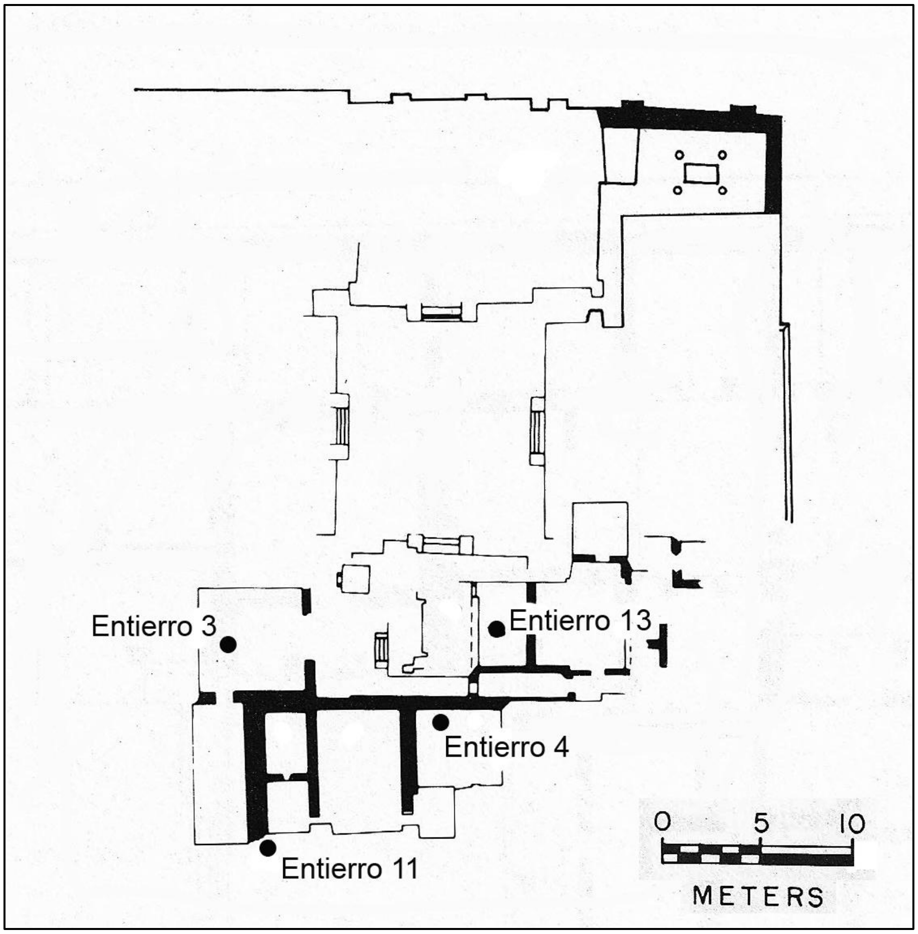

Figure 6.4 Plan view of the excavated portion of the Zacuala Patios compound showing the location of burials selected for sampling. The exact location of Burials 23 and 28 are unspecified on Séjourné's floor plan. Image adapted from Séjourné (1959).

Sempowski (1994) has supplemented these descriptions with her own catalog of the grave offerings present in the Museo Nacional de Antropología. Sempowski (1987, 1994, 1999) notes that that burial richness and complexity of individuals interred in Zacuala Patios is intermediate between that of individuals interred in Tetitla and in the La Ventilla B compound, placing its residents firmly within an intermediate elite category. However, during later phases of occupation, burial richness falls approximately to the level of the residents of La Ventilla B.

La Ventilla Frente 2. The residential district of La Ventilla is located to the southwest of the ceremonial center of the city (Figure 1). The portion of the district excavated by the Proyecto La Ventilla 1992-1994 comprises four excavation sectors (*frentes*) spanning both residential and public neighborhood spaces (Cabrera 1996, 1998, 2000; Gómez Chávez 1996, 2000; Serrano 2003). Frente 2 consists of administrative building called the Compound of the Glyphs (Gómez Chávez and Núñez 1999). The compound is named after one of its internal plazas, which features a number of painted glyphs on the stucco floor of the compound that may have been used during the governmental, administrative, or political activities taking place within the compound (Cabrera and Gómez Chávez 2008:61; Nielsen and Helmke 2011). The high quality architectural finishes and murals found in this location also speak to the high status of its occupants (Gómez Chávez 1996, 2000; Gómez Chávez and Padilla 1998), as does the presence of luxury items such as ornaments and musical instruments not found in other compounds within the La Ventilla neighborhood (Cabrera and Gómez Chávez 2008:43). The southern portion of the compound consists of areas containing evidence for food preparation and tool storage, which may have functioned as service areas of the compound used by lower status service personnel rather than directly by the intermediate elites (Cabrera and Gómez Chávez 2008:59).

Excavations within the Compound of the Glyphs uncovered 50 burials, the spatial location of which within the compound and brief descriptions of accompanying mortuary artifacts are presented in Gómez Chávez and Núñez (1999) and in Rubio Chacon (2003). The overrepresentation of adult males among the burials in this compound has been usedto suggest that the individuals interred in this location represent intermediate elite administrators who lived and worked in this location for certain periods of time separated from their families (Gómez Chávez and Núñez 1999). Studies of the skeletal remains have focused on demographic information, pathology, and cranial modification forms within the skeletal sample (Huicochea and Márquez 2006; Serrano and Terrazas 2003; Serrano et al. 2003). The generally lower rates of nutritionally based pathologies among the burials of the Compound of the Glyphs as compared to those of La Ventilla Frente 3, an excavation sector in the same neighborhood containing a residential compound belonging to middle-status artisans, have been used to suggest that many of the individuals buried within this compound belonged to a higher socioeconomic status than

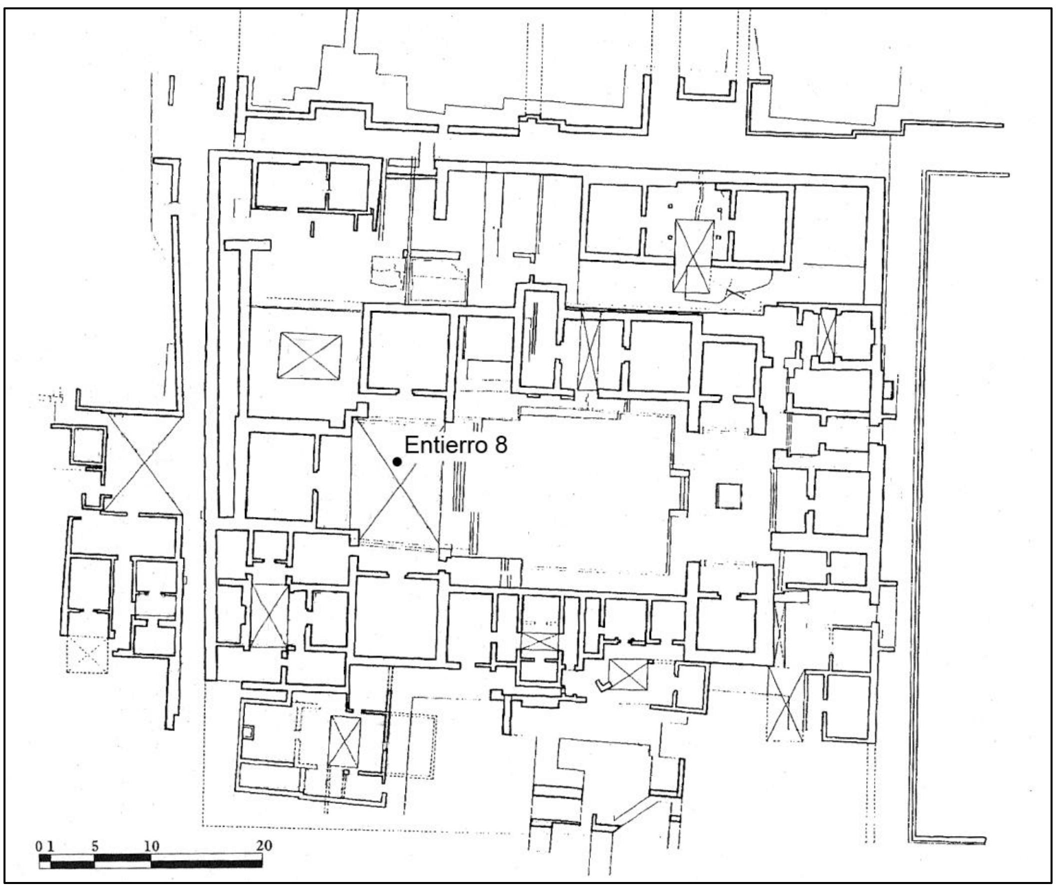

Figure 6.5 Plan view of the barrio center within La Ventilla Frente 2 showing the location of the burial selected for analysis. Image adapted from Gómez Chávez and Núñez (1999).

those buried in Frente 3 (Huicochea and Márquez 2006). Additionally, initial paleodietary data from the analysis of major, minor, and trace elemental concentrations (Ochoa Ocaña 2003) indicates that these individuals consumed greater quantities of animal protein than those buried in La Ventilla Frente 3, a possible additional line of evidence concerning their higher status.

Middle Socioeconomic Status

In contrast to the residences and barrio centers of the intermediate elites, the residential structures of the many craftspeople comprising the intermediate socioeconomic groups of the Teotihuacan hierarchy include smaller rooms, lower quality construction materials and finishes, fewer or no murals, and clear artifactual evidence for craft production. These compounds are also frequently less formally planned and have a more variable layout than those associated with the elite segments of society.

La Ventilla B. The La Ventilla B compound is located to the southwest of the Great Compound and was partially excavated in 1964 by Juan Vidarte (1966). The excavated portion consists of the rooms and patios in the northwestern section of the compound. Researchers disagree concerning the socioeconomic status of residents, who may fall somewhere in between the intermediate elites resident in barrio centers and the craftspeople living in domestic compounds documented through excavations at La Ventilla Frente 3 or San Antonio de las Palmas.

Millon (1976:227-228) attributes La Ventilla B to a low intermediate status level and suggests that the compound represents a residence of farmers, due to the lack of evidence for a clear craft specialization. The burial offerings included with individuals interred at La Ventilla B are less rich and complex than those found in Tetitla or in Zacuala Patios during both the Tlamimilolpa and Xolalpan phases (Sempowski 1987:125), potentially supporting the categorization of this compound in a lower intermediate class grouping separate from the compounds attributed above to intermediate elites. Some architectural features do, however, seem to link the La Ventilla B compound with a higher socioeconomic class of residents. Sánchez (1991:175) suggests that due to the relatively large room size and the occasional presence of murals found in La Ventilla B, the residents of the compound likely belonged to a relatively high residential status, perhaps comparable to the residents of Zacuala, Tetitla, and Yayahuala, a view shared by Gómez Chávez (2012). La Ventilla B also displays a large surrounding wall similar to those found in higher status structures such as Zacuala and Yayahuala (Sánchez 1991:172).

The skeletal collection from La Ventilla B is very large, consisting of 178 individuals spanning the Early Tlamimilolpa through Metepec ceramic phases at the site (Rattray 1992). Serrano and Lagunas (1974, 1999) have extensively studied the skeletons of La Ventilla B and provided information concerning the sex, age, pathology, stature, burial positioning and treatment, and dental and cranial modification of the individuals in the collection. Spence (1971, 1994) has also analyzed the skeletons for age and sex, as well as for nonmetric variation pertaining to the biological relationships of members of this compound. Information concerning the location of burials within the La Ventilla B

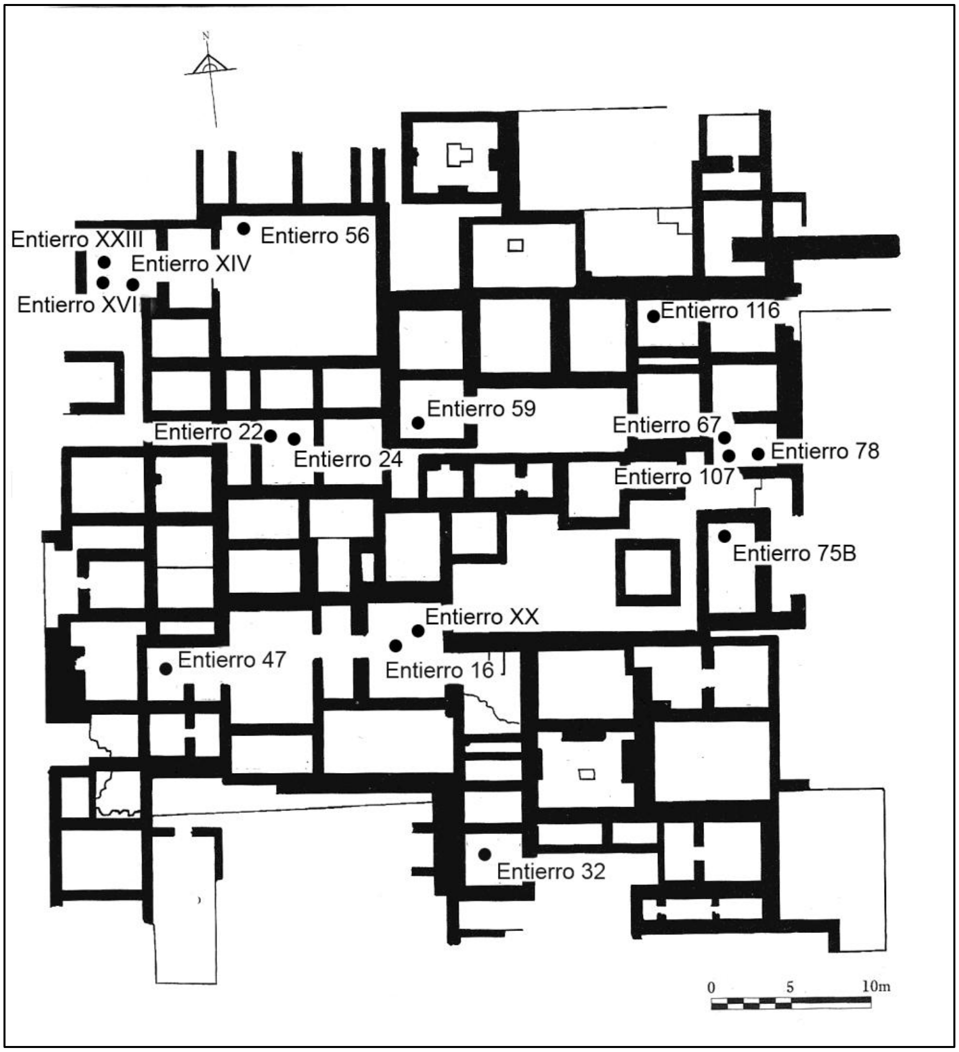

Figure 6.6 Plan view of the La Ventilla B compound showing the approximate location of burials selected for analysis. Burials are shown in the room from which they were excavated, as more precise information concerning burial location is not available to the author. The precise location of Burial 101 within the compound is unknown. Image adapted from Serrano and Lagunas (1999).

compound as well as the grave goods associated with each individual are available in Vidarte's (1966) report about the excavation of the La Ventilla B compound as well as in Sempowski's (1994) synthetic analysis of mortuary practices at Teotihuacan.

La Ventilla Frente 3. The residential compound in Frente 3, also called Conjunto Arquitectónico A, is located just to the north of the public plaza in the La Ventilla neighborhood, and it is believed to have housed lapidary artisans dedicated to the production of stone and shell ornaments (Cabrera and Gómez Chávez 2008; Gómez Chávez 2000). The domestic compound in Frente 3 contains at least 19 architectural units constructed of simple materials and lacking both mural painting and the large perimeter wall characteristic of intermediate elite structures (Cabrera and Gómez Chávez 2008:69). The different artifact assemblages found on the floors and within the fill of each of these units, including a mix of raw materials, tools, and objects in various stages of the production process, suggest that each unit within the larger compound specialized in the working of certain materials and/or different part of the production process (Gómez Chávez and Gazzola 2011).

A few architectural units within the larger compound (units 5, 6, 11, and substructure 8) feature more spacious rooms, better architectural finishes, and temple structures. The residents of these units may have held a slightly higher status than the rest of the residents of Conjunto Arquitectónico A. The high frequencies of bone and obsidian tools that would have been used in lapidary construction found on the floors and fills of these compounds suggests that the remainder of the residents of Conjunto Arquitectónico A may have been dependent on these higher status individuals for access to the tools of their trade, as well as potentially raw materials (Gómez Chávez 2000; Gómez Chávez and Gazzola 2011:121). Sampling in this location targeted burials in both types of architectural unit, while keeping in mind that the socioeconomic status of the individuals

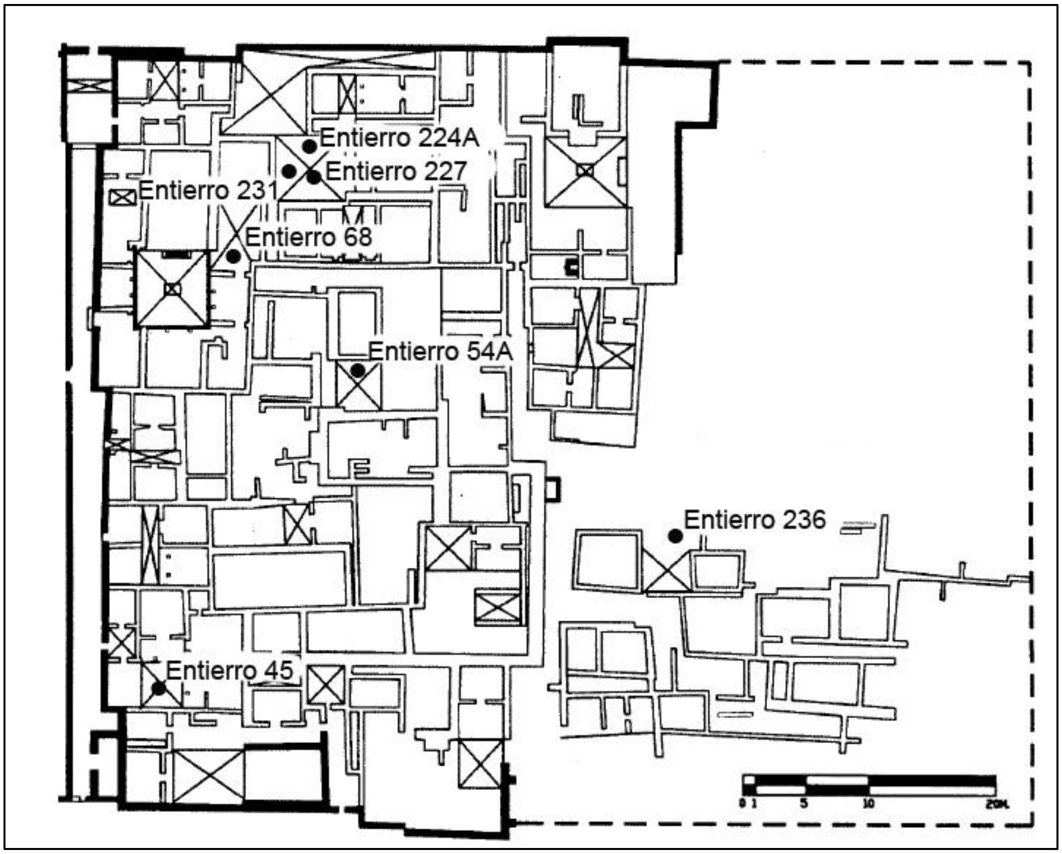

Figure 6.7 Plan view of the La Ventilla Frente 3 compound showing the approximate location of burials selected for analysis. Image adapted from Cabrera and Gómez Chávez (2008).

buried in each may not be the same.A large number of burials dating to the Tlamimilolpa through Metepec ceramic phases were discovered during excavations at Conjunto Arquitectonico A. Burials within this compound contain materials and tools associated with the lapidary trade, reflecting the status of residents as craftspeople (Gómez Chávez 2000; Gómez Chávez and Núñez 1999). The spatial location of these burials within the compound are presented in Gómez Chávez and Núñez (1999), while the skeletons themselves have been studied for demographic information (Serrano and Terrazas 2003), cranial modification forms (Serrano et al. 2003), activity-induced and nutritionally based pathologies (Huicochea and Márquez 2006) as well as for limited paleodietary information from major, minor, and trace elemental concentrations (Ochoa Ocaña 2003).

San Antonio de las Palmas. Located in the northwestern periphery of the city, the small residential structure at San Antonio de las Palmas was originally identified based on surface collections as a regional obsidian workshop producing bifacial blanks, scrapers, knives, and projectile points from grey obsidian (Spence 1981:781). The excavation of this structure as part of the Proyecto Arqueólogico Teotihuacan 80-82 (Monzón 1982, 1989) revealed a quadrangular residential compound containing twenty rooms surrounding three patios. The presence of exhausted cores amongst the lithic assemblage uncovered during excavations at the compound is consistent with the idea that residents were engaged in obsidian tool manufacture (Monzón 1989:148).

The main occupation at San Antonio de las Palmas as well as all of the burials uncovered within the compound walls date to the Tlamimilolpa period (González 2009; Monzón 1989:208, 215). Like the other burials uncovered during the Proyect Arqueológico Teotihuacan 80-82, the skeletons from San Antonio de las Palmas have been thoroughly studied for sex, age, pathology, state of conservation, burial positioning, mortuary goods, and cranial and dental modification, and these details have been published (González 2009). Studies of the activity related skeletal pathology among skeletons of San Antonio de las Palmas (Chilcote 2010) have documented patterns of musculoskeletal stress that would be consistent with a pressure-flaking method of obsidian tool manufacture, complementing the artifactual evidence that residents belonged to an intermediate class consisting of craft producers.

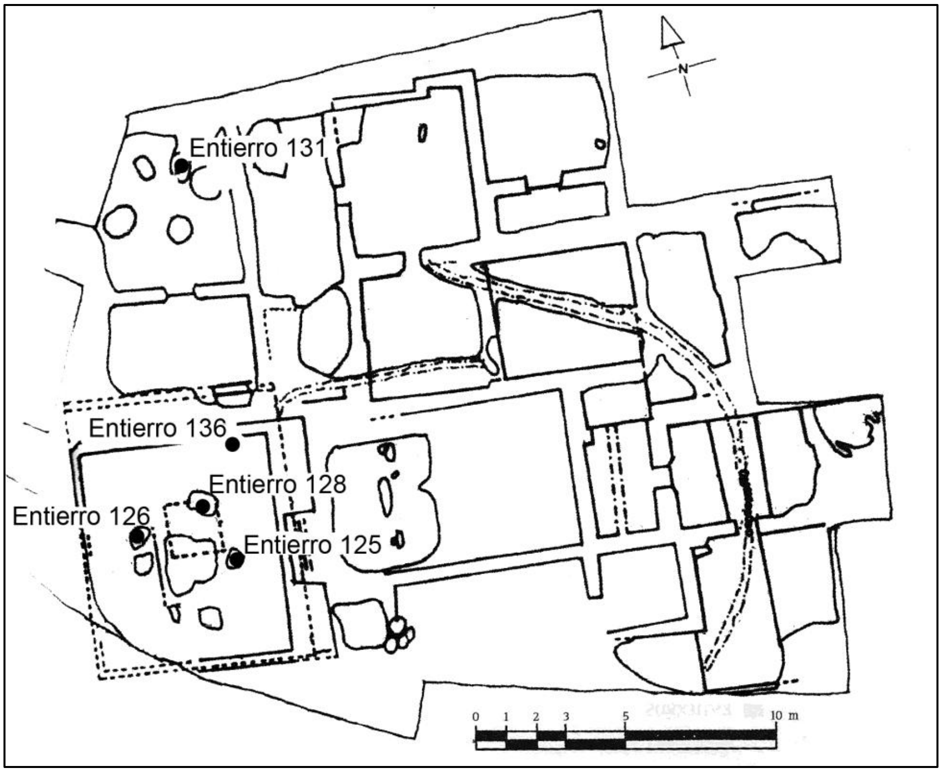

Figure 6.8 Plan view of the San Antonio de las Palmas compound showing the location of burials selected for analysis. Image adapted from González (2009).

Low Socioeconomic Status

San José 520. The insubstantial structure site of San José 520 is located in the semi-periphery of the city, toward the southeastern portion of the Valley of Teotihuacan. In contrast to the apartment compounds housing the majority of the city's population, insubstantial structure sites contain the remains of residences constructed from ephemeral building materials and attributed to individuals of the lowest socioeconomic standing within Teotihuacan society (Cowgill et al. 1984). Excavations at San José 520 directed by Oralia Cabrera during 2004 and 2005 field seasons uncovered evidence for a small residential community engaged in ceramic production during the Tlamimilolpa and Xolalpan phases (O. Cabrera 2006, 2011).

Only three burials containing portions of at least five individuals were recovered from the San José 520 site. The primary osteological analysis of these skeletal remains was performed by Nado and Cruz (2006), who documented the sex, age, and pathology of each individual. Several individuals were also analyzed for oxygen isotopes by White and Spence (2008).

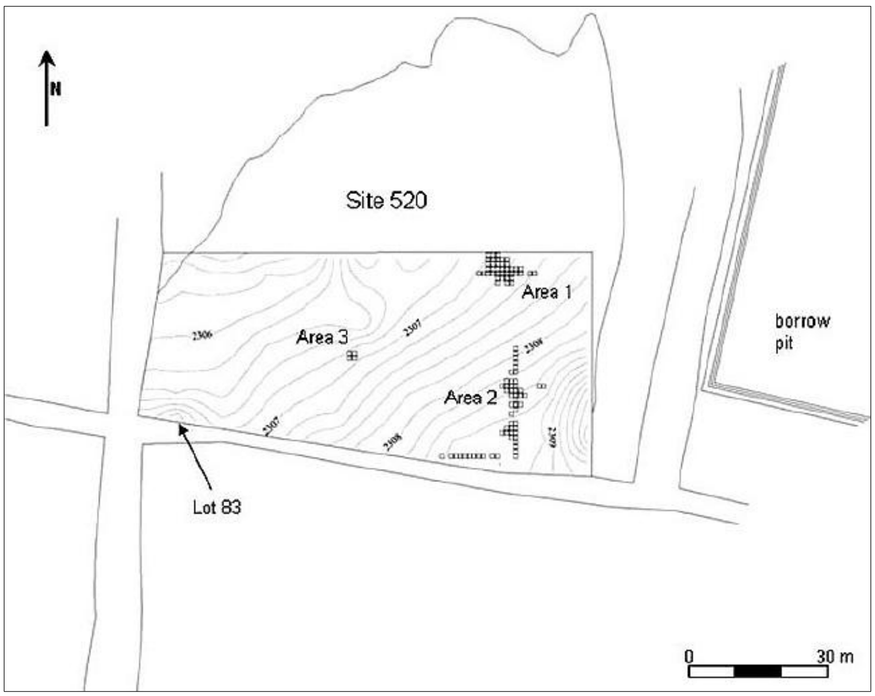

Figure 6.9 Location of excavation units within the San José 520 site. After Cabrera (2006).

Specialized Contexts

In addition to the above eight residential contexts, samples were selected from the Oaxaca Barrio, in order to represent an ethnic group living in an enclave setting distinct from the general Teotihuacan population, and from a dedicatory offering complex located at the base of the Feathered Serpent Pyramid, in order to represent a possible specialized subestate grouping of the Teotihuacan military. As reviewed in Chapter 5, the the military was one of the groups within Teotihuacan society that appears to have the most symbolic salience as a distinctive social category separate from the purely economic realm. These two specialized contexts are analyzed separately from the rest of the residential population of the site within this dissertation in order to control for the potential impacts of ethnicity and subestate on diet.

Tlailotlacan TL1, TL11 and TL67. The neighborhood of Tlailotlacan, also known as the Oaxaca Barrio, is located toward the western limit of the urban center in Teotihuacan Mapping Project squares N1W6 and N2W6. The neighborhood consists of approximately ten apartment compounds with artifactual and mortuary evidence suggesting that residents maintained a distinctive Zapotec ethnic identity despite their long-term residence in Teotihuacan (Rattray 1987, 1993; Spence 1989, 1992, 2002; Spence and Gamboa 1999). While the specific economic role played by residents of the Oaxaca barrio has been a matter of debate, most individuals have considered the inhabitants of the barrio to be members of an intermediate socioeconomic class, either as craftspeople engaged in masonry or in the production of cochineal dyes (Crespo and Mastache 1981; Diaz 1981; Rattray 2002) or as merchants engaged in a trade-diaspora with other Zapotec settlements in central Mexico (Smith and Montiel 2001; Spence 2005).

While there have been a number of excavation projects carried out in various structures within the limits of the Oaxaca Barrio (Gamboa 1995; Paddock 1983; Quintanilla 1982; Rattray 1987; Spence 1989), the samples incorporated into this

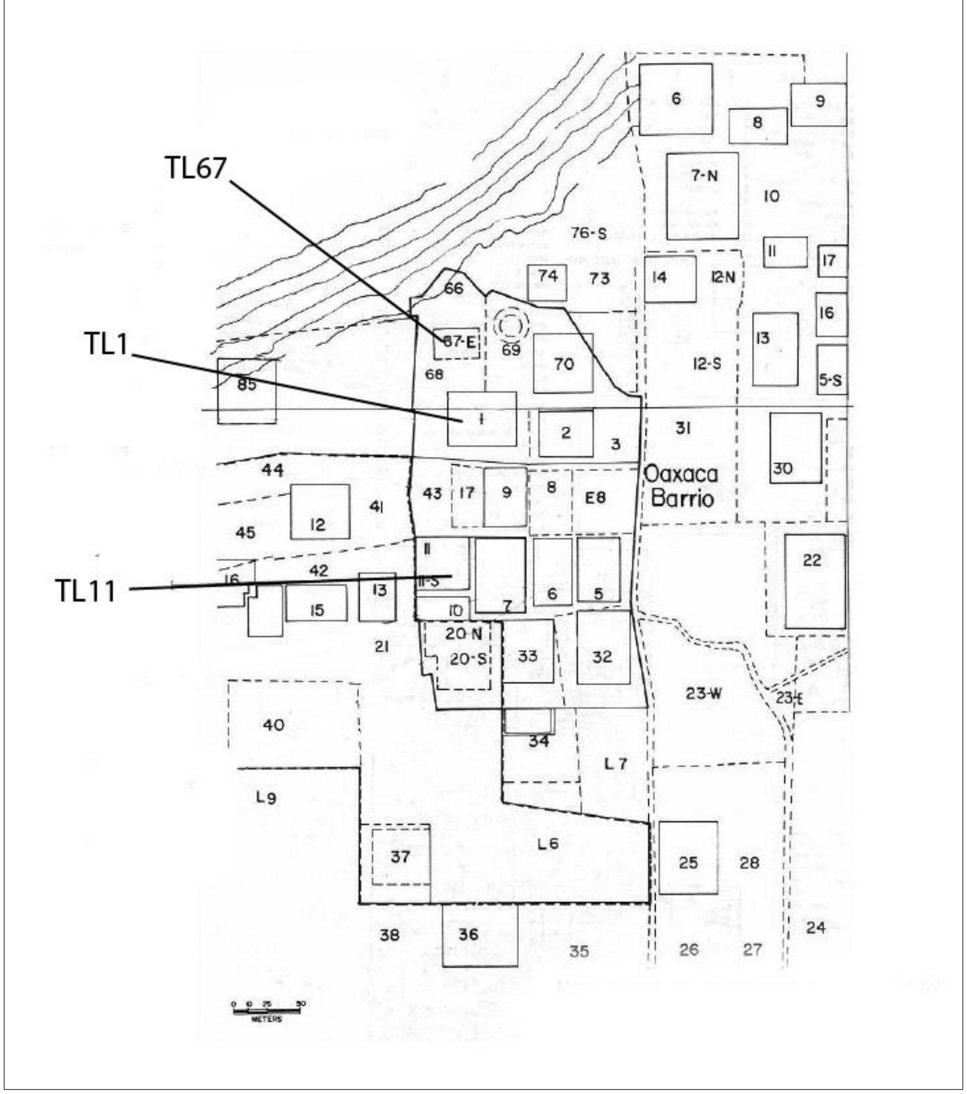

Figure 6.10 Layout of Tlailotlacan, showing the location of structures TL1, TL11, and TL67. Image adapted from Archer (2012).

dissertation come from the two most recent. One of the structures incorporated, TL1, was partially excavated by María Palomares in 2002 as part of an archaeological salvage project (Palomares 2003, 2007). The two other structures, TL11 and TL67, were excavated between 2008 and 2010 as part of the Proyecto de Investigación Arqueológica Barrio Oaxaqueño, directed by Verónica Ortega (Ortega 2009, 2010; Ortega and Archer 2014). While structure TL11 shows a slightly higher architectural quality than the other two structures, all three contexts display evidence of craft production and a construction quality consistent with the inclusion of their residents within a broad lower middle socioeconomic status group (Ortega 2009, 2010).

The skeletons from these structures have been extensively studied by Jorge Archer Velasco for age, sex, stature, pathology, activity markers, and cultural modification of the cranium and teeth (Archer 2012). Descriptions of mortuary treatment and accompanying funerary objects for each individual are also available (Archer 2012). While no isotope analyses have been undertaken for the skeletons from the three structures investigated here, White et al. (2004b) have generated stable carbon and nitrogen isotope data for individuals from the structure of TL6 within the Oaxaca barrio, demonstrating similar dietary patterns between the members of that residential structure and members of other intermediate status residential structures throughout the city. Oxygen and radiogenic strontium isotope analyses have also been undertaken for individuals interred in TL6 and have demonstrated that both local and immigrant individuals were resident in the barrio (Price et al. 2000; White et al. 1998, 2004b).

Feathered Serpent Pyramid. The Feathered Serpent Pyramid lies within the Ciudadela enclosure in the ceremonial core of Teotihuacan. Flanked on both sides by massive residential structures believed to have been palaces for rulers, priests, or elite administrators, the pyramid stands at the back of a spacious plaza that would have been able to hold a substantial proportion of the city’s population during public gatherings and ceremonies (Cowgill 1983). The last of the major pyramid structures to be constructed at Teotihuacan, the Feathered Serpent Pyramid was built during the Miccaotli and Early

Tlamimilolpa phases (A.D. 150-250), a period when Teotihuacan was consolidating its influence in central Mexico and the massive reorganization of the city's population into a series of standardized apartment compounds was underway (Sugiyama 2005).

A series of excavation projects within the Ciudadela compound during the 1980s and 1990s uncovered an extensive burial or offering complex distributed in a symmetrical pattern under and around the base of the Feathered Serpent Pyramid (Cabrera et al. 1991; Sugiyama 2005). The complex contains more than 200 sacrificial burials made during the construction of the monument around A.D. 200 (Cabrera et al. 1991; Sugiyama 1989, 2005:54). Human remains included within this offering deposit are located both in mass graves underneath the central portion of the pyramid and in long rows distributed around the periphery of the pyramid (Figure 5.12). While individuals buried underneath the central portion of the pyramid have been interpreted as possible foreign dignitaries or captives (White et al. 2002:232-233), peripheral burials have been associated with a military occupational role due to the interment of individuals surrounded by multiple obsidian projectile points, adorned with ornaments of real and imitation human maxillae, and wearing slate back disks portrayed only in Teotihuacan period representations of military figures (Cabrera et al. 1991:78; Sugiyama 1989:98, 1991:319). While both the central burials and that subset of peripheral burials located underneath the foundations of the monument appear to have been interred during a single dedicatory event during the early construction phases of the monument, stratigraphic relationships suggest that at least some of the peripheral burials located outside of the face of the pyramid were added somewhat later, toward the end of the construction program (Sugiyama 2005:94-95).

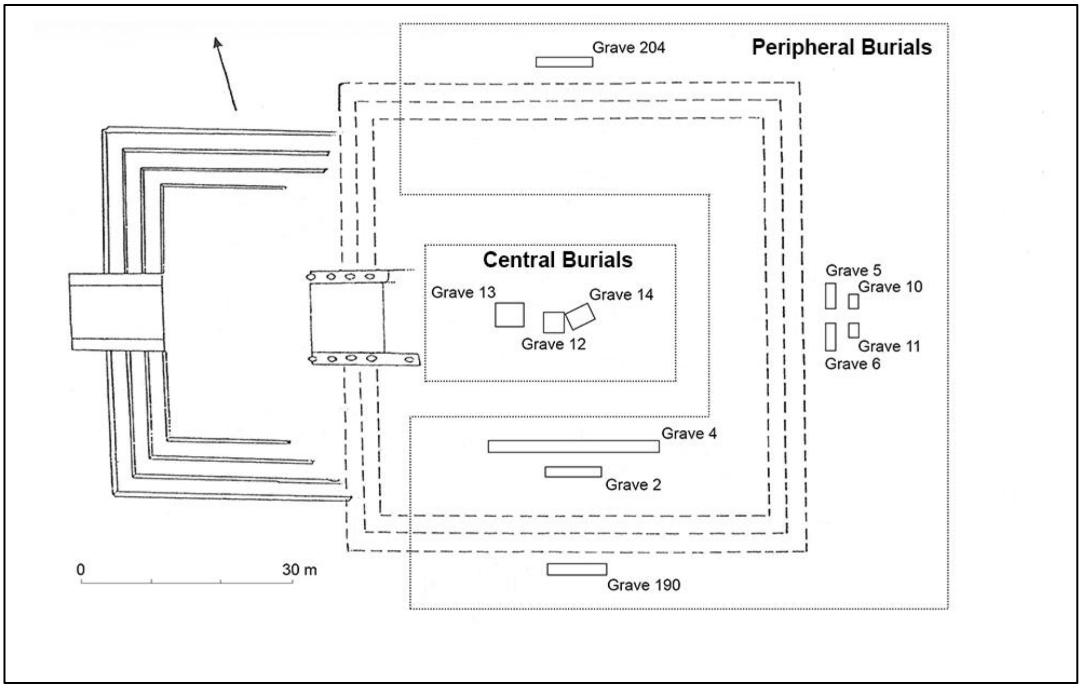

Figure 6.11 Location of graves within the dedicatory offering complex beneath the Feathered Serpent Pyramid. Image adapted from Sugiyama (2005).

Individuals of both sexes are present within the peripheral graves, though groups of males and females are buried in separate burial pits from one another. Due to the generally young age and military garb of the males interred around the periphery of the pyramid, Spence et al. (2004) have suggested that individuals within each separate burial pit represent distinct military units that were sacrificed and buried together within the pyramid. Due to the fact that the females interred within peripheral graves lack the collars and stone disks used to identify their male counterparts as soldiers, these individuals have been interpreted as possible wives or concubines of the soldiers interred in the first category of offering deposit (White et al. 2002:232). However, given the martial symbolism of other aspects of their offering context, such as the inclusion of projectile points within burial pits containing groups of female individuals, there is no *a priori* reason to reject the idea that these females could also have held military roles, albeit ones with apparently different activities and garb than their male counterparts.

Samples for this study came exclusively from the males and females interred around the periphery of the pyramid in Burials 5, 6, 10, and 11. These burials are located just outside of the east face of the pyramid and are among those that were likely added toward the end of the period of construction of the Feathered Serpent Pyramid (Sugiyama 2005:94-95). Burials 5 and 6 each contain the remains of nine male individuals, while Burials 10 and 11 each contain the remains of four female individuals (Serrano et al. 1991). A subset of these individuals, as well as others from the Feathered Serpent Pyramid, have been previously analyzed for oxygen isotope information by Christine White and colleagues (White et al. 2002). Within this dissertation, I rely on interpretations of the individual buried within this context as members of the Teotihuacan military (cf. Cowgill 1997, 2015:97; Spence et al. 2004; White et al. 2002). However, it is important to recognize the additional possibility that, given the many symbolic aspects of the sacrificial complex underlying the Feathered Serpent Pyramid, these individuals may have been civilian commoners dressed to symbolically represent military themes, rather than individuals who had served as professional soldiers during life (Manzanilla 2001:392; Sugiyama 2005).

Sampling Methodology

Sample Selection

The first step of the sampling process was to identify burials that contained well-preserved rib fragments and third molar crowns in order to represent both childhood and adult diet, respectively. Initial calcification of the third molar crown begins at approximately eight years of age, while crown formation is completed by approximately sixteen years of age (Ash and Nelson 2003). Therefore, these teeth should reflect the post-weaning childhood diet of the sampled individuals. In contrast, somatic bone remodels throughout an individual's life and features chemical values characteristic of diet during the last years prior to an individual's death (Katzenberg 2008). Rib samples were selected because they are infrequently incorporated into morphological analyses of the human skeleton, and therefore their destruction during the course of biogeochemical analysis is less impactful upon future skeletal studies than the destruction of more morphologically informative areas of the skeleton. Rib fragments that displayed evidence of pathology or taphonomic changes such as burning that could have altered the isotopic values within the bone were excluded from sampling (cf. DeNiro et al. 1985; Munro et al. 2008; Olsen et al. 2014).

Skeletons that contained both a third molar and rib fragments of a minimum size of 4-5 g were preferentially selected for analysis. However, because relatively few individuals contained both skeletal elements, selecting for analysis only those individuals with both preserved rib fragments and a third molar would have resulted in an extremely small sample size. Consequently, when a burial contained well-preserved rib fragments, it was selected for sampling regardless of whether or not it also contained a third molar. Individuals represented only by a rib sample will be used provide information about the adult diet of individuals buried within a particular archaeological context even if they cannot be used to investigate dietary changes that occurred during the life of that individual. Additional sampling criteria such as the age or sex of individuals or the specific phasing of burials could not be used without reducing the sample size beyond utility.

This project originally aimed to sample a subgroup of 15 individuals from each of the ten archaeological contexts for chemical analysis. This sample size was selected in order to balance the competing needs of limiting damage to the archaeological record during destructive chemical analysis while maintaining a sample large enough for statistically valid comparisons between groups. However, the final number of individuals selected depended on the number of burials with suitable skeletal elements present within the skeletal collections from each context. Due to poor preservation, the final sample size incorporated into the analysis was frequently smaller than 15 individuals from each context (Table 6.1).

In order to assess the utility of the final sample in detecting meaningful dietary variation between social and economic groups, a post-hoc power analysis was conducted using the final sample sizes to assess the effect sizes that could be detected within this dissertation project. Using a significance level of 0.05 and a power level of 0.80, power analyses indicate that t-tests comparing mean isotope values between socioeconomic and social groups of the sizes specified above should be able to detect large effects (Cohen's *d* between 0.8 and 1.2) - or very large effects (Cohen's *d* between 1.2 and 2.0) in the case of comparisons with the low socioeconomic status group - though medium or small effects will go undetected in all comparisons (see Cohen 1992). Evaluation of the results from this project must therefore take into account the fact that some forms of dietary differentiation between groups may not be recognized using the sample sizes incorporated into this project, particularly if they involved subtle differences in food consumption practices between groups.

Context	Number of Individuals Sampled
High Socioeconomic Status……………………………………………………………….22	
Conjunto Noroeste del Rio San Juan	11
Tetitla	4
Zacuala	6
La Ventilla Frente 2	1
Middle Socioeconomic Status…………………………………………………………….27	
La Ventilla B	15
La Ventilla Frente 3	7
San Antonio de las Palmas	5
Low Socioeconomic Status………………………………………………………………5	
San José 520	5
Comparative Ethnic Group……………………………………………………………….15	
Tlailotlacan	15
Comparative Subestate Group.....…………………………………………………………12	
Feathered Serpent Pyramid	12
Total……………………………………………………………………………………81	

Table 6.1 Number of individuals selected for analysis from each archaeological context

Age and Sex Estimation

After specific individuals were selected for sampling, it was necessary to assess the sex and age-at-death of each skeleton that would be included in the analysis so that it would be possible to control for the effects of gender and age on diet. As mentioned above, the sex and age of adult individuals within each of the collections incorporated into the proposed study have previously been estimated by various researchers (Archer 2012; González 2009; Nado and Cruz 2006; Spence 1971, 1994; Serrano and Lagunas 1974, 1999). Prior to inclusion in the current study, these published sex and age estimates were verified or reassessed, as appropriate, using standard osteological procedures (Buikstra and Ubelaker 1994). Because of the variable preservation of the skeletons within each collection, the specific age and sex estimation techniques used depended on which portions of the skeleton were preserved. When possible, both sex and age were estimated based preferentially on the morphology of the *os pubis* (Brooks and Suchey 1990). When the *os pubis* was not preserved, age estimations were based on the morphology of the auricular surface of the *os coxae* (Lovejoy et al. 1985). When neither of these portions of the skeleton was preserved, the skeleton was simply designated as an "adult" as long as all epiphyses had fused and all teeth had completely erupted. When the *os pubis* was not preserved, sex was estimated based on information from the morphology of the greater sciatic notch of the pelvis and/or on cranial morphology (Buikstra and Ubelaker 1994). If none of these indicators was preserved, the sex of the individual was designated as "indeterminate".

Sample Documentation

Because the chemical analyses used in this dissertation project are destructive, several steps were taken to preserve the maximum morphological information possible from the samples before their exportation and analysis. Prior to any sample processing, both rib and molar samples were photographed against a black background using a Nikon D3100 digtital camera. Rib samples were photographed on both medial and lateral surfaces, while tooth samples were photographed on all four sides (mesial, distal, buccal, and lingual) as well as on the occlusal surface.

Additionally, plaster molds were made of each tooth sample to serve as a record of the morphological and metric characteristics of the tooth. Due to the fragile nature of most rib samples, molds could not be taken of these samples without damaging them to the point that they would no longer be useful for chemical analysis. Dental impressions were made by immersing the molar in alginate impression material until the impression material solidified. The teeth were then removed from the impression, and it was filled with dental plaster, which was allowed to dry overnight. The next morning, the hardened plaster molds were removed from the casting material and checked against the original teeth to make sure that they did not contain any flaws that would obscure important morphological features of the original tooth. When the molds were completely dried, they were then placed with the remainder of the corresponding skeleton within the collections repositories so that they would be accessible to future researchers studying the collection.

Sampling of Dental Enamel

At the request of the Instituto Nacional de Antropología e Historia, powdered dental enamel was removed from each molar sample in the appropriate collections repositories in Mexico, so that the tooth samples could remain accessible to other researchers throughout the duration of this dissertation project. First, the surface of each sample was mechanically cleaned using a Dremel MultiPro dental drill in order to eliminate contamination on the surface of the tooth. Then, using a clean drill bit, powdered enamel was removed from each tooth with the drill. When a sufficient quantity of enamel had been removed from the tooth (approximately 0.015 g), the enamel was placed in a clean, labeled microcentrifuge tube for export. Every effort was made to avoid taking enamel from a side of the tooth that displayed interesting morphological features, dental calculus, or other dental pathology that may be of interest to future researchers. Rib samples and powdered tooth enamel samples were exported from Mexico with the permission of the Instituto Nacional de Antropología e Historia.

Laboratory Procedures

I prepared all bone and tooth samples for analysis using standard methodologies employed in the Archaeological Chemistry Laboratory at Arizona State University, as described below, and chemically analyzed them at the W.M. Keck Foundation Laboratory for Environmental Biogeochemistry at Arizona State University or at the Colorado Plateau Stable Isotope Laboratory at Northern Arizona University. Prior to all other sample preparation steps, both the inner and outer surface of all rib samples were mechanically cleaned using a Dremel MultiPro dental drill with a carbide burr to remove both surface contamination and trabecular bone, which is particularly subject to diagenetic contamination (Lambert et al. 1982). Tooth enamel samples had been previously mechanically cleaned in the field, as described in the previous chapter.

Stable Carbon and Nitrogen Isotopes from Collagen

Bone collagen was isolated from the mineral portion of bone and extracted through high-temperature solubilization in hydrochloric acid following standard laboratory procedures (see Ambrose 1990; Tykot 2004). First, contaminants were removed from approximately 1-2 g of mechanically cleaned rib from each individual through a multi-step chemical cleaning procedure. Samples were sequentially treated with Millipore water, 95% ethanol, 100% ethanol, and acetone, and were placed in an ultrasonic bath for 5 minutes submerged in each chemical. The bone samples were then placed in the oven to dry at 50˚C for one hour.

Samples were treated with 0.25M hydrochloric acid in order to dissolve the hydroxyapatite component of the bone, thereby isolating the organic component for analysis. Samples remained submerged in hydrochloric acid until the demineralization process was complete, a period of time between two and six weeks depending on the state of preservation of the sample. During this time, the hydrochloric acid was decanted from the samples every 48 hours and replaced with new hydrochloric acid. Once demineralization was complete, samples were rinsed with Millipore water and treated with 0.125 M sodium hydroxide for a period of 24 hours in order to remove any remaining contaminant humic substances.

Bone collagen was extracted through high-temperature solubilization in hydrochloric acid. Samples were submerged in a pH 3 solution of hydrochloric acid and placed in the oven at 70-90˚C for a period of 24 hours, after which the hydrochloric acid containing dissolved collagen was transferred to a Teflon beaker and new hydrochloric acid solution was introduced to the glass beaker containing the sample. This process was repeated a total of three times to completely solubilize the sample. The hydrochloric acid solution containing the dissolved collagen was dried down in the Teflon beaker and re-dissolved in 3.0 mL of pH 3 solution of hydrochloric acid before being transferred to a lidded glass vial. Samples were frozen overnight and freeze-dried using a Labconco FreeZone freeze-dryer.

Immediately prior to analysis, freeze-dried collagen samples were weighed into tin capsules for continuous flow combustion and isotopic analysis using a Delta Plus Mass Spectrometer coupled to a Costech Elemental Analyzer operated by N. Zolotova at the W.M. Keck Foundation Laboratory for Environmental Biogeochemistry at Arizona State University. The accuracy and reproducibility of analytical results were monitored by including several replicates of internal laboratory standards calibrated against NIST Standard Reference Materials USGS-40, USGS-41, IAEA-N-2, NBS-18, and NBS-19. The resulting carbon and nitrogen isotope values are expressed as a δ value, defined as δ (‰) = $[(R_{sample}/R_{standard})-1] * 1000$ (Coplen 1994). R is $^{13}C/^{12}C$ for carbon and $^{15}N/^{14}N$ for nitrogen, while the primary reference standards used to calculate the δ value are VPDB for carbon and N_2 in air for nitrogen. The long-term standard deviation of data produced at the W.M. Keck Foundation Laboratory at Arizona State University is +/- 0.2‰ for both $\delta^{13}C$ and $\delta^{15}N$.

Stable Carbon and Oxygen Isotopes from Carbonate

Bone and tooth enamel samples were prepared for carbonate analysis using standard procedures described in Koch et al. (1997). An approximately half-inch square fragment of each mechanically cleaned bone was ground with an agate mortar and pestle to produce a fine powder. Approximately 10 mg of bone powder or 15 mg of powdered tooth enamel were treated with 2% bleach for 24 hours in order to remove organic compounds from the sample, were rinsed thoroughly with Millipore water, then were treated with 0.1 M acetic acid for an additional 24 hours in order to remove diagenetic calcites. Following an additional rinsing step with Millipore water, samples were dried in the oven at 50˚C for 24 hours.

Isotopic analysis of these samples was performed on a Gasbench interfaced with a Delta V Advantage isotope ratio mass spectrometer (IRMS) at the Colorado Plateau Stable Isotope Laboratory at Northern Arizona University. Replicate analyses of international standards NBS-18 and NBS-19 were analyzed on the spectrometer throughout the sample run to monitor data quality. Oxygen isotope values ($\delta^{18}O$) are defined similarly to $\delta^{13}C$, though the ratio of $^{18}O/^{16}O$ is substituted for $^{13}C/^{12}C$. The precision of data produced at the Colorado Plateau Stable Isotope Laboratory at Northern Arizona University is demonstrated by duplicate analyses of NBS-18, NBS-19, and Joplin calcite on the Delta V Advantage spectrometer, which indicate a reproducibility of +/- 0.2‰ for both $\delta^{18}O$ and $\delta^{13}C$.

To facilitate comparison of the $\delta^{18}O_{carbonate\ (VPDB)}$ values produced in this study with the oxygen isotope values reported in previous studies of paleomobility at

Teotihuacan (Morales Puente et al. 2012; Spence et al. 2004; White et al. 1998, 2002, 2004a, 2004b, 2007), the data was converted into $\delta^{18}O_{phosphate\ (VSMOW)}$ values using the following conversion equations:

1) $\delta^{18}O_{carbonate\ (VSMOW)} = [1.03091 * (\delta^{18}O_{carbonate\ (VPDB)})] + 30.91$ (Coplen et al. 1983)
2) $\delta^{18}O_{phosphate\ (VSMOW)} = [0.98 * \delta^{18}O_{carbonate\ (VSMOW)}] - 8.5$ (Iacumin et al. 1996)

Additionally, because controlled feeding studies have demonstrated that the $\delta^{18}O_{carbonate\ (VSMOW)}$ values in tooth enamel apatite are systematically enriched by 1.7‰ relative to those in bone apatite (Warinner and Tuross 2009), tooth enamel $\delta^{18}O_{carbonate\ (VSMOW)}$ values were corrected for this enrichment prior to conversion into $\delta^{18}O_{phosphate\ (VSMOW)}$ values.

Major, Minor, and Trace Elemental Analysis

Strontium isotopes are present at trace levels in the mineral fraction of bone and are particularly subject to diagenetic alteration due to their low concentration within the bone structure (Budd et al. 2000; Lee-Thorp and Sponheimer 2003). Consequently, each sample analyzed for stable strontium isotopes was first screened for diagenetic contamination using major, minor, and trace elemental concentrations (see Kohn et al. 1999; Sillen 1989). Prior to analysis, a half-inch square section of each bone sample for stable and radiogenic strontium isotope analysis was chemically cleaned via a three-step procedure in an ultrasonic bath (Nielsen-Marsh and Hedges 2000b; Price et al. 1992;

Sillen 1989). Samples were first sonicated with Millipore water for a period of 30 minutes, followed by sonication in a 5% acetic acid solution for an additional 30 minutes and sonication for a second time in Millipore water for an additional 5 minutes. Bone samples were placed in the oven at 50˚C overnight to dry. Dry bone samples were then placed in crucibles and ashed in a Thermo/Electron Lindberg Blue furnace at approximately 800˚C for 10 hours to remove all remaining organic content. These ashed bone samples were crushed into a fine powder using an agate mortar and pestle.

Approximately 3 mg of bone ash or powdered tooth enamel were dissolved in 0.5 mL of trace-metal grade concentrated (15.5-16 M) nitric acid, which was then diluted to a final concentration of 2 M nitric acid with Millipore water to create a stock solution that would be used in both elemental analysis and strontium istope analysis. A 0.53 mL aliquot of this stock solution was then brought up to volume in a 15 mL centrifuge tube using 0.32 M nitric acid. Samples were analyzed on a Thermo X Series quadrupole inductively coupled plasma mass spectrometer (Q-ICP-MS) operated by G. Gordon at the W.M. Keck Foundation Laboratory for Environmental Biogeochemistry at Arizona State University. The accuracy and reproducibility of analytical results were monitored throughout the machine run by including samples of international standard NIST-1400 as well as internal laboratory standards interspersed with the archaeological samples.

Stable and Radiogenic Strontium Isotopes

The strontium content of all uncontaminated samples was isolated using the prepFAST-MC automated ion exchange chromatography system in the W.M. Keck

Foundation Laboratory for Environmental Biogeochemistry using established procedures (Romaniello et al. 2015). For optimal chromatographic performance, samples loaded onto the prepFAST-MC should contain precisely 100 μg of calcium. The elemental concentration data produced during the analysis of major, minor, and trace elemental concentrations were used to calculate the volume of stock solution that should be prepared to load onto the prepFAST-MC for each sample in order to meet this calcium concentration requirement. In the trace-metal clean lab of the W.M. Keck Foundation Laboratory for Environmental Biogeochemistry, stock solution aliquots of the appropriate volume were diluted to a final volume of 1 mL using 2 M nitric acid and loaded onto the prepFAST-MC. Small aliquots of the sample were taken prior to and after loading of the sample onto the prepFAST-MC system in order to monitor the chemical recovery of strontium, or strontium yield, throughout the chromatography procedure, as isotope fractionation can occur during the procedure if insufficient strontium yield is obtained.

Following chromatographic separation of the strontium, samples were evaporated and heated overnight with concentrated distilled nitric acid and 30% hydrogen peroxide. This process was repeated twice in order to digest any residual organic compounds that had not been completely separated during the chromatographic process. Finally, samples were evaporated and redissolved in 0.32 M nitric acid. Pre- and Post-column aliquots were analyzed for strontium concentration on a Thermo X Series quadrupole inductively coupled plasma mass spectrometer (Q-ICP-MS) operated by G. Gordon at the W.M. Keck Foundation Laboratory for Environmental Biogeochemistry at Arizona State University. The accuracy and reproducibility of analytical results were monitored throughout the machine run by including samples of international standard NIST-1400 as well as internal laboratory standards interspersed with the archaeological samples. Samples were analyzed for stable strontium isotope ratios using sample-standard bracketing on a Thermo Neptune multicollector inductively coupled plasma mass spectrometer (MC-ICP-MS) operated by G. Gordon at the W.M. Keck Foundation Laboratory for Environmental Biogeochemistry at Arizona State University. At Arizona State University, MC-ICP-MS analysis of international standard SRM-987 produced 87Sr/86Sr = 0.710265 +/- 0.000010 (2σ, n=25), comparable to published values of 87Sr/86Sr = 0.710263 +/- 0.000016 (2σ) (Stein et al. 1997).

CHAPTER 7: ELEMENTAL AND ISOTOPIC RESULTS

As delineated in previous chapters, the isotopic data produced in this dissertation must be considered in multiple phases before it can be brought to bear on the question of socioeconomic mobility at Teotihuacan. First, I assess the quality of the underlying data to ensure that the isotopic values are biogenic values that are informative of human behavior rather than diagenetic values resulting from postburial chemical alteration. Then, I screen the bone and tooth samples to identify individuals who may have spent some portion of their lives in a geographic area outside of Teotihaucan. The paleodietary information contained in the bones and teeth of these individuals must be considered separately from that of local individuals in order to control for the possible effects of nonlocal residence on diet. Once I am able to distinguish a subset of individuals who appear to have lived in the local Teotihuacan area during both late childhood and adulthood, I then undertake the task of defining dietary variation among groups at Teotihuacan based on socioeconomic status, gender, age, ethnicity, and occupation. Finally, I compare diet between different chronological points in the lives of single individuals to identify a single individual who appears to have experienced a change in socioeconomic status during his lifetime.

Data Quality

Because different forces result in diagenetic contamination in bone mineral as compared to bone collagen (Smith et al. 2007; Tütken and Vennemann 2011), distinctive measures are used to assess the preservation of biogenic isotope signals in each component of bone. Evidence of diagenetic contamination in one component does not preclude the possibility of well-preserved biogenic ratios in the other component.

Elemental Evidence of Contamination of Bone Mineral

Seven of the bone samples analyzed here demonstrate evidence of diagenetic contamination of the hydroxyapatite matrix. These seven samples all produced Ca/P values within the range of 1.2-1.3, well below the biogenic ratio of Ca/P = 2.15 (Sillen 1989). Consequently, these samples were removed from further analyses involving the mineral component of bone. Uranium concentrations are low for all samples, which is expected in enamel and bone that has not been diagenetically altered (cf. Kohn et al. 1999; Price et al. 2002). The highest ratio of U/Ca found among the samples was 1.8×10^{-4}, which is comparable to values considered acceptable by other authors (e.g. Price et al. 2002).

Collagen Yield

The atomic C/N value of all samples analyzed within the current project ranged from 2.9 to 3.1, well within the acceptable range of variation for well-preserved and uncontaminated human bone of 2.9-3.6 (Ambrose 1990; DeNiro 1985). The percent yield of bone collagen extracted from rib samples ranged from 2.3% to 14.7% by weight, with the exception of two low-yield samples (ACL-3069 TEO-LV224A and ACL-5356 TEO-

BO2TL1), which produced only 0.49% and 0.68% extracted collagen by weight, respectively. With the exception of these two samples, which were removed from the further analysis of collagen data, all other archaeological bone samples produced usable collagen exceeding the accepted minimum collagen concentration necessary for analysis of approximately 1.8% (Ambrose 1990).

Geographic Mobility within the Social Landscape of Teotihuacan

Any comparison of the dietary practices of individuals buried within residential contexts throughout the city must control for the possible effects of nonlocal residence on diet. This project used a combination of stable oxygen and radiogenic strontium isotopes to identify individuals who had lived outside of Teotihuacan area either during the period of time represented by their third molar or during a later portion of their adult life as represented by their somatic bone. Because this project did not analyze early forming teeth, the data reported here do not identify individuals who were born or spent early childhood outside of the Teotihuacan area. Instead, these data simply serve to identify individuals whose dietary isotope values reflect the consumption of nonlocal resources or water sources during some portion of that individual's late childhood or adult life.

Stable Oxygen Isotope Analysis

Defining a stable oxygen isotope baseline for a particular archaeological site can be difficult due to a number of factors that complicate the use of local water, faunal, or human bone samples to identify the full range of oxygen isotope values that should be expected among individuals drinking local water sources. Environmental change between the archaeological period of interest and the present day frequently means that oxygen isotope values in modern-day water sources may be different from those found in the same water sources in the past (Dansgaard 1964; Yurtsever and Gat 1981). Similarly, the extent of fractionation that occurs when oxygen isotopes from imbibed water are incorporated into mammalian skeletal tissues depends in part on body size (Bryant and Froelich 1995; Kohn 1996; Kohn et al. 1996), meaning that oxygen isotope values in local microfauna would be expected to differ from those seen in human bones. Even direct analysis of a sample of human individuals interred at a particular site may not be fully representative of the oxygen isotope variation expected amongst individuals drinking local water sources if different residents of a particular site exploit multiple water sources with different evaporative histories or engage in cultural practices such as water storage or boiling, which can be expected to alter the oxygen isotope content of imbibed water (Knudson 2009).

The majority of publications using oxygen isotope information to study residential mobility at Teotihuacan involve data produced in the University of Western Ontario isotope laboratory (Spence et al. 2004; White et al. 1998, 2002, 2004a,b), which has defined a local range in $\delta^{18}O_{phosphate\ (VSMOW)}$ of 14-16‰ based on the analysis of archaeological human skeletal remains from 11 individuals interred in the Tlajinga 33 compound. Modern water samples from the Basin of Mexico produce a similar range of $\delta^{18}O_{phosphate\ (VSMOW)}$ of 13.8-16.0‰ (Morales Puente et al. 2012). However, the possibility exists that this baseline, derived from the analysis of a single residential group, may underestimate the local range of variability in oxygen isotope values observed among an entire city of individuals who likely exploited diverse water sources ranging from collected rainwater, river water from the Rios San Juan and San Lorenzo, and water from natural spring sources near the city.

Due to the fact that interlaboratory differences in sample preparation techniques and instrumentation can affect oxygen isotope data (Knudson et al. 2014; Pestle et al. 2014), the oxygen isotope values produced in this dissertation are not directly equivalent to $\delta^{18}O_{phosphate\ (VSMOW)}$ data produced at the University of Western Ontario. However, several individuals from the Feathered Serpent Pyramid who were included in this dissertation have previously been analyzed for oxygen isotope composition in the University of Western Ontario (White et al. 2002), allowing direct comparison of the oxygen isotope values from the Colorado Plateau Stable Isotope Laboratory at Northern Arizona University to those produced at the University of Western Ontario. Interlaboratory comparisons suggest that the oxygen isotope values produced at the University of Western Ontario are almost always higher than those produced at Northern Arizona University. This relationship can be seen in Figure 7.1, where nearly all data points fall above a 1:1 identity line. However, while there is an approximately linear relationship between the data produced in both laboratories (Figure 7.1), the fit of a linear model between the two data sets (R^2=0.32) is not strong enough to suggest a clear calibration between them.

Consequently, I rely on the Meaningful Minimum Difference (MMD) value of 3.1‰ in order to define a local range that can be applied to the oxygen isotope values produced in this dissertation. Based on an extensive study of interlaboratory variation in

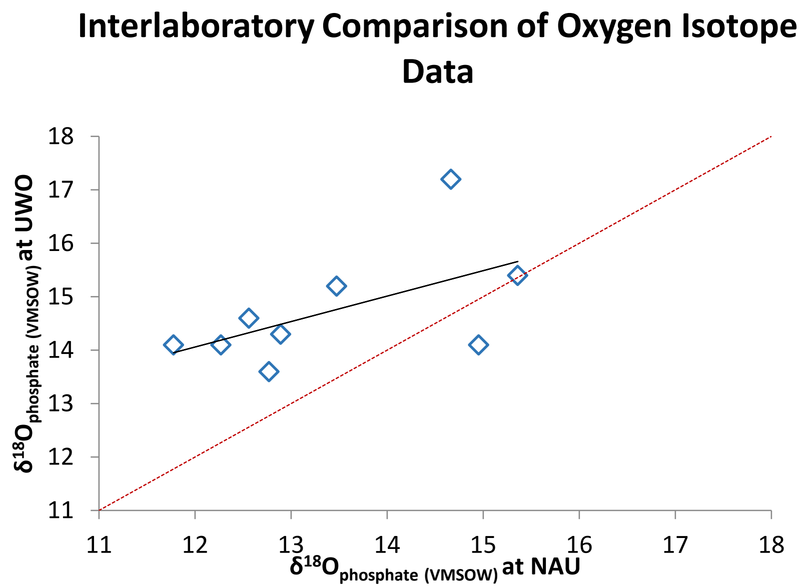

Figure 7.1 Comparison of oxygen isotope data produced at the University of Western Ontario and at Northern Arizona University. The dashed red line represents a 1:1 identity line, while the solid black line is the regression line relating the two data sets.

oxygen isotope values, Pestle et al. (2014) suggest that differences between values produced in different labs that exceed the MMD value can be reasonably assumed to be archaeologically meaningful, rather than a product of interlaboratory error. Because the oxygen isotope values produced at Northern Arizona University are systematically lower than those produced at the University of Western Ontario, I apply this MMD correction only to the lower end of the suggested local range of 14-16‰, to produce a range of 10.9-16‰ that will be tentatively considered to represent local values within the Northern Arizona University data set. While the use of this broad range may underestimate the number of individuals featuring nonlocal oxygen isotope values in their bones and teeth, it does allow for the detection of clear outliers within the data set (Figure 7.2).

Using this range as representative of of local variation, two individuals stand out as having distinctively nonlocal oxygen isotope values in their somatic bone. An individual interred in the Feathered Serpent Pyramid (ACL-2879 TEO-PTQ11A) and another interred in the Zacuala compound (ACL-5196 TEO-ZAC4) both appear to have spent some portion of their adult lives living outside of the local Teotihuacan area. All dental enamel samples produced oxygen isotope values within the local range.

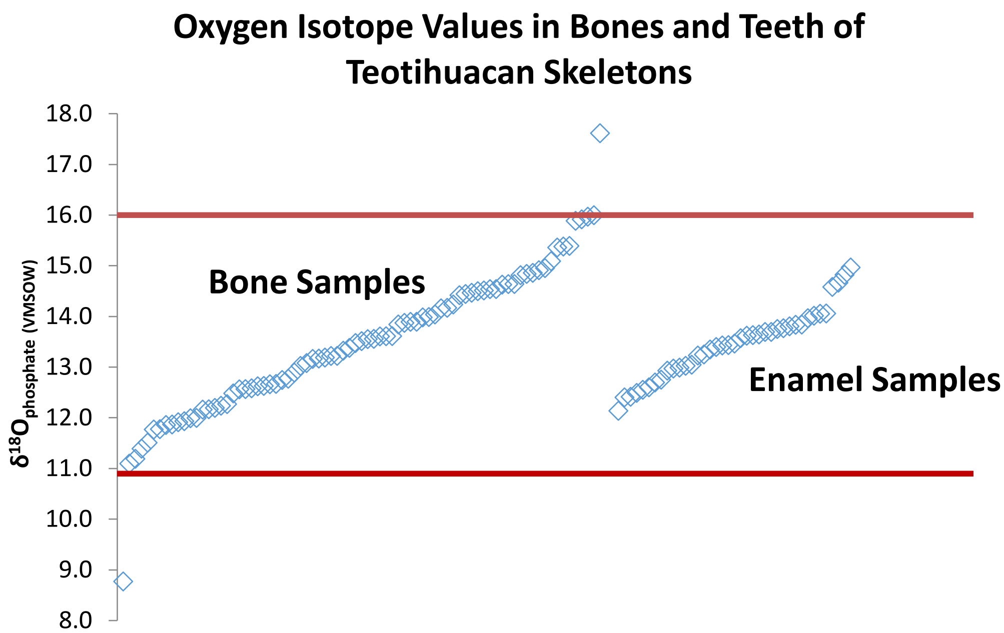

Figure 7.2 Oxygen isotope values derived from the analysis of 74 bone samples and 39 enamel samples from Teotihuacan. The red lines indicate the δ18O range of 10.9-16‰ used to represent local values in this dissertation. Within each tissue type, cases are ordered along the x-axis on the basis of the magnitude of observed δ18O values.

Radiogenic Strontium Isotope Analysis

In an urban context, interpretation of the strontium data pertaining to place of residence is complicated by the fact that some local individuals may have been consuming imported foodstuffs. As reviewed in Chapter 5, estimates of Teotihuacan's population and of arable land in the Teotihuacan Valley suggest that some proportion of the staple foods consumed by residents was obtained from areas further afield than the

Teotihuacan Valley itself. If this is the case, isotope values in bone that fall outside of the local Teotihuacan Valley baseline range could, but need not, indicate nonlocal residence. In order to distinguish nonlocal residence from the consumption of imported foodstuffs, it is important not only to consider isotope values in conjunction with established baseline data, but also to evaluate the sample independently in order to understand which values constitute normative and outlier values within the Teotihuacan population.

Baseline ranges of the strontium isotope values that we should expect to see in individuals living and consuming local resources in the Teotihucan Valley come primarily from the analysis of local faunal samples. Price et al. (2000) defined a local range of $^{87}Sr/^{86}Sr = 0.7046\text{-}0.7049$ for the Teotihuacan Valley based on the analysis of nine modern and archaeological rabbit bones from the site. Expanding the geographic perspective to the entire Basin of Mexico, Price et al. (2008) report a slightly broader local range of $^{87}Sr/^{86}Sr = 0.7046\text{-}0.7051$, based on the inter-quartile range of values found in analyses of local fauna and human dental enamel from archaeological contexts around the Basin. Due to the high likelihood of the exploitation of food or lake resources outside of the Valley of Teotihuacan proper, I consider the Basin of Mexico range to be a more appropriate baseline by which to define expected values for local Teotihuacanos consuming a typical diet. While areas immediately surrounding the Basin of Mexico have strontium isotope ranges similar to that of the Basin proper, several areas of Teotihuacan's "outer hinterland" (Cowgill 2015:135), including portions of Morelos, Hidalgo, Tlaxcala, and Puebla, feature slightly higher radiogenic strontium isotope values than the Basin proper (see Price et al. 2008). It is possible that imports of food products from some of these areas could have elevated the strontium isotope values in the bones of the consumers slightly above the Basin of Mexico range defined above.

In the absence of local biological or geological baselines, the generally accepted method for distinguishing local from nonlocal radiogenic strontium isotope values is to statistically analyze the $^{87}Sr/^{86}Sr$ values present in a sample. Price et al. (1994) suggest a cutoff of two standard deviations from the mean as a criterion for distinguishing migrants from locals, though other scholars have noted that the success of this approach may depend on both the proportion of migrants within the population and on local environmental variability in strontium isotope ratios (Wright 2005). Generally, however, it is assumed that strontium isotope variation within the bones and teeth of local residents will approximate a normal distribution, and Wright (2005) suggests applying the two-standard-deviations cutoff criterion to a trimmed data set that removes far outliers to more closely approximate a bell-shaped curve.

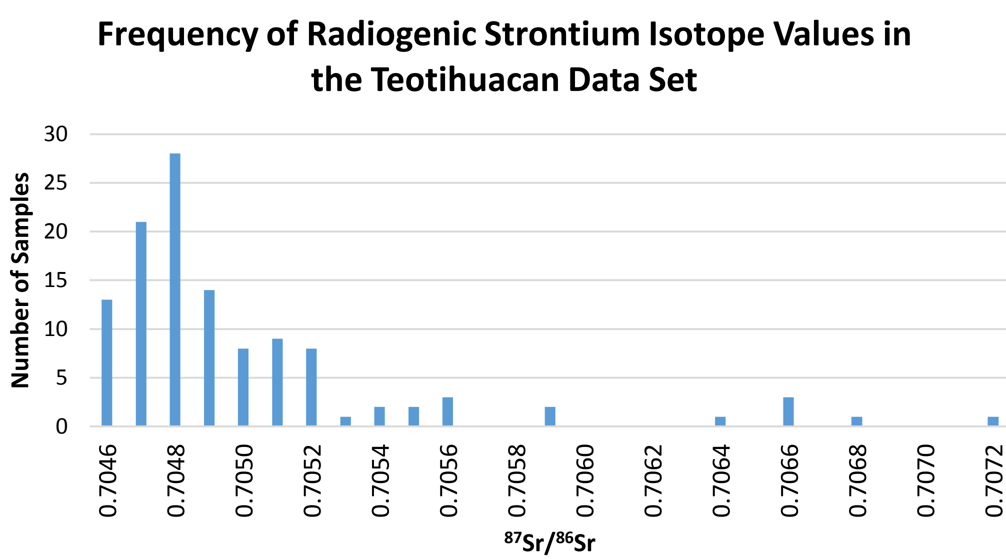

Figure 7.3 Distribution of different radiogenic strontium isotope values within the sample of 74 ribs and 34 teeth producing usable data.

The radiogenic strontium isotope values found amongst individuals sampled in this dissertation are roughly normally distributed with a long right skew that includes small numbers of individuals who featured bone or tooth enamel isotopic values that fall well outside of the local range of strontium isotope variation (Figure 7.3). In order to trim this data set to more closely resemble a normal distribution, I iteratively removed nineteen values from this right tail until the Kolmogorov-Smirnov statistic, indicating deviations of a sample distribution from a normal distribution, was reduced to statistical nonsignificance at an $\alpha=0.05$ level ($D=0.089$, df=96, p=0.06). This trimmed range of radiogenic strontium isotope values (0.7046 to 0.7052) approximates a normal distribution, though there is still a positive skew to the data (Figure 7.4). This distribution has a mean and median that are identical ($^{87}Sr/^{86}Sr=0.7048$), as would be expected in a normally distributed data set, and a standard deviation of 0.0002. The radiogenic strontium isotope value of $^{87}Sr/^{86}Sr=0.7052$ therefore falls just within two standard deviations of the mean within this trimmed data set.

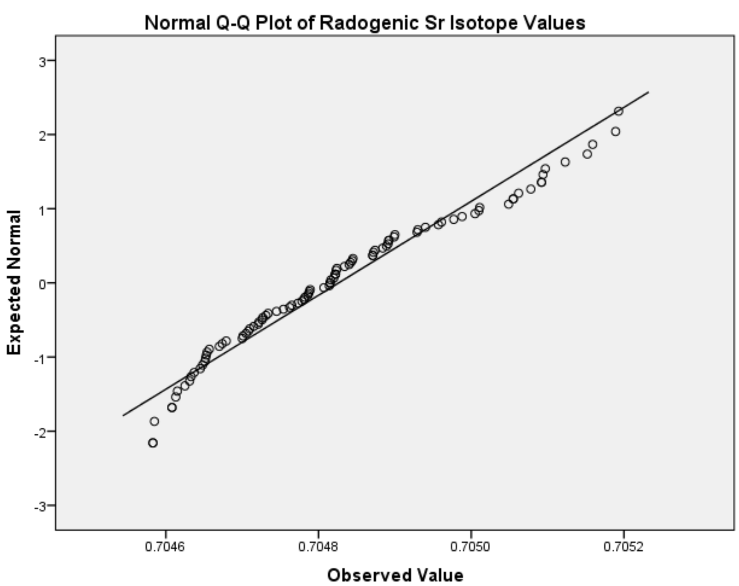

Figure 7.4 Normal probability (Q-Q) plot of the trimmed Teotihuacan data set.

Tung and Knudson (2011) suggest an additional method of defining local strontium isotope ranges based on the offset between consecutive, ranked values within a large sample. In this method, exploratory identification of particularly large differences between consecutive values is used to indicate breakpoints in the data set that differentiate local from nonlocal individuals. When all outliers eliminated using the previous method were returned to the data set, these large offsets appeared between the 103rd and 104th consecutive value within the data (Figure 7.5), which corresponds to the breakpoint between radiogenic strontium isotope values of 0.7052 and 0.7053.

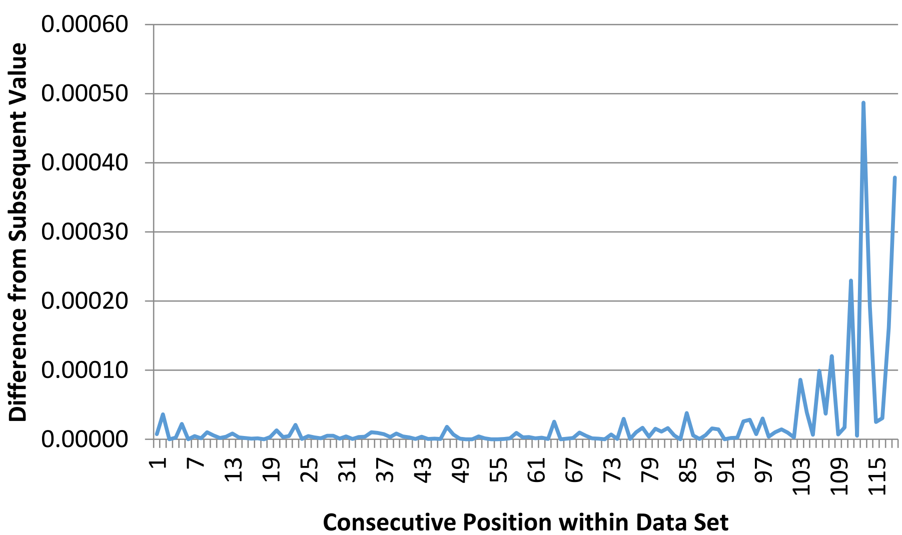

Figure 7.5 Offsets between consecutive radiogenic strontium isotope values within the Teotihuacan data set.

The local range suggested by both of these methods is 0.7046-0.7052, larger than the currently suggested baseline range for geological and biological materials from the Teotihuacan Valley of 0.7046-0.7049 (Price et al. 2000). It is important to note that values in this range are not unique within Mesoamerica, and there is some overlap in local range with the volcanic highlands of Guatemala ($^{87}Sr/^{86}Sr$ = 0.7043-0.7052) and with the Soconusco region of Chiapas ($^{87}Sr/^{86}Sr$ = 0.7046-0.7047) (Price et al. 2008). Immigrants from these geographic areas into Teotihuacan may not be detected through strontium isotope analysis alone.

Of the 74 rib samples producing biogenic bone mineral data, the majority fall within the range expected for long-term residence in the Basin of Mexico (Figure 7.6). Only two individuals display radiogenic strontium isotope values in their somatic bone that are outside of the local range. These individuals were both interred within the Oaxaca Barrio (ACL-5353 TEO-BO1TL1A and ACL-5360 TEO-BO2TL11) and display strontium isotope values above the local range. In stark contrast, a reasonable proportion

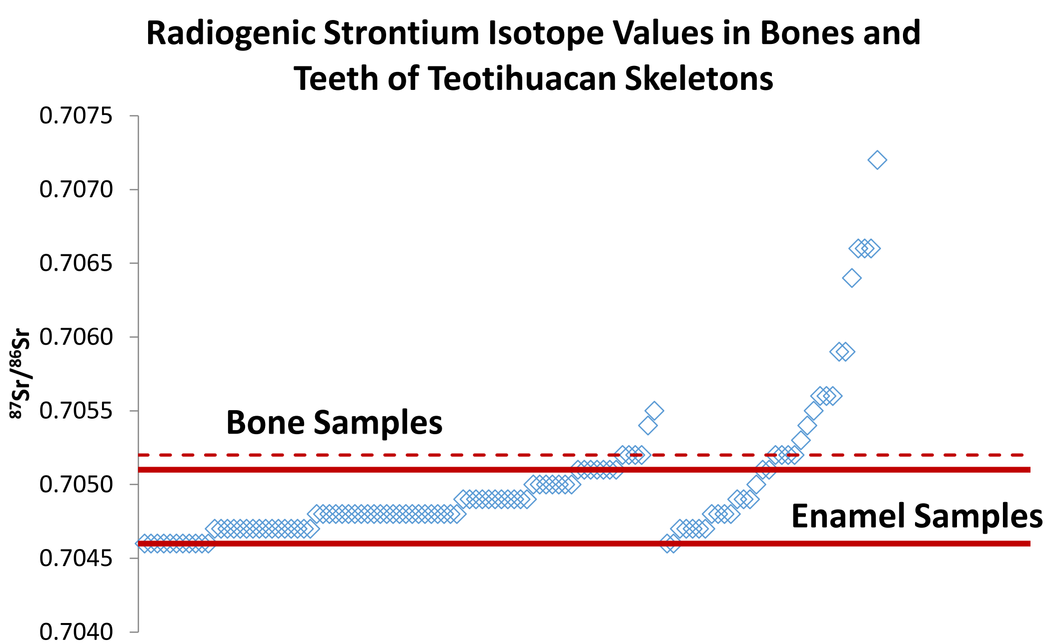

Figure 7.6 Radiogenic strontium isotope values derived from the derived from the analysis of 74 bone samples and 34 enamel samples from Teotihuacan. The solid lines represent the published baseline range for the Basin of Mexico (Price et al. 2008), while the dashed line extends the upper edge of this local range to include $^{87}Sr/^{86}Sr$=0.7052.

of the individuals for whom third molar samples could be obtained appear to have lived elsewhere in late childhood or early adolescence. Of 34 tooth samples analyzed, a full 13 display $^{87}Sr/^{86}Sr$ values outside of the local range. Of this 13, over half are individuals interred in the Oaxaca Barrio (see Table 7.1 below for full listing), while the remainder of the group consists of one individual from the La Ventilla B compound (ACL-5168 TEO-LVB75B), one individual from the Zacuala compound (ACL-5199 TEO-ZAC11), one individual from the Feathered Serpent Pyramid (ACL-2872 TEO-PTQ5D), and two individuals from the Conjunto Noroeste del Rio San Juan (ACL-5384 TEO-CN38 and ACL-5388 TEO-CN58).

Combining Radiogenic Strontium and Stable Oxygen Information

Because radiogenic strontium and stable oxygen provide different perspectives on geographic residence, it is necessary to combine the information from both to produce the best picture of residential mobility possible given the methodological limitations of both techniques. Table 7.1 presents a list of the individuals incorporated into this project who display either radiogenic strontium or stable oxygen evidence for nonlocal residence in either adolescence or adulthood. Two patterns stand out. First, joint consideration of strontium and oxygen isotope systems suggests that while nonlocal residence during late childhood or early adolescence was not uncommon amongst individuals buried at Teotihuacan, particularly for those interred in the Oaxaca Barrio, most individuals buried at the site had resided there for long periods during their adult life. Furthermore, the individuals who do display evidence for nonlocal residence during adulthood feature isotopic values in their teeth consistent with residence at Teotihucan earlier in their lives, though the small sample size of individuals displaying nonlocal values in their somatic bone is too small to know how generalizable this pattern may be. Second, in all cases identified here, nonlocal strontium isotope signatures in bone and teeth are not matched by nonlocal oxygen isotope signatures, and vice versa. This suggests that some of the areas to and from which people living in Teotihucan migrated were either geologically or hydrologically dissimilar from the Teotihucan area, but not both. The likely implication of this fact is that studies using only one or the other of the two isotope systems may be missing a good proportion of geographic mobility occurring amongst residents.

		Adolescence		**Adulthood**	
Context	**Sample Number**	$\delta^{16}O$	$^{87}Sr/^{86}Sr$	$\delta^{16}O$	$^{87}Sr/^{86}Sr$
FSP	TEO-PTQ11A	-	-	Nonlocal	Local
Zacuala	TEO-ZAC4	Local	Local	Nonlocal	Local
Oaxaca Barrio	TEO-BO1TL1A	Local	Local	Local	Nonlocal
Oaxaca Barrio	TEO-BO2TL11	Local	Local	Local	Nonlocal
FSP	TEO-PTQ5D	Local	Nonlocal	Local	Local
Oaxaca Barrio	TEO-BO21TL11	Local	Nonlocal	Local	Local
Oaxaca Barrio	TEO-BO5TL1	Local	Nonlocal	-	-
Oaxaca Barrio	TEO-BO2TL1	Local	Nonlocal	Local	Local
Oaxaca Barrio	TEO-BO20TL11	Local	Nonlocal	Local	Local
Oaxaca Barrio	TEO-BO10TL11	Local	Nonlocal	Local	Local
Oaxaca Barrio	TEO-BO3TL67	Local	Nonlocal	Local	Local
Oaxaca Barrio	TEO-BO4TL67	Local	Nonlocal	Local	Local
Oaxaca Barrio	TEO-BO41TL11	Local	Nonlocal	Local	Local
Conjunto NO	TEO-CN38	Local	Nonlocal	-	-
Conjunto NO	TEO-CN58	Local	Nonlocal	Local	Local
La Ventilla B	TEO-LVB75B	Local	Nonlocal	-	-
Zacuala	TEO-ZAC11	Local	Nonlocal	Local	Local

Table 7.1 Combined oxygen and strontium information about individuals displaying nonlocal residence during some proportion of their adolescent or adult lives.

The possible geographic locales where individuals displaying nonlocal isotope values in their bones or teeth may have spent time, along with implications for understanding residential mobility at Teotihuacan, are discussed in the following chapter. For now, this information is used simply to screen individuals for inclusion or exclusion from the analysis of paleodietary data. Individuals who display local radiogenic strontium and stable oxygen values in their somatic bone are included in the sample used to define normal adult dietary patterns based on socioeconomic status, sex, occupation, and ethnicity. This is true regardless of whether or not those same individuals displayed nonlocal isotope values in any paired teeth. Nonlocal isotope values in paired teeth are used only to exclude individuals from assessment of lifetime dietary change, since any differences in paleodietary isotopes between bone and tooth could be attributable to nonlocal residence during adolescence.

While it is possible that a person's identity as an immigrant may have caused people to maintain different dietary patterns than individuals born and raised locally, as mentioned previously, the data available in this dissertation does not bear directly on the birthplace of individuals included in the analysis. It is possible that individuals displaying evidence of nonlocal residence during adolescence may nevertheless have been born in Teotihuacan and simply spent some portion of their early life abroad before returning to their home city. Conversely, individuals who display local isotope signatures in their third molars may have been born in a completely different geographic locale but immigrated to the city prior to the calcification of the third molar crown. Therefore, while a shortcoming in the current analysis, the effect of a person's birthplace on their diet during their period of residence at Teotihuacan is not a topic that can be explored here.

Diet, Economics, and Identity in Teotihuacan Society

After screening for individuals who subsided on a nonlocal resource base during adulthood, it is now possible to discuss adult dietary patterns that correspond with economic and social distinctions within the Teotihuacan social landscape. This discussion is based exclusively on data from somatic bone samples, which most closely reflect adult diet in the years prior to death (though see discussion of bone turnover in Chapter 4). Because the power analysis performed in the previous chapter indicated that medium or smaller effect sizes will go unrecognized at the $\alpha=0.05$ significance level, I explore all patterns for which the *p* value for statistical significance is equal to or less than 0.1. However, my substantive interpretations are based primarily on those patterns in which the *p* value is less than 0.05.

As a supplement to statistical significance testing, I also report Cohen's *d* measures of effect size for all pairwise differences in means between groups. The Cohen's *d* statistic represents a standardized measure of the difference between two means, expressed relative to the size of the pooled standard deviation of the data (Cohen 1988, 1992). While statistical significance testing provides insight into how likely it is that observed differences between sample means could be produced through random processes, effect size measures instead give insight into the practical significance of differences between sample means in terms of the magnitude of these differences. I evaluate Cohen's *d* values against the standard benchmark values of 0.2 = small effect size, 0.5 = moderate effect size, and 0.8 = large effect size (Cohen 1988). All boxplots used to visualize data in this section were produced using SYSTAT Version 12. The box displays the median and interquartile range of the data, while the upper and lower whiskers indicate data that falls within 1.5 times the interquartile range from the upper or lower quartiles, respectively. Outliers outside of this range are indicated with an individual plotting symbol.

I first discuss differences in paleodietary isotope values between individuals in the high, middle, and low status groups defined in Chapter 6. As noted previously, the individuals interred within the Oaxaca Barrio are excluded from this initial analysis in order to control for the possible effect of ethnic identity on diet. I then distinguish socioeconomic dietary differences from those based on social characteristics such as gender, ethnicity, and subestate. A discussion of age-based dietary patterns is deferred to the next section, where I will incorporate enamel isotope data reflecting diet in early adolescence in order to distinguish typical and atypical age-based dietary changes and to identify an individual who may have changed socioeconomic groups at some point during his lifetime.

Diet and Socioeconomic Group

Carbon, nitrogen, and stable strontium isotope results are presented in Appendix 3. Perhaps unsurprisingly, carbon isotope results suggest that the adult diet of individuals interred in all residential contexts relied heavily both on C_4 or CAM plant products and on animal species fed C_4 or CAM-based foods. Stable isotope values from the entire set of somatic bone samples range from -6.3‰ to -10.4‰ for $\delta^{13}C_{collagen}$ and from -1.9‰ to -5.9‰ for $\delta^{13}C_{carbonate}$, values that are well within the range expected for individuals consuming a diet based primarily on C_4 or CAM inputs. In a bivariate plot of $\delta^{13}C_{collagen}$ against $\delta^{13}C_{carbonate}$ (Figure 7.7), individuals from all residential contexts cluster tightly around the upper end of the C_4/marine protein regression line (cf. Froehle et al. 2010; Kellner and Schoeninger 2007), a result that indicates that both dietary proteins and dietary energy sources (i.e., carbohydrates and lipids) are heavily based on C_4 or CAM

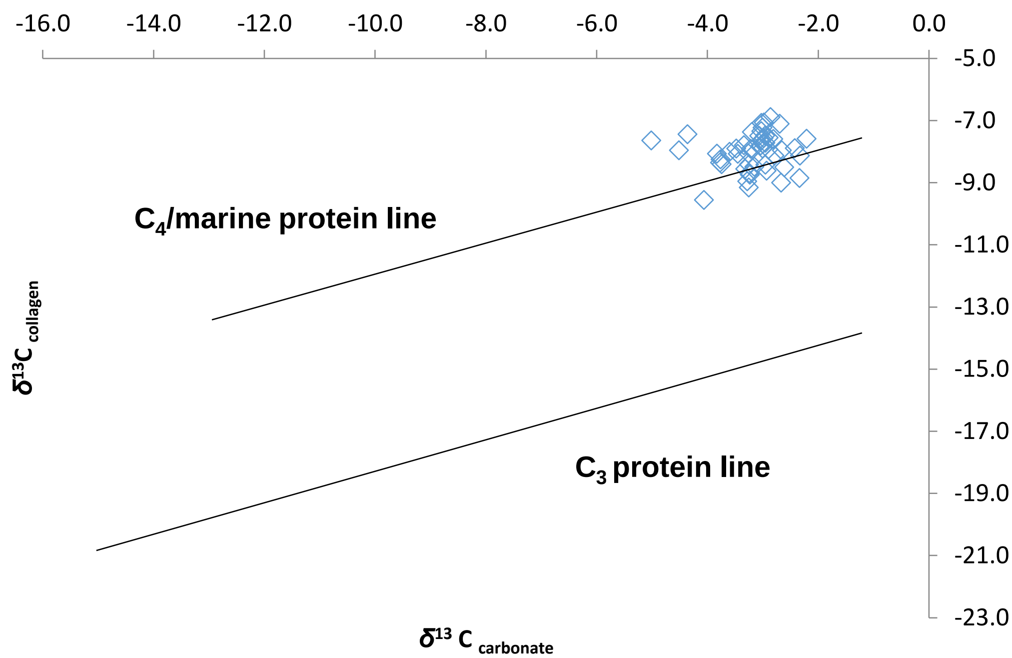

Figure 7.7 Carbonate and collagen carbon isotope variation across all status groups at Teotihucan. The regression lines, based on data from Froehle et al. (2010), incorporate an adjustment to the underlying carbon isotope data to reflect preindustrial atmospheric carbon levels.

sources. As in other highland Mexican contexts (see Warinner et al. 2013), the extensive overlap in the Teotihuacan Valley of the carbon isotope values characteristic of C_4 and CAM plants does not allow us to reliably distinguish between consumption of these two categories of plants using carbon isotope analysis (Lounejeva Baturina et al. 2006; Morales Puente et al. 2012). The overall dietary characteristics of the Teotihuacan population, particularly as compared to other geographic regions in Mesoamerica, are discussed more extensively in the next chapter.

First, issues of temporal control must be considered, as changes through time in the diets maintained by Teotihuacan's population could potentially confound intergroup comparisons of diet. Unfortunately, firm ceramic phasing information is available for relatively few of the burials included in this dissertation. However, the sample does include phased individuals who span the Tlamimilolpa (n=14), Xolalpan (n=14), and Metepec (n=4) ceramic phases. Comparing mean dietary isotope values between these three groups revealed no temporal trends in $\delta^{13}C_{carbonate}$ (one-way ANOVA, $F(2,24)=0.14$, $p=0.87$), $\delta^{13}C_{collagen}$ (one-way ANOVA, $F(2,29)=1.42$, $p=0.26$), $\delta^{15}N$ (one-way ANOVA, $F(2,29)=1.55$, $p=0.23$), or $\delta^{88}Sr/^{86}Sr$ (one-way ANOVA, $F(2,21)=0.49$, $p=0.62$) values that would suggest significant dietary change through time within the multi-phase samples from the residential sites.

Despite variability in the isotopic signatures observed among individuals interred within each archaeological status group, the groups differ chemically from each other in important ways. These differences are not of the same variety across the status hierarchy, however. Instead, diet differs between high and mid-status individuals in a way that is qualitatively different from the way in which diet differs between these two groups and the lowest-status members of the site.

As demonstrated by the boxplots in Figure 7.8, there are noticeable distinctions between members of different status groups in terms of total dietary carbon inputs, as reflected in $\delta^{13}C_{carbonate}$ values. Specifically, residents in the middle status category appear to have much more isotopically enriched median $\delta^{13}C_{carbonate}$ values as compared to either of the other status groups, which would suggest a greater average consumption of C_4 or CAM components to the diet. While it is important to note there is substantial overlap in $\delta^{13}C_{carbonate}$ values between each of the groups, the difference in means between groups is statistically significant at the $\alpha=0.05$ level (one-way ANOVA, $F(2,46)=8.11$, $p<0.01$), with the mean $\delta^{13}C_{carbonate}$ value of the middle status category ($\bar{x}$ = -3.0‰) significantly

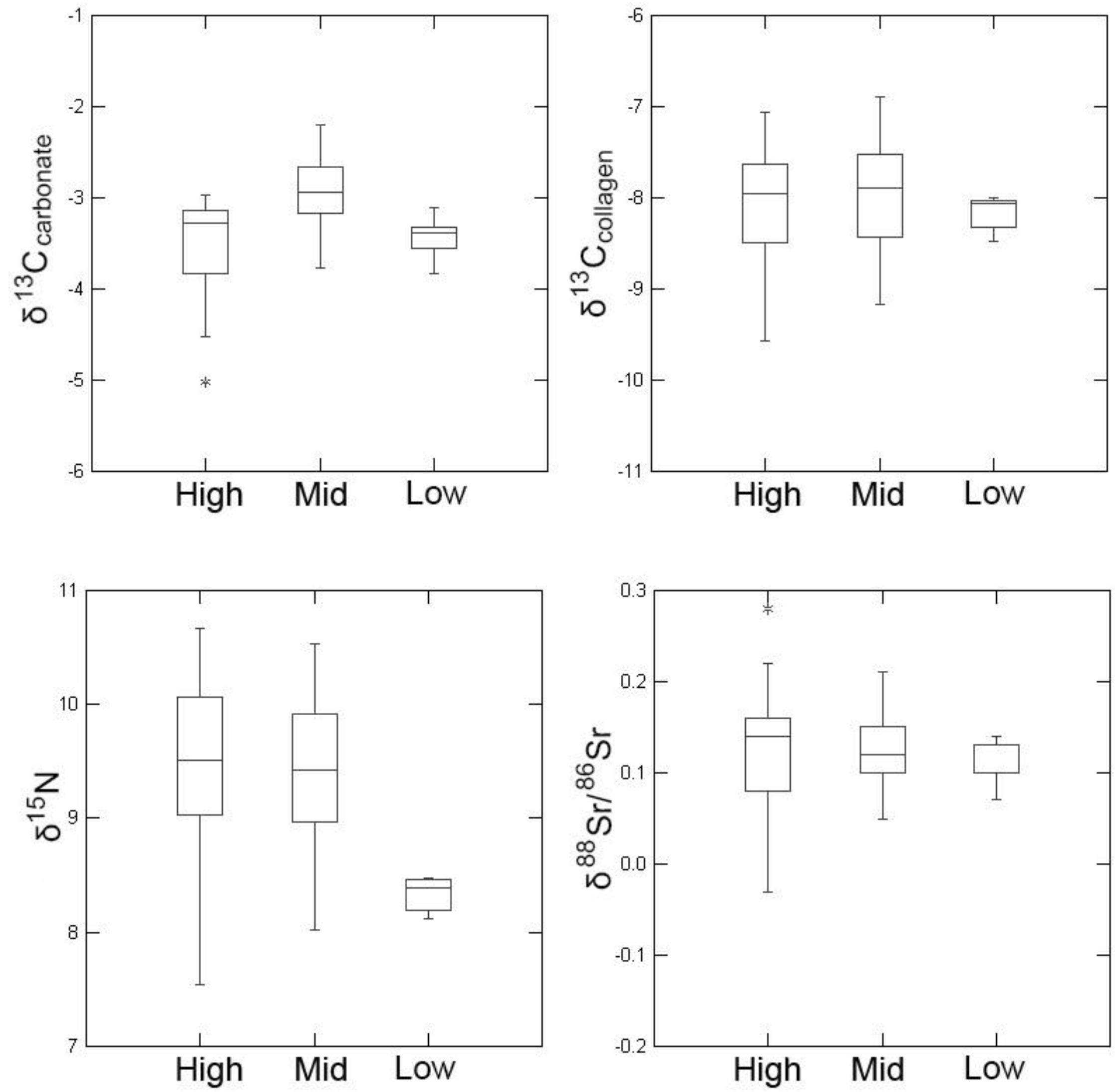

Figure 7.8 Carbon, nitrogen, and stable strontium isotopic variation between status groups. These and all following boxplots display the median and interquartile range of the data, while the upper and lower whiskers indicate data that falls within 1.5 times the interquartile range from the upper or lower quartiles, respectively. Outliers outside of this range are indicated with an individual plotting symbol.

higher than that of the high status sample ($\bar{x}$ = -3.5‰) (Tukey-Kramer, $p<0.01$). The pairwise Tukey-Kramer comparison between the mean $\delta^{13}C_{carbonate}$ values of the low status sample with the other two groups does not reach statistical significance at the $\alpha=0.05$ level, likely due to the small sample size (n=5) of this group (see Table 7.3). However, the very large effect size of differences in means between the mid and low status groups (Cohen's *d*=1.25) coupled with a relatively low p-value ($p=0.10$) may suggest that it may be reasonable to assume that the mean $\delta^{13}C_{carbonate}$ value of the mid status group is also meaningfully higher than that of the low status group ($\bar{x}$ = -3.4‰), as well. Because there are no statistically significant differences between groups in average $\delta^{13}C_{collagen}$ values (one-way ANOVA, $F(2,50)=0.65$, $p=0.53$), which most closely reflect the protein portion of the diet, it is likely that the underlying factor driving the differences between groups in $\delta^{13}C_{carbonate}$ values are differences in the species of low-protein plants and plant products being consumed by the middle status group as compared to the other two. Carbon isotope results therefore indicate that while residents of all socioeconomic status groups consumed isotopically similar animal species or other protein sources, individuals associated with both the high and low status groups appear to have supplemented their primarily maize or amaranth-based diet to a greater extent with wild or domesticated C_3 plant products than did individuals interred in a middle status grouping.

The low status group is distinguished from the others primarily on the basis of lowered animal protein consumption as reflected in $\delta^{15}N$ values (see Figure 7.8). There are statistically significant differences in $\delta^{15}N$ values between status groups (one-way ANOVA, $F(2,50)=5.55$, $p<0.01$), with the mean $\delta^{15}N$ value of the low status category

	$\delta^{13}C_{carbonate}$	$\delta^{13}C_{collagen}$	$\delta^{15}N$	$\delta^{88}Sr/^{86}Sr$
ANOVA p-value	**<0.01**	0.53	**<0.01**	0.79

Table 7.2 One-way ANOVA probabilities for difference of means between status groups.

	$\delta^{13}C_{carbonate}$			$\delta^{13}C_{collagen}$			$\delta^{15}N$			$\delta^{88}Sr/^{86}Sr$		
	High	Mid	Low	High	Mid	Low	High	Mid	Low	High	Mid	Low
High	-	-	-	-	-	-	-	-	-	-	-	-
Mid	**<0.01**	-	-	-	-	-	0.94	-	-	-	-	-
Low	0.94	**0.1**	-	-	-	-	**<0.01**	**<0.01**	-	-	-	-

Table 7.3 Tukey-Kramer probabilities for pairwise differences in means between status groups.

	$\delta^{13}C_{carbonate}$			$\delta^{13}C_{collagen}$			$\delta^{15}N$			$\delta^{88}Sr/^{86}Sr$		
	High	Mid	Low	High	Mid	Low	High	Mid	Low	High	Mid	Low
High	-	-	-	-	-	-	-	-	-	-	-	-
Mid	**1.15**	-	-	0.22	-	-	0.10	-	-	0.04	-	-
Low	0.14	**1.25**	-	0.26	0.50	-	**1.56**	**1.67**	-	0.24	0.50	-

Table 7.4 Cohen's *d* effect sizes for pairwise differences in means between status groups

($\bar{x}$ = 8.3‰) significantly lower than that of both the high ($\bar{x}$ = 9.5‰) and middle status ($\bar{x}$ = 9.4‰) samples (see Table 7.3). The very high effect size of these differences in mean $\delta^{15}N$ values also speaks to the behavioral significance of this difference (Table 7.4). Interestingly, despite the trophic level differences among adults highlighted by nitrogen isotope differences between status groups, stable strontium isotope data does not demonstrate the same pattern. There are no statistically significant differences in mean $\delta^{88}Sr/^{86}Sr$ values between high, middle, and low status groups (one-way ANOVA, $F(2,42)=0.24$, $p=0.79$), despite the expectation that differences in levels of animal food consumption should also have been reflected in this isotope system. This similarity in central tendency between status groups can also be seen in Figure 7.8.

There are several potential reasons why nitrogen and stable strontium istope systems provide conflicting information regarding animal food consumption and socioeconomic status. First, while there is a general expectation that strontium isotope values should fractionate with changes in trophic level within a single geologic region, the specific stable strontium isotope values in foodwebs can differ geographically (de Souza et al. 2010; Halicz et al. 2008). Without a stable strontium isotope baseline for the Basin of Mexico, the expected isotopic differences for individuals following different dietary patterns are unknown, particularly when imported foods may be incorporated into the diets of some or all individuals.

Second, the differences between nitrogen and stable strontium isotope results may be related to the different chemical behavior of these two elements. Because high-calcium food sources will provide a disproportionate amount of an individual's dietary strontium (see discussion in Chapter 4), strontium isotope values may preferentially reflect the consumption of high-calcium animal foods while nitrogen isotope differences provide a more balanced perspective on the consumption of all animal food products, regardless of calcium content. While this suggestion has yet to be systematically tested through controlled feeding experiments, it may be possible to speculate that in the case of Teotihuacan, the reduced animal food consumption in the low status group, as detected in the nitrogen isotope system, related primarily to differences between groups in the consumption of lower-calcium animal products such as eggs and the meat of terrestrial animals such as deer, rabbit, or dog. However, the lack of similar differences in the stable strontium isotope system may mean that there were no differences between groups in the average consumption of higher-calcium animal food sources, such as small lake fish that may have been eaten whole, along with their calcium-rich skeletons (Avila Serratos 2012; Munoz Zurita 2012:385).

Figure 7.8 demonstrates that while the medians of each status group are similar, there are differences in the range of variation of stable strontium isotope values within each group. Particularly, the variability in stable strontium isotope values appears to increase with rising socioeconomic status. While the low range of variability observed within the low status group may simply be a product of small sample size, the same cannot be argued for the differences in variability between the high and medium status groups, which have very similar sample sizes. Indeed, the variances of the high and middle status groups are significantly different at the $\alpha=0.05$ level (Lavene's test, $F(15,23)=3.94$, $p<0.01$), with greater variability found within the high status group. While caution must be exercised due to the uncertain relationship between different food sources and stable strontium isotope values in the Central Mexican foodweb, it may be the case that while while average levels of high-calcium animal food consumption did not vary much between high and middle status groups, certain individuals within the high status group had at their disposal a greater variety of food sources from which they could choose according to personal preference and other social identity concerns. An alternative interpretation could be that residents of higher-status compounds had greater access to nonlocal food sources, which may have featured different stable strontium isotope values from local foods, even if the broad types of foods consumed were the same.

To summarize, combinations of carbon and nitrogen isotope data serve to distinguish socioeconomic status groups from one another. When compared to the high status group, moderate status individuals have significantly higher $\delta^{13}C_{carbonate}$ values but similar $\delta^{15}N$ values, suggesting greater reliance on C_4 or CAM carbohydrate sources despite similar overall levels of consumption of animal protein resources. Low status individuals have reduced animal protein consumption as measured by statistically significant differences in $\delta^{15}N$ values, but they have $\delta^{13}C_{carbonate}$ values similar to those found among high status individuals, suggesting greater supplementation of diet with C_3 carbohydrates among both lower and higher status individuals as compared to individuals of intermediate status. In a central Mexican context, C_3 plants include most potential food sources other than maize, amaranth, and cactus products, including foods such as squash, husk tomatoes, chili peppers, or *quelites*. It is not possible to speculate from the isotopic data alone, however, which specific C_3 food resources were consumed in different relative quantities among different status groups at Teotihuacan.

Despite these differences, other aspects of the diet of individuals in these three group did not differ. The similar $\delta^{13}C_{collagen}$ values seen in all three groups suggest that dietary protein was similarly based on C_4 or CAM foods, or on animals fed on C_4 or CAM foods. Similarities in the mean $\delta^{88}Sr/^{86}Sr$ values among groups, while difficult to interpret without baseline data for the region, may suggest that there were no meaningful differences in the level of consumption of calcium-rich animal protein sources such as lake fish. Extremely high or low values in the stable strontium isotope system may, however, be characteristic of a high-status diet, where individuals may have had access to certain food sources not available to others.

Diet and Social Identities: Gender

The inference of gendered dietary practices from sexed skeletal remains is complicated by the imperfect correspondence between sex, based on biological differences between males and females, and gender, the culturally specific concepts and identities that serve to organize and interpret this sexual difference (Conkey and Spector 1984; Gilchrist 1999:1). Unfortunately, only biological sex is accessible to the skeletal analyst. Some scholars (e.g., Geller 2005) have voiced concern that the investigation of gender based on the dichotomous osteological estimation of sex may overlook fluidity in gender identity and may prevent the recognition of individuals whose gender identity does not correspond with their biological sex as expected from a Western perspective. However, though the investigation of sex-based patterns within the mortuary record almost certainly homogenizes variation within a gender system, it may nevertheless provide insights into normative gender paradigms, as consistent differences between the sexes in any particular context likely relate directly or indirectly to gender identity.

This dissertation uses comparisons of stable isotope values in male and female skeletons as a proxy for gender differences in diet while fully recognizing that gender is not a dichotomous variable, nor does it always correspond neatly with biological sex. It must be recognized that analyzing dietary patterns by sex could potentially mask certain gendered patterns in diet that do exist, particularly if these gender patterns are continuous rather than dichotomous in nature. However, a more nuanced approach to diet and gender is unfortunately outside of the scope of this dissertation project.

Due both to poor preservation of many skeletal remains at Teotihuacan and to the presence of individuals whose morphology cannot be confidently assessed as either male or female, the overall sexed sample (n=45) is smaller than the total sample of individuals incorporated into the socioeconomic-based discussion of diet (n=53), limiting the way in which the data can be partitioned when drawing sex-based comparisons within particular groups. As discussed in Chapter 4, previous research on gender at Teotihuacan has suggested that gender norms may have varied throughout Teotihuacan society (Clayton 2011). While the sample size of sexed individuals within individual compounds is too small to expect statistically meaningful patterns to emerge from intra-compound comparisons, sex-based comparisons can be drawn within middle and upper level status groups as well as between males and females across the sample as a whole. The small sample size of the low status group precludes a meaningful discussion of gendered dietary differences in this group.

Excluding for the moment individuals from the Oaxaca Barrio, there appear to be no statistically significant differences in mean $\delta^{15}N$ values (two-sample t-test, df=42, p=0.38), in mean $\delta^{88}Sr/^{86}Sr$ values (two-sample t-test, df=35, p=0.86), or in mean

$\delta^{13}C_{carbonate}$ values (two-sample t-test, df=39, p=0.32) throughout the sexed sample from all socioeconomic groupings (females, n=17; males, n=28). There are, however, statistically significant differences in mean $\delta^{13}C_{collagen}$ values between male ($\bar{x}$ = -7.8‰)

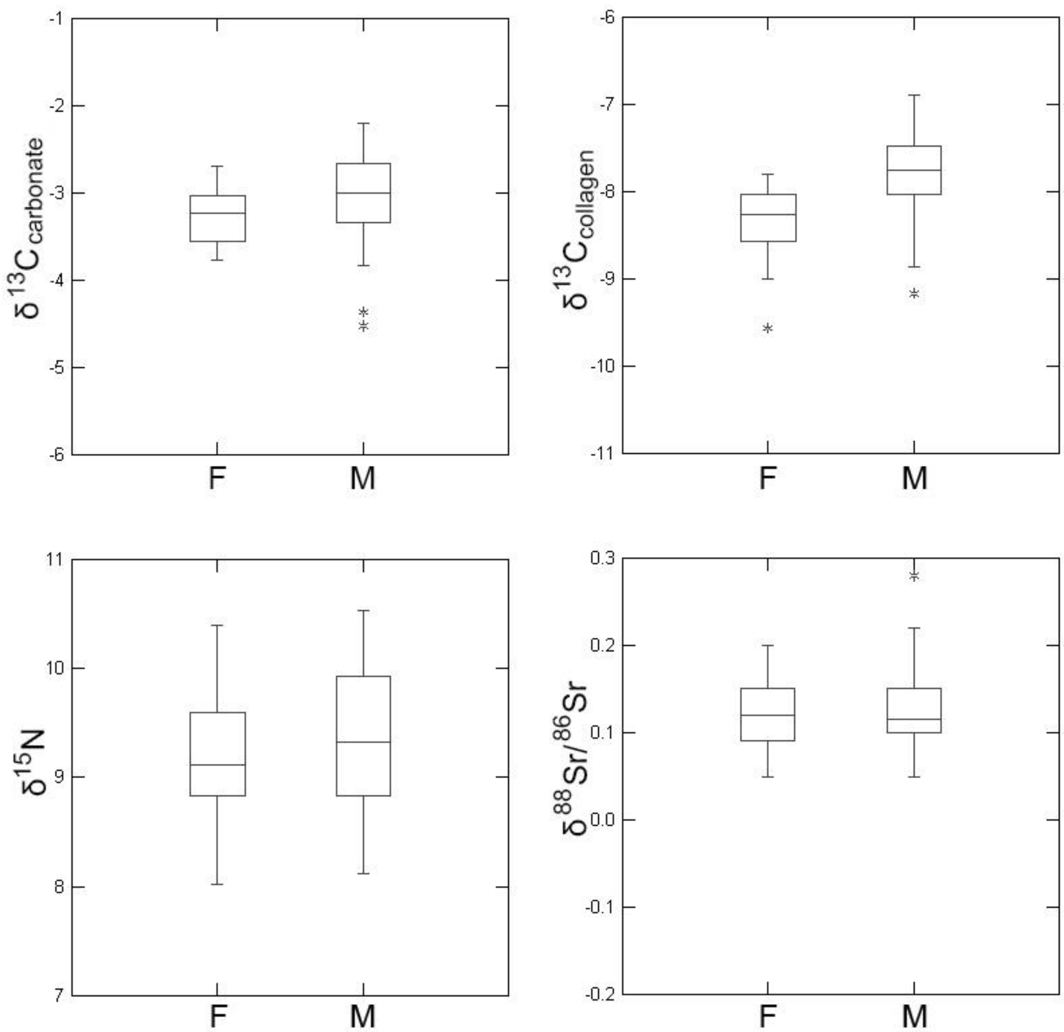

Figure 7.9 Carbon, nitrogen, and stable strontium isotope variation between males and females of all socioeconomic standings.

and female ($\bar{x}$ = -8.3‰) skeletons (two-sample t-test, df=42, p<0.01), with female skeletons showing a lower mean $\delta^{13}C_{collagen}$ value suggestive of a slightly greater proportion of carbon from protein sources coming ultimately from a C_3 source (though as mentioned previously, all individuals demonstrate carbon isotope values suggesting that the vast majority of carbon in both protein and carbohydrate portions of the diet came from C_4 or CAM sources) (Figure 7.9).

	$\delta^{13}C_{carbonate}$	$\delta^{13}C_{collagen}$	$\delta^{15}N$	$\delta^{88}Sr/^{86}Sr$
Pooled Status Groups	.32	**<.01**	.38	.86
High Status	.78	**.02**	.14	.50
Mid Status	**.02**	**.01**	.81	.42
Oaxaca Barrio	.99	**.06**	.72	.76

Table 7.5 Two-sample *t*-test probabilities for differences in means between males and females

	$\delta^{13}C_{carbonate}$	$\delta^{13}C_{collagen}$	$\delta^{15}N$	$\delta^{88}Sr/^{86}Sr$
Pooled Status Groups	0.33	**1.12**	0.28	0.06
High Status	0.17	**1.34**	**0.86**	0.46
Mid Status	**1.22**	**1.07**	0.10	0.40
Oaxaca Barrio	0.00	**1.29**	0.22	0.20

Table 7.6 Cohen's *d* effect sizes for differences in means between males and females

Separating skeletons by status group, additional sex-based patterns begin to emerge. Within the high status group, males (n=10) and females (n=5) continue to be distinguished based only on differences in $\delta^{13}C_{collagen}$ (two-sample t-test, df=13, p=0.02), with females ($\bar{x}$ = -8.5‰) displaying a significantly lower mean $\delta^{13}C_{collagen}$ value than males ($\bar{x}$ = -7.8‰). No differences observed in mean values for $\delta^{13}C_{carbonate}$ (two-sample t-test, df=11, p=0.77), $\delta^{15}N$ (two-sample t-test, df=13, p=0.14), or $\delta^{88}Sr/^{86}Sr$ (two-sample t-test, df=9, p=0.51) were statistically significant at the α=0.05 level. It may be worthwhile to note the large effect size (Cohen's *d* = 0.86) that characterizes the differences in mean $\delta^{15}N$ values between males ($\bar{x}$ = 9.6‰) and females ($\bar{x}$ = 9.1‰) in the high status group, in conjunction with a p-value that is relatively low (p=0.14) may suggest that lower animal food consumption among high-status females is a potential gendered dietary pattern within the high status that could be investigated further with larger sample sizes. However, even if this pattern does emerge as behaviorally meaninful in the future, the mean $\delta^{15}N$ values of high-status females still exceeds the mean value characteristic of the low status group ($\bar{x}$ = 8.3‰) (two-sample t-test, df=8, t=2.74, p=0.03) making it unlikely that lifetime dietary changes in animal protein consumption due to gendered dynamics in the high status would be mistaken for those due to movement into or out of the low status group.

Within the middle status group (males, n=16; females, n=11), females display not only lower mean $\delta^{13}C_{collagen}$ values ($\bar{x}$ = -8.3‰) as compared to males ($\bar{x}$ = -7.7‰) (two-sample t-test, df=24, p=0.01) but also statistically lower mean $\delta^{13}C_{carbonate}$ values ($\bar{x}$ = -3.2‰) as compared to males ($\bar{x}$ = -2.8‰) (two-sample t-test, df=23, p=0.02). Here again, no differences in mean values are statistically detectable in $\delta^{15}N$ values (two-sample t-test, df=24, p=0.81) or in $\delta^{88}Sr/^{86}Sr$ values (two-sample t-test, df=19, p=0.50). It appears that while broad similarities in gendered differences in diet exist regardless of socioeconomic standing in the types of proteins consumed by males as compared to females, gender may have been marked in a different way through diet for females in the middle status group as compared to in the upper economic levels of society.

I analyze the Oaxaca Barrio separately here because it has been hypothesized to have had differing gender ideologies from the remainder of Teotihuacan society based on mortuary patterns (Spence and Gamboa 1999). However, no statistically significant differences in mean $\delta^{13}C_{carbonate}$ values (two-sample t-test, df=9, p=0.99), $\delta^{15}N$ values (two-sample t-test, df=9, p=0.72), or $\delta^{88}Sr/^{86}Sr$ values (two-sample t-test, df=9, p=0.74) were observed within the Oaxaca Barrio sample. Like the general population living outside of the Oaxaca Barrio, females within the Oaxaca Barrio display lower mean $\delta^{13}C_{collagen}$ values ($\bar{x}$ = -8.0‰) as compared to their male counterparts ($\bar{x}$ = -7.3‰) (two-sample t-test, df=9, p=0.06). Though this difference is not statistically significant at the α=0.05 level, the probablility that this difference in means could have been produced through random processes is still quite small. I consider this difference likely to be behaviorally and statistically meaningful given the small sample sizes involved in this comparison (females, n=5; males, n=6) and the large effect size (Cohen's *d* = 1.29) documented for the difference between the means.

For the most part, gendered differences in diet are qualitatively different from those seen between socioeconomic groups. While males and females are distinguished primarily by differences in the collagen carbon isotope system, this system did not play a role in socioeconomic differentiation in diet, which instead manifested itself within the nitrogen and carbonate carbon isotope systems. However, additional dietary differences within specific status groups indicate that gender must be taken into consideration as a possible confounding factor in assessing social mobility processes into and out of these specific groups. Specifically, females within the middle socioeconomic group have a lower average $\delta^{13}C_{carbonate}$ value than males within their status group, and it is possible, though less certain, that females within the high status group may have been distinguished from males within their status group based on lower average $\delta^{15}N$ values.

Diet and Social Identities: Ethnicity

While several ethnic barrios are known within Teotihuacan, this dissertation explores ethnic differentiation in diet exclusively through the lens of the Oaxaca Barrio, also known as Tlailotlacan. While this limits understanding of the relationship between ethnicity and diet at the site, the approach was a practical necessity due to limitations on access to samples from other known ethnic barrios within the city. Because various archaeological indicators suggest a roughly intermediate socioeconomic level for most residents of Tlailotlacan, I compare the dietary information from the Tlailotlacan sample to that in the non-barrio resident intermediate status group in an attempt to isolate the effects of ethic differences in diet from those based on socioeconomic status.

Indeed, individuals interred within the Oaxaca Barrio show both carbonate carbon and nitrogen isotope values that are consistent with what would be expected based on membership in an intermediate status category as defined previously using only non-barrio resident individuals (Figure 7.10). No statistically significant differences are found between residents of the Oaxaca Barrio (n=13) and non-barrio members of the intermediate status group (n=29) in $\delta^{13}C_{carbonate}$ values (two-sample t-test, df=37, p=0.42) or in $\delta^{15}N$ values (two-sample t-test, df=38, p=0.59). While the mean $\delta^{13}C_{collagen}$ value is slightly higher among Oaxaca Barrio residents ($\bar{x}$ = -7.6‰) as compared to the non-barrio intermediate status sample ($\bar{x}$ = -7.9‰), the effect size of this difference is only moderate

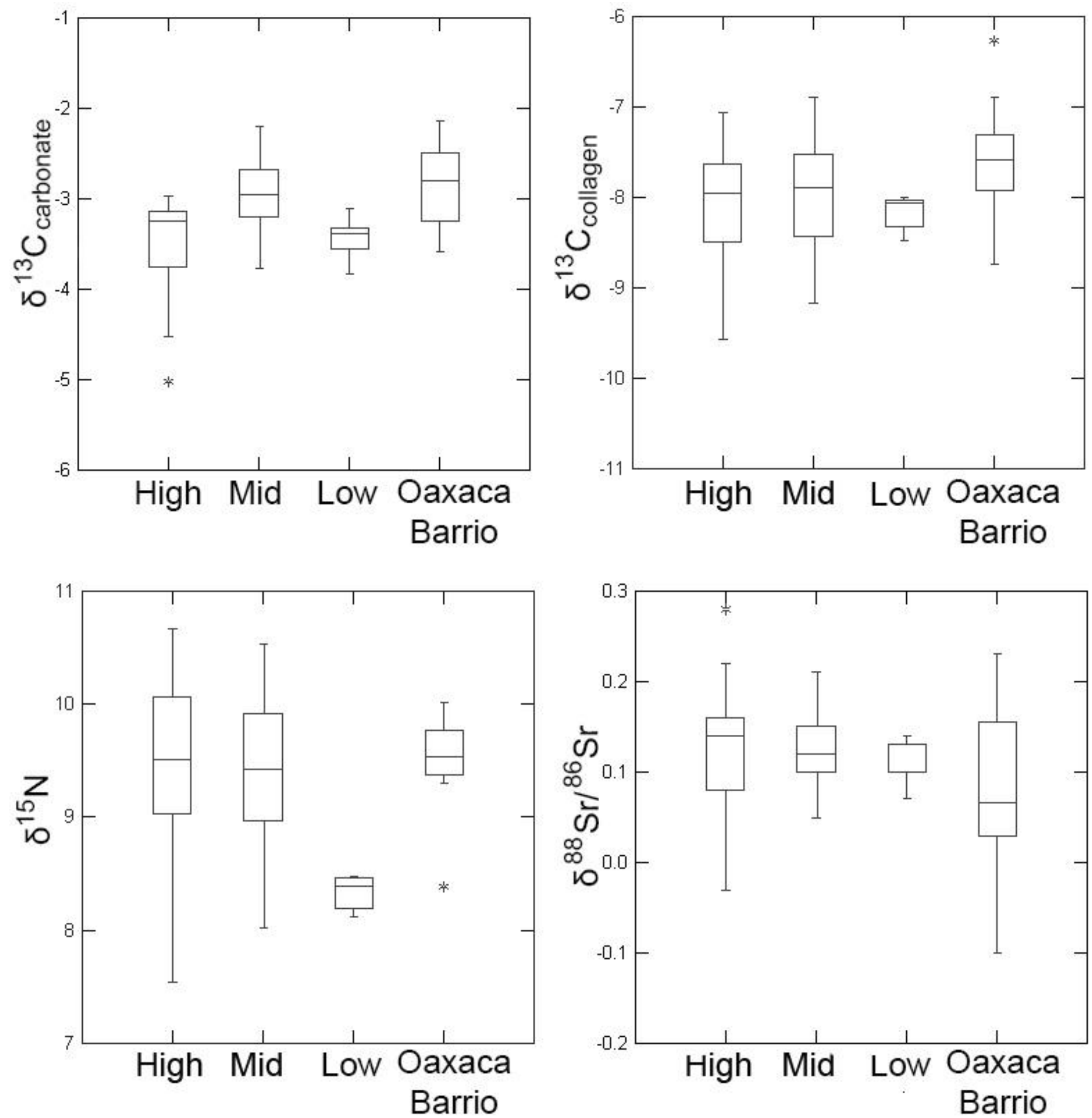

Figure 7.10 Carbon, nitrogen, and stable strontium isotope variation between the non-barrio residential status groups and the Oaxaca Barrio. Note the similarity in both carbonate carbon and nitrogen isotope values between the Oaxaca Barrio sample and the intermediate status sample.

(Cohen's *d*=0.56). While the low p-value of the difference in means (two-sample t-test, df=38, p=0.10) suggests that this difference is relatively unlikely to have occurred based on chance, the difference does not meet traditional scientific standards for statistical significance at the α=0.05 level. In my interpretations, I treat this difference as a possible behavioral pattern worthy of additional investigation, though not one that is as certain as other dietary differences between groups that have been shown to have both practical and statistical significance in the form of very large effect sizes and very low p-values.

	$\delta^{13}C_{carbonate}$	$\delta^{13}C_{collagen}$	$\delta^{15}N$	$\delta^{88}Sr/^{86}Sr$
p-value	0.42	**0.10**	0.59	**0.02**

Table 7.7 Two-sample *t*-test probabilities for differences in means between residents of the Oaxaca Barrio and members of the non-enclave resident middle status group.

	$\delta^{13}C_{carbonate}$	$\delta^{13}C_{collagen}$	$\delta^{15}N$	$\delta^{88}Sr/^{86}Sr$
Cohen's *d*	0.28	0.56	0.19	**0.87**

Table 7.8 Cohen's *d* effect sizes for differences in means between residents of the Oaxaca Barrio and members of the non-enclave resident middle status group

The clearest dietary difference separating the Oaxaca Barrio sample from non-barrio resident intermediate status individuals is evident in their stable strontium isotope values. Residents of the Oaxaca Barrio demonstrate a significantly lower mean $\delta^{88}Sr/^{86}Sr$ value ($\bar{x}$ = 0.07) compared to the intermediate status group ($\bar{x}$ = 0.13) (two-sample t-test, df=34, p=0.02). As discussed above, it is difficult to know exactly what aspect of diet is being reflected in these stable strontium isotope values without a comprehensive baseline for the Basin of Mexico. However, it may be reasonable to speculate that ethnic differences in diet are being expressed within the Oaxaca Barrio, at least in part based on greater reliance on calcium-rich animal protein resources such as lake fish. This ethnic difference in diet is of a qualitatively different nature than the socioeconomic dietary differences defined previously between either socioeconomic or gender groups, where no statistically significant differences in $\delta^{88}Sr/^{86}Sr$ values were found among different groups.

Diet and Subestate

The individuals who were sacrificed and interred in military garb beneath the Feathered Serpent Pyramid were incorporated into this dissertation project as potential representatives of a specialized social category based on economic activities. While there is scholarly diagreement regarding the interpretation of this group as members of the military or of an elite guard (see Chapter 6 for a review), I use a literal interpretation for the purposes of this dissertation. As we shall see, unique dietary patterns observed among these individuals is perhaps suggestive of the idea that these individuals may have belonged to a unique social category.

Because there are no specific status expectations for the individuals included within the Feathered Serpent Pyramid complex, which may have included individuals of varying ranks, I compare their paleodietary isotope values to those of each of the three status groups (Figure 7.11). No statistically significant differences between groups are detected in mean $\delta^{88}Sr/^{86}Sr$ values (one-way ANOVA, $F(3,52)=1.63$, $p=0.19$). While there are differences between groups in mean $\delta^{13}C_{carbonate}$ values (one-way ANOVA, $F(3,56)=3.36$, $p=0.03$), these differences appear to have been driven by the statistically significant difference in mean $\delta^{13}C_{carbonate}$ values between the mid and high status groups.

Pairwise Tukey-Kramer comparisons of the Feathered Serpent Pyramid sample with each of the three status groupings fails to identify any significant differences between the Feathered Serpent Pyramid sample and other groups in the carbonate carbon isotope system (see Table 7.10).

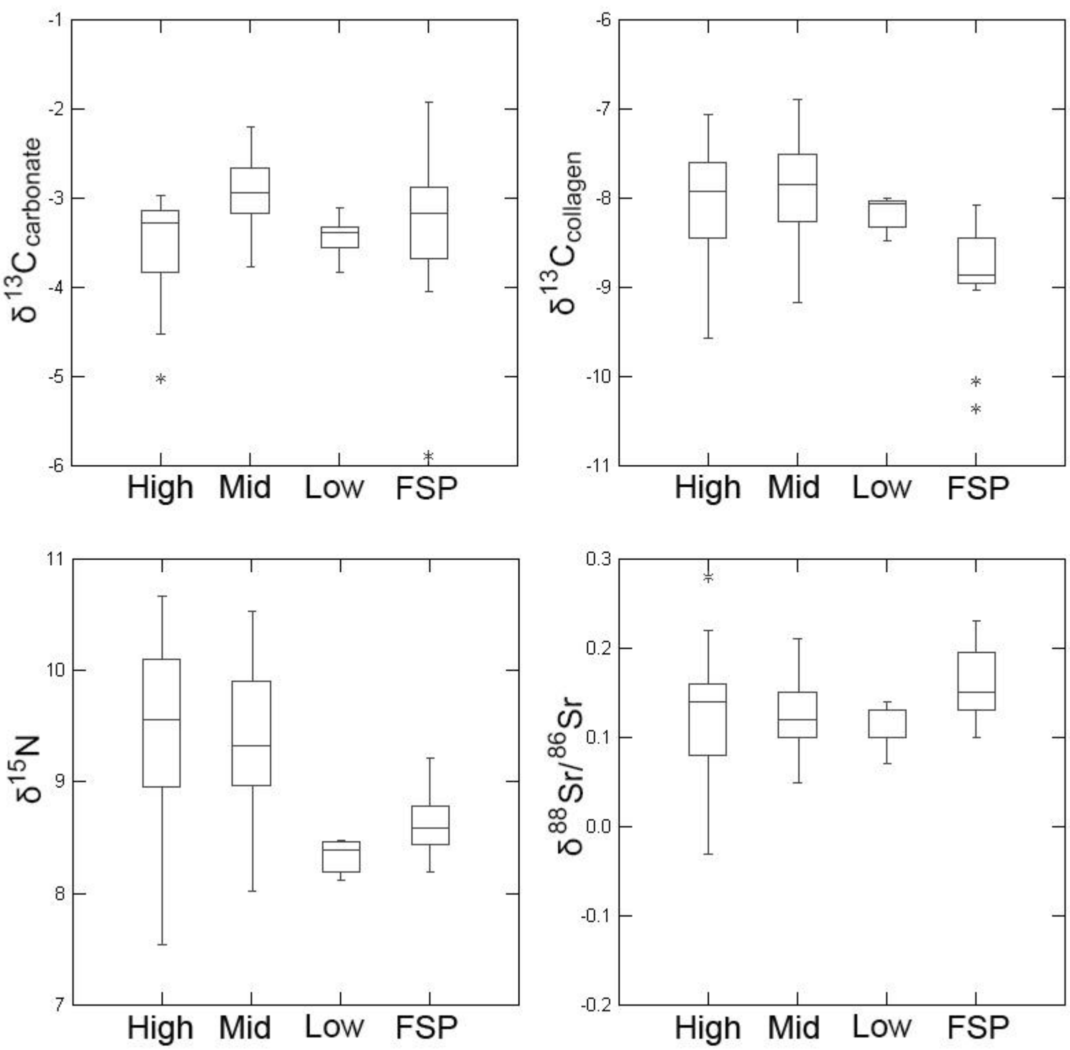

Figure 7.11 Carbon, nitrogen, and stable strontium isotopic variation between residential status groups and the Feathered Serpent Pyramid.

In contrast, the statistically significant difference between groups in mean $\delta^{15}N$ values (one-way ANOVA, F(3,60)=7.68, p<0.01) does appear to correspond with significantly lower $\delta^{15}N$ values in the Feathered Serpent Pyramid group (x̄ = 8.6‰) as compared to both the high (x̄ = 9.5‰) and mid-status (x̄ = 9.4‰) residential groups (see Table 7.10). The mean nitrogen isotope values of the individuals interred in the Feathered Serpent Pyramid does not differ significantly from that of the low status group (x̄ = 8.3‰) interred in the San José 520 site.

There is also a significant difference in mean $\delta^{13}C_{collagen}$ values between the Feathered Serpent Pyramid Sample and the residential sample. While comparisons among status groups (described above) failed to find significant differences in $\delta^{13}C_{collagen}$, including the Feathered Serpent Pyramid sample in the statistical analysis produced results that are statistically significant at the α = 0.05 level (one-way ANOVA, F(3,60)=7.63, p<0.01), with the Feathered Serpent Pyramid sample displaying significantly lower mean $\delta^{13}C_{collagen}$ values (x̄ = -8.9‰) than both high (x̄ = -8.0‰) and mid (x̄ = -7.9%) status groups (see Table 7.10). Here again, though the difference between the Feathered Serpent Pyramid and the low status sample (x̄ = -8.1‰) did not reach statistical significance at the α=0.05 level, the relatively low p-value (p=0.12) coupled with a very high effect size (Cohen's *d* = 1.19) of this difference suggests that it

	$\delta^{13}C_{carbonate}$	$\delta^{13}C_{collagen}$	$\delta^{15}N$	$\delta^{88}Sr/^{86}Sr$
ANOVA p-value	**0.03**	**<0.01**	**<0.01**	0.19

Table 7.9 ANOVA probabilities for difference of means between the Feathered Serpent Pyramid and three status groups.

	$\delta^{13}C_{carbonate}$			$\delta^{13}C_{collagen}$			$\delta^{15}N$			$\delta^{88}Sr/^{86}Sr$		
	High	Mid	Low	High	Mid	Low	High	Mid	Low	High	Mid	Low
High	-	-	-	-	-	-	-	-	-	-	-	-
Mid	**0.02**	-	-	0.87	-	-	0.98	-	-	-	-	-
Low	0.99	0.38	-	0.96	0.78	-	**<0.01**	**<0.01**	-	-	-	-
FSP	0.89	0.29	0.99	**<0.01**	**<0.01**	0.12	**<0.01**	**<0.01**	0.84	-	-	-

Table 7.10 Tukey-Kramer probabilities for pairwise differences in means between the Feathered Serpent Pyramid and three status groups.

	$\delta^{13}C_{carbonate}$			$\delta^{13}C_{collagen}$			$\delta^{15}N$			$\delta^{88}Sr/^{86}Sr$		
	High	Mid	Low	High	Mid	Low	High	Mid	Low	High	Mid	Low
High	-	-	-	-	-	-	-	-	-	-	-	-
Mid	**1.15**	-	-	0.22	-	-	0.10	-	-	0.04	-	-
Low	0.14	**1.25**	-	0.26	0.50	-	**1.56**	**1.67**	-	0.24	0.50	-
FSP	0.21	0.60	0.10	**1.35**	**1.61**	**1.19**	**1.25**	**1.27**	**1.01**	0.56	**0.85**	**1.31**

Table 7.11 Cohen's *d* effect sizes for pairwise differences in means between the Feathered Serpent Pyramid and three status groups

may be worth considering as a behaviorally meaningful difference between groups, albeit with less certainty than the other intergroup differences.

To summarize, while socioeconomic status differences in diet are reflected by variation between groups in the carbonate carbon and nitrogen isotope systems, dietary differences related to the aspects of social identity explored here are reflected primarily in other combinations of isotope systems. Gendered differences appear to be reflected primarily in carbon isotopes derived from bone collagen, though there does appear to be some gendered variation in carbonate carbon values within the middle status grouping. Ethnic differences in diet seen within the Oaxaca Barrio pertain to the stable stronium isotope system, rather than to either of the isotope systems involved in socioeconomic dietary differentiation. Finally, dietary differences related to a specialized military role appear to combine both collagen carbon and nitrogen isotope system simultaneously, unlike differences between socioeconomic groups, which involve only a single isotope system in each pairwise comparison between groups.

Dietary Change Through Life

Now that I have defined adult dietary patterns related to social and economic categories within the Teotihuacan social landscape, comparisons of tooth and bone values of $\delta^{13}C_{carbonate}$ and $\delta^{88}Sr/^{86}Sr$ can be carried out to investigate certain aspects of dietary change through life. A discussion of age-related effects on diet is naturally intertwined with this analysis, since any assessment of dietary change through life must distinguish between the normal changes in diet that occur with age and specialized dietary shifts that represent movement between social or economic groups.

To review, the middle socioeconomic group was differentiated from the others based on higher average $\delta^{13}C_{carbonate}$ values representing more intensive consumption of C_4 or CAM food resources than the other groups, while the lower socioeconomic group was differentiated from the others based on lower average $\delta^{15}N$ values representing lower consumption of animal-derived proteins than the other groups. Because carbon isotopes in carbonate are present in both somatic bone and tooth enamel, a comparison of the two can identify dietary shifts that may correspond with shifts in total carbon consumption that might be expected to accompany movement into and out of the middle socioeconomic group. Because nitrogen isotopes are not present in tooth enamel, however, they cannot directly be used to infer changes in animal protein consumption through life.

While this research program was designed under the assumption that the stable strontium isotopes present in tooth enamel could provide information about trophic level shifts through life, the results presented above unfortunately indicate that the information provided by stable strontium isotopes does not appear to correspond with the trophic level information provided by stable nitrogen isotopes in this geographic context. Average stable strontium isotope values did not differ between socioeconomic groups, and they consequently cannot be used to detect the shifts in animal protein consumption that might be expected with movement into and out of the lowest socioeconomic group. Therefore, while it may be possible to use carbonate carbon isotopic information 1) to detect an individual interred in a high-status context who started life in a moderate-status setting, or 2) to detect an individual interred in a moderate-status context who started life in a high-status group, it may not be possible to detect movement into or out of the lowest status group.

Additional difficulties are imposed by the fact that, while mean carbon isotope values in bone and tooth carbonate are distinct within the moderate status group as compared to the other two, the range of variation overlaps between each of the groups. Therefore, it is necessary to look for patterns in the amount of change a typical (presumably not socially mobile) individual can be expected to demonstrate throughout his or her lifetime. Outliers who experienced lifetime shifts in diet that vastly exceed the amount expected for a typical individual can be identified as possibly socially mobile individuals.

As reviewed in Chapter 4, comparisons of the carbon isotope values in tooth and bone carbonate must take into account the fact that there is a different diet-tissue offset for the two tissue types. Raw $\delta^{13}C_{carbonate}$ values in enamel were adjusted downward by 2.3‰ to account for this difference so that enamel values could be directly compared to the $\delta^{13}C_{carbonate}$ values in the bones of the same individuals (cf. Warinner and Tuross 2009). Adjusted enamel $\delta^{13}C_{carbonate}$ values can be found in Appendix 3.

Comparisons reflecting such tissue-type differences indicate that most of the 18 individuals who displayed local isotope values in bone and teeth and for whom paired bone-tooth samples could be sampled show very little difference in $\delta^{13}C_{carbonate}$ values between early adolescence and adult portions of the lifecourse (Figure 7.17). The average difference between bone and enamel $\delta^{13}C_{carbonate}$ values for the same individual is 0.25‰

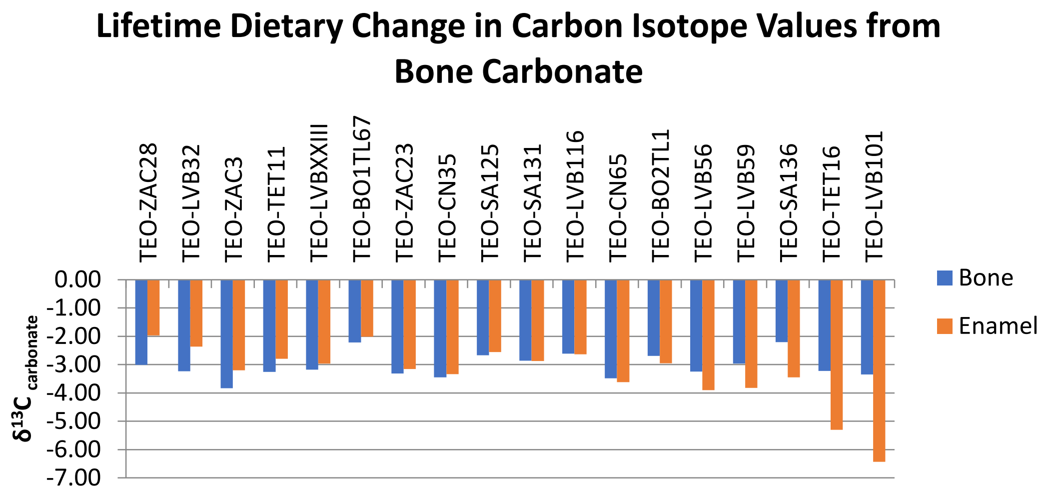

Figure 7.12 Carbon isotope values from bone and tooth carbonate of 18 individuals interred in Teotihucan. The $\delta^{13}C_{carbonate}$ values displayed incorporate a -2.3‰ adjustment to account for the different diet-tissue offsets between enamel and somatic bone.

(σ = 1.03‰). Although two individuals display shifts in $\delta^{13}C_{carbonate}$ values that exceed one standard deviation from the mean (TEO-TET16 and TEO-LVB101), only individual TEO-LVB 101 demonstrates a lifetime change in $\delta^{13}C_{carbonate}$ that exceeds two standard deviations from the mean. This individual, a male interred in the La Ventilla B compound, displays paleodietary isotope values typical for an intermediate status individual within his somatic bone. However, the adjusted $\delta^{13}C_{carbonate}$ value within his tooth enamel matches some of the more extreme $\delta^{13}C_{carbonate}$ values within the high status residential group. This individual displays the type of paleodietary shift that might be expected from an individual who had experienced downward socioeconomic mobility during his or her lifetime. A contextual discussion of this individual, including discussion of burial location and mortuary treatment, are presented in the next chapter.

While differences in average levels of animal food consumption did differentiate the diets of members of the low status group from the middle and high status groups, this effect was only captured in the nitrogen isotope system and not in the stable strontium isotope system. However, some interesting patterns emerged from bone-tooth comparisons within this isotope system that bear discussion here. Particularly, large differences in $\delta^{88}Sr/^{86}Sr$ values are observed between the dental enamel and bone of all individuals displaying local isotope values in both bone and tooth samples (Figure 7.18). All individuals for whom stable strontium isotope values could be measured in both tissue types show higher isotope values in bone samples as compared to corresponding tooth samples. In some cases, the differences between the two tissue types are quite extensive.

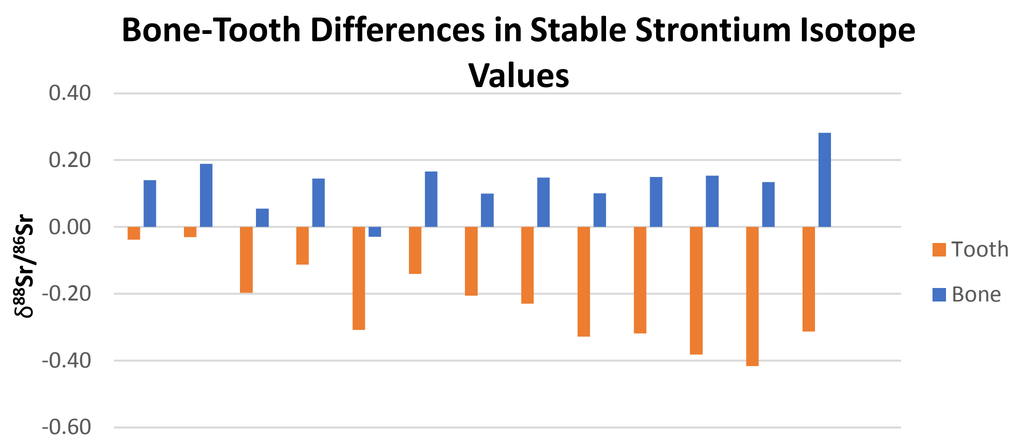

Figure 7.13 Stable strontium isotope values from the bones and teeth of 14 individuals interred in Teotihuacan. Only 14 of 18 individuals with bone-tooth pairs produced usable strontium isotope data in both tissue types.

While Knudson et al. (2010) suggest that comparisons between bone and teeth of individuals may sometimes be able to detect trophic level changes accompanying the weaning process, the third molars incorporated into this project can be reasonably assumed to have formed entirely during the postweaning portion of a person's life. Therefore, the systematic depletion of $\delta^{88}Sr/^{86}Sr$ values in teeth compared to bones from the same individual cannot be attributed to trophic level differences due to the consumption of breast milk. There are, however, several possible explanations for these differences, none of which can be clearly confirmed at this time. First, it could be the case that the stable strontium isotope differences between tissue types reflects age-related differences in diet, in which young people consumed much higher quantities of high-calcium protein foods than did older people. Second, there could be as-of-yet incompletely understood biological mechanisms that underly the differences in values between bone and tooth enamel samples. While radiogenic strontium isotopes do not fractionate as they are incorporated into body tissues, stable strontium isotopes are known to do so, and it is possible that within-body metabolic processes that differentially fractionate stable strontium istopes as they are incorporated into different types of bodily tissues. Differential fractionation of this kind related to tissue type has previously been noted for the light stable isotopes of carbon and oxygen (Warinner and Tuross 2009). Third, it could be the case that the stable strontium isotopes in enamel and bone samples are an artifact of unexpected differential fractionation occurring during some point in the laboratory processing procedure. Future experimental tissue-diet studies for the stable strontium isotope system and systematic studies of samples undergoing slightly different laboratory processing protocols could help to distinguish some of these possibilities. However, in the absence of such studies, it is currently difficult to make any archaeologically meaningful interpretations based on bone-tooth differences in stable strontium isotope values within the Teotihuacan data set.

This chapter has combined information from multiple isotope systems to screen for individuals who had spent portions of their late childhood or adulthood outside of the local Teotihuacan area, to explore how dietary patterns among individuals consuming local Teotihuacan resources varied based on both economic and social identities, and to assess whether or not any individuals displayed lifetime dietary change that would be consistent with a change in socioeconomic status. Due both to poor skeletal preservation, which limited the number of individuals for whom paired bone and tooth samples could be selected for analysis, and to the presence of a relatively large number of individuals displaying nonlocal isotope values in their third molars, the final sample of individuals for whom lifetime dietary change could be assessed was small. However, even within this small subset of individuals, an individual was identified who displayed a type and extent of lifetime dietary change that would be consistent with movement between socioeconomic groups. The next chapter will discuss the implications of the data produced in this dissertation not only for the archaeological study of social mobility, but also for understanding processes of geographic mobility and paleodiet within Teotihuacan society.

CHAPTER 8: DISCUSSION

As the largest single isotopic study of human remains at Teotihuacan to date in both number of residential contexts and individuals analyzed, this project has produced data that provide information on a broad assortment of archaeological issues. This chapter begins by discussing the new information that the project has provided on life at Teotihuacan, including residential mobility, diet, and social identities. It then provides a contextual discussion of the individual that this dissertation has identified as socioeconomically mobile during his lifetime. While the data produced in this study does not allow a full characterization of social mobility processes within Teotihuacan as outlined in previous chapters, the ability of this dissertation to convincingly identify an individual who likely experienced a lifetime change in socioeconomic status represents an important first step toward the archaeological study of the topic of social mobility. The concluding chapter will then take a broader look at the methodological approach to social mobility developed within this dissertation and assess both its strengths and weaknesses as it has been applied in the case of Teotihuacan.

Geographic Mobility at Teotihuacan

This research contributes to our understanding of patterns of geographic mobility into and out of Teotihuacan in both technical and substantive ways. Particularly, this research has 1) suggested that the range of strontium isotope values found among individuals residing locally may be broader than previously understood due to the likely consumption of imported foods, 2) reinforced patterns previously identified in other research suggesting strong demographic patterns among immigrants into the city, and 3) provided interesting glimpses of foreign sojourning amongst individuals who lived their early lives at Teotihuacan and returned there for burial.

Strontium Isotope Baseline and Imported Foods

From a technical standpoint, the results of this study have implications for understanding the expected range of isotopic variation observed among individuals residing locally within the Teotihuacan area. While previous estimates of the local range of radiogenic strontium isotope variation do appear to correspond with local expectations based on samples of local bedrock, faunal bone, plants, and soils within the geographic boundaries of the Teotihuacan Valley (Price et al. 2000; Schaaf et al. 2012; White et al. 2007), the broader range of variation observed among the sample of individuals included in this research indicates that imported foodstuffs may be an important consideration in assessing normal "local" variation at Teotihuacan.

The idea that imported foods may affect the range of normal strontium isotope variation among local individuals is hardly new within the Mesoamerican literature. Wright (2005), for example, has noted a similar difference between the strontium isotope values characteristic of the residential population of Tikal and those characteristic of baseline faunal and geological samples, a difference that she attributes to the consumption of imported sea salt. Due to the high calcium content of salt, statistical modeling suggests that the regular consumption of this commodity could plausibly have resulted in an offset of up to 0.0003 between human and faunal mean local strontium isotope values (see also Fenner and Wright 2014). Statistical modeling to determine the precise amount of imported foods needed to elevate strontium isotope ratios at Teotihuacan would be complicated both by the wide variety of geographic areas from which imported foods could have been obtained and by the variable calcium content of different types of foods. Such an undertaking is beyond the scope of this dissertation.

However, it is worth noting that several ecological and cultural factors make it highly probable that foods imported from areas farther afield than the Teotihuacan Valley should be reasonably assumed to impact the strontium isotope values in the bones and teeth of local residents. First, the importance of salt in traditional Mesoamerican diets is discussed in postconquest records, which describe fasts of penance as consisting of a diet without chile or salt (Coe 1994:62). Archaeological and documentary evidence suggest that portions of the saline Lake Texcoco in the Basin of Mexico were exploited by residents of the Basin for saltmaking from prehispanic through modern times (Parsons 2001). Salt derived from this lake represents a mixture of dissolved minerals from the natural weathering of volcanic geological deposits around the lake as well as salts brought up from subterranean sources by thermal springs (Parsons 2001:148). While local to the Basin of Mexico, these salts contain strontium derived from several geological sources outside the Teotihuacan Valley proper. Imports of salt from further abroad are also not out of the question, and Triple Alliance tribute lists record salt arriving into the Basin of Mexico from multiple geographic areas, including the western province of Ocuilán, the Tehuacan area of southern Puebla, and several coastal areas (Parsons 2001:154).

Imported lime used to nixtamalize maize could also be a source of nonlocal strontium consumed by residents of Teotihuacan, particularly since the strontium-isotope composition of lime may swamp that of other dietary inputs due to the high calcium content of the mineral (Burton and Wright 1995; Wright 2005). We know that lime was imported into Teotihuacan to produce lime mortar and plaster for construction purposes, with the largest nearby large limestone deposits located approximately 30-40 km away from the city in the northwestern Basin of Mexico (Parsons 2008). Additional sources that may have been exploited by Teotihuacanos include sources to the northwest of the city by approximately 55 km, near the archaeological site of Tula, and additional sources in modern-day Puebla, located approximately 100 km to the southeast of the city (Barba et al. 2009; Cowgill 2015:37). Other forms of alkaline materials, such as ash, can also be used in the nixtamalization process, and it is not necessarily the case that all maize prepared for consumption at Teotihuacan incorporated strontium contributed by nonlocal lime imports.

Other, minor sources of nonlocal strontium likely consumed by Teotihuacanos include imported plant foods from areas within and beyond the Basin. As described in Chapter 5, population estimates in conjunction with considerations of arable land within the Teotihuacan Valley suggest that even staple crops were likely imported from outside of the immediately local area, with some paleoethnobotanically and iconographically documented individual species such as avocado and cacao traveling over even greater distances from lowland geographical regions. Though likely an uncommon food limited to the more wealthy within society, the cacao plant is particularly interesting from a strontium isotope perspective given its relatively high calcium content (Wright 2005:563).

It is interesting to note that there are patterns with respect to the radiogenic strontium isotope ranges characteristic of local individuals at different residential sites within the city that may be related to different levels of consumption of imported foods by different groups. Figure 8.1 demonstrates the distribution of radiogenic strontium isotope values within the somatic bone of adult individuals in each of the three socioeconomic groups and the Oaxaca Barrio. As in the previous chapter, individuals from the Oaxaca Barrio are analyzed separately from the remainder of the middle status group here in order to control for dietary differences related to ethnic affiliation. Higher radiogenic strontium isotope values within the local range ($^{87}Sr/^{86}Sr=0.7050$-0.7052) tend to be found among individuals interred in the higher status residential locations, such as Conjunto Noroeste and Zacuala, while the lower radiogenic strontium isotope values within the local range ($^{87}Sr/^{86}Sr=0.7046$-0.7047) are much more common among individuals interred in mid- or lower-status residential locations, such as San Antonio de las Palmas and San José 520. Individuals interred in the Oaxaca Barrio also feature radiogenic strontium isotope signatures within the mid to upper part of the local range. These differences between socioeconomic and ethnic groups are statistically significant (one-way ANOVA, $F(3,55)=13.5$, $p<0.01$). Pairwise Tukey-Kramer comparisons indicate that each group is differentiated from the others based on mean radiogenic strontium isotope value, with the exception of the high status group and the Oaxaca Barrio sample, which have similarly high mean values (Table 8.1).

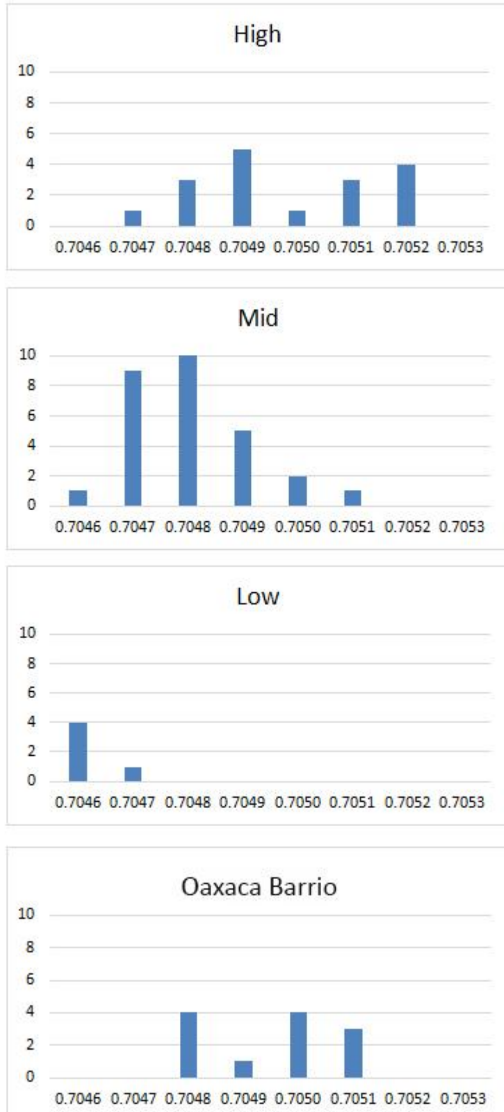

Figure 8.1. Distribution of radiogenic strontium isotope values by socioeconomic and ethnic grouping.

Both high status and ethnically distinct individuals are exactly those groups whom we might expect to be more likely to consume imported foods. Due to the lack of clear state-controlled storage areas as well as the prevalence of market-based economies in ethnohistorically documented societies throughout Mesoamerica, Teotihuacan is generally assumed to have had a market-based economy (Cowgill 2015:181; though see

Manzanilla 1992), including both a large central marketplace located in the Great Compound opposite the Ciudadela (Millon et al. 1973) as well as smaller *tianguis* taking place in the smaller neighborhood plaza areas located throughout the city. However, the

	High	Mid	Low	Oaxaca Barrio
High	-	-	-	-
Mid	**<0.01**	-	-	-
Low	**<0.01**	**0.02**	-	
Oaxaca Barrio	0.88	**0.02**	**<0.01**	-

Table 8.1 Tukey-Kramer probabilities for pairwise differences in means between groups.

existence of a market economy does not mean that access to certain sets of resources is limited only by economic cost. Both high status and ethnically distinctive groups might be expected to maintain economic connections with groups or individuals elsewhere, either as part of an ethnic diaspora as has been discussed for the Oaxaca Barrio (Spence 2005; White et al. 2004b) or as part of a regional or larger network of elites and intermediate elites, as has been hypothesized to have taken place throughout time in Mesoamerica (Hirth 1992; Molloy and Rathje 1974; Smith 1986). Indeed, recent excavations in the Teopancazco barrio center have documented a range of imported goods, including raw materials, finished products, and animal remains from the Gulf Coast, a pattern that Manzanilla (2007) attributes to relationships maintained between the elites residing in the compound and areas outside of Central Mexico. The presence of a greater diversity and quantity of marine fish remains within this barrio center as compared to other intermediate elite residential contexts within the city suggests that access to these specific goods operated semi-independently of centralized market or state-controlled aspects of the economy.

As discussed in Chapter 7, food imports from several of the areas within Teotihuacan's "outer hinterland" would be expected to raise the strontium isotope values of local individuals consuming these imported foods, a process that could be responsible for the slightly broader "local" range produced and used in this dissertation as compared to previous strontium isotope baselines derived from the analysis of local fauna. Indeed, the higher values in this range are found among residential groups within Teotihuacan that we would expect *a priori* to be consuming at least some quantities of imported foods. It is important to highlight imported sources of dietary strontium given the silence on this subject within the strontium isotope literature for Teotihuacan, despite the general assumption within the broader archaeological literature that such long-distance procurement was happening (see discussion in Chapter 5).

While the small extension in the "local" Teotihuacan strontium isotope baseline to include slightly higher values as discussed here may seem like a relatively minor point, it in fact has a measurable impact on interpretation of processes of mobility within the city. Specifically, neglecting the possible impact of imported foods on the strontium isotope values of local individuals could lead researchers to overestimate the frequency of migration into the city. For example, while I assessed 27% of individuals within this dissertation project as geographically mobile during some portion of their lives using the a local range of $^{87}Sr/^{86}Sr$ = 0.7046-0.7052, this figure would have been inflated to a full

45% of individuals had I used the the Teotihuacan Valley local range of $^{87}Sr/^{86}Sr$ = 0.7046-0.7049 that has previously been used within the literature.

Immigration and Sojourning at Teotihuacan

Beyond simply refining our understanding of strontium isotope variation among residents, however, this research also adds to our contextual understanding of geographic mobility within Teotihuacan. Before discussing the details of geographic mobility at Teotihuacan, it is important to once again emphasize the limitations of the radiogenic strontium and stable oxygen isotope data produced in this project in providing a full understanding of the movement of peoples into and out of the city. Particularly, as mentioned previously, the use of third molar samples and somatic bone samples limits our consideration of residential mobility to geographic residence during both late childhood and the years of adulthood leading up to death. The data produced in this dissertation cannot provide information about the birthplace or early childhood residential location of various individuals or about residence outside of the Teotihuacan area that occurred after late childhood but far enough before death not to be apparent in the isotopic values in somatic bone.

However, because most previous studies of residential mobility at Teotihuacan utilize early-forming teeth rather than third-molar samples, these data do provide an interesting lens into late childhood residential mobility that has not previously been evaluated. When combined with information from previous research, this perspective helps expand our understanding of migratory processes within Mesoamerica.

Additionally, many prior residential mobility studies have focused on burials in either monumental ceremonial contexts (e.g., Spence et al. 2004; Stuart-Williams et al. 1996; White et al. 2002, 2007) or one of the multiple ethnic enclaves within the city (e.g., Price et al. 2000; Spence et al. 2005, Stuart-Williams et al. 1996; White et al. 1998, 2004b). Notable exceptions to this trend include isotopic analyses at the residential compounds of Oztoyahualco (Price et al. 2000), Teopancazco (Morales Puente et al. 2012; Schaaf et al. 2012), and Tlajinga 33 (Stuart-Williams et al. 1996; White et al. 1998, 2004a). This research complements and extends prior studies by producing data primarily for individuals interred in non-enclave residential contexts throughout the city.

The information produced in this dissertation highlights the range of geographic areas within Mesoamerica that had relationships with the people of Teotihuacan through migration and sojourning. While geological, methodological, and biological complications make a precise "sourcing" of individuals difficult (Burton and Price 2013), strontium and oxygen isotope data can allow informed conjectures about the regions in which individuals buried at Teotihuacan may have spent time. Before discussing specific geographic areas, however, it is worth reiterating that there are a number of regions within Mesoamerica with similar local strontium isotope ranges (Hodell et al. 2004; Price et al. 2008; Schaaf et al. 2012) and others with similar local oxygen isotope ranges (White et al. 2007). An additional complication for oxygen isotope data lies in the interlaboratory comparison issues (see Chapter 7) that make it difficult to match the specific numbers produced in this dissertation with those produced in the baseline studies carried out in other laboratories.

The time-averaging nature of skeletal tissues (see Chapter 4) introduces an additional complication in matching isotope values in bones and teeth to a specific geographic place of residence. Due to the slow turnover of somatic bone, it is possible that the values present in an individual's somatic bone represent a value intermediate between a specific nonlocal area of residence and Teotihuacan if the person died when their bone was still in the process of equilibrating to their new place of residence. The specific value present in the bone at the time of death may, therefore, spuriously match a third geographic area where that person never actually lived during his or her life. While tooth enamel does not remodel throughout life, the bulk sampling procedure used in this dissertation means that, once again, the specific isotope values reported in this dissertation may combine distinct values present in different portions of the tooth crown if a person relocated at any point during the period of several years in which the tooth crown formed, or potentially even earlier given the potential existence of a strontium reservoir effect (see Montgomery et al. 2010).

Despite all of these caveats, the strontium and oxygen isotope data produced in this dissertation do indicate that individuals interred in Teotihuacan had spent time in multiple distinct areas of Mesoamerica prior to their arrival or final interment in the city. I evaluate possible places of geographic residence through general patterns of deviation from the Teotihuacan local range (i.e., higher strontium isotope values than Teotihuacan matched with lower oxygen isotope values) and highlight multiple possible areas that are consistent with these general patterns of directionality. It is important to note here that not all areas of Mesoamerica have been well characterized isotopically, and while certain regions are highlighted as possible areas of nonlocal residence based on current data, it could also be the case that individuals interred in Teotihuacan spent time in completely different geographic areas not yet included in regional comparative baselines.

The most frequent nonlocal pattern seen within the sample involves individuals displaying strontium isotope values in their bones or teeth that are higher than the local Teotihuacan range but oxygen isotope values that are broadly consistent with an extended range that could be considered similar to Teotihuacan. All the individuals displaying nonlocal values within the Oaxaca Barrio (see Table 7.1) display this pattern, as do individuals interred in the Zacuala (TEO-ZAC11), Conjunto Noroeste (TEO-CN38 and TEO-CN58), and La Ventilla B (TEO-LVB75B) compounds. This isotope pattern suggests nonlocal residence in one or more geologically distinct highland locations. For the individuals interred within the Oaxaca Barrio, it is tempting to hypothesize that these elevated strontium isotope values represent migration from the Oaxacan highlands, which feature a faunal radiogenic strontium isotope range of approximately 0.7075-0.7076 and oxygen isotope values overlapping the Teotihuacan area, once interlaboratory differences are considered (Price et al. 2008; White et al. 2007). Radiogenic strontium isotope values in the bones and teeth of individuals interred in the Oaxaca Barrio are all intermediate between the Oaxacan highlands and Teotihuacan, consistent with what might be expected if movement occurred during the period of formation of the third molar and if bone were in the process of equilibration at the time of death. The possibility cannot be ruled out, however, that some of these individuals interred both within and outside of the Oaxaca Barrio came from other highland regions with strontium isotope baselines intermediate between Teotihuacan and Oaxaca, such as the volcanic highlands of Guatemala or portions of Chiapas. None of the individuals analyzed here from the Oaxaca Barrio displayed bone chemistry consistent with migration from portions of West Mexico, which are characterized by strontium isotope values lower than those found in the Teotihaucan region.

The Zacuala compound includes an individual (TEO-ZAC4) with strontium isotopes consistent with Teotihuacan but with higher oxygen isotope values, suggesting residence within a region of Mesoamerica geologically similar to the Basin of Mexico but at a slightly lower elevation, such as the volcanic highlands of Guatemala. Finally, one individual interred in the Feathered Serpent Pyramid (TEO-PTQ11A) shows evidence of adult residence in a location with strontium isotopes roughly consistent with the Teotihuacan local range but oxygen isotopes much lower than Teotihuacan, suggesting a highland location. This individual presents a bit of a puzzle, since the obtained oxygen isotope value of 8.8‰ is much lower than the oxygen isotope baseline ranges that have been obtained archaeologically for regions of Mesoamerica that have been well characterized isotopically, even when interlaboratory comparison issues are taken into account. Possibly, this individual came from a portion of Mesoamerica that has not seen intensive isotopic investigation.

Regardless of specific geographic location, it is clear that some individuals buried within Teotihuacan had spent time in several geographic areas. While the strontium and oxygen isotope data produced in this dissertation and in other venues cannot distinguish a one-way immigration process from practices of temporary sojourning to other geographic areas, it is clear from the mounting body of evidence that Teotihuacan was far from an insular place, with large portions of individuals who had spent at least some portion of their lives abroad.

One interesting pattern that we do see among adult individuals is that several individuals whose third molars feature strontium and oxygen isotope values that would be consistent with local residence at Teotihuacan during late childhood and early adolescence display isotope values within their somatic bone that suggest that they spent some portion of their adult lives in a different geographic location before finally returning to Teotihuacan at some point prior to their burial. Three individuals within the sample show this pattern, two of whom were interred within the Oaxaca Barrio (TEO-BO1TL1A, TEO-BO2TL11) and one of whom was interred in the Zacuala compound (TEO-ZAC4). These individuals are interesting given speculation concerning the sojourning of individuals from Teotihuacan to other portions of Mesoamerica as representatives, traders, or soldiers (e.g., Braswell 2003; Sanders 1977; Stone 1989). While few individuals featuring isotopic values characteristic of the Teotihuacan region have been found interred abroad, it is possible that at least some individuals engaged in foreign sojourning may have been returned to their home city for burial. Given the very small proportion of the currently analyzed sample that displays this isotopic pattern, however, it is difficult to know how extensive this pattern this might have been.

Geographic Mobility and Social Identity

The presence of relatively high proportion of immigrants in the city has been a topic that has been discussed for a while, with some arguing that a constant influx of people would be necessary to sustain the population size in the face of high childhood mortality as seen in many preindustrial cities (Storey 1992; see Chapter 5 for a critique of this argument). While the results of this dissertation confirm that geographic mobility certainly seems to be far from uncommon at Teotihuacan, people were more mobile in certain societal contexts than in others. As explained below, not only did ethnicity matter in geographic mobility, but so did social categories such as age and, perhaps, gender.

As described above, while the most parsimonious explanation for mobility patterns within the Oaxaca Barrio need not involve migration from anywhere other than the Zapotec homeland, overall levels of adolescent and adult mobility are greater in the Oaxaca Barrio than elsewhere. The proportion of individuals with nonlocal molar values is significantly associated with residential location in either an ethnic barrio or a status-grouping (Chi-square test of 2x3 contingency table, $\chi^2 = 10.2$, df=2, p=0.01). A much higher percentage of nonlocal molar values is found within the Oaxaca Barrio sample as compared to the other groups, followed by the upper status residential locations such as Tetitla, Zacuala, Conjunto Noroeste, and La Ventilla Frente 2 (Table 8.2). Middle status residential locations show a lower percentage of nonlocal molar values than the other two groupings, though the difference between the upper and middle status residential locations is not statistically significant (Fisher's Exact test of 2x2 contingency table, p=0.59). Because no tooth samples were obtained from San José 520, the low status residential group could not be included in this comparison.

The relatively high frequency on nonlocal molar values within the Oaxaca Barrio mirrors the conclusions of previous isotopic studies of residential mobility within Teotihuacan's ethnic barrios (Price et al. 2000; Spence et al. 2005; White et al. 2004b, 2008-2009). The presence within the Oaxaca Barrio of geographically mobile individuals and of individuals who likely consumed nonlocal foods, as discussed above, makes intuitive sense given that exactly those groups with the external connections that would allow them to obtain imported foods would also be more likely to receive people moving into the city from elsewhere. As mentioned above, previous research both on Teotihuacan and on Mesoamerica more broadly suggest that the Oaxaca Barrio was part of a regional Zapotec diaspora that circulated individuals and goods throughout a number of locations within Mesoamerica.

This data set also adds to the growing indications suggesting strong demographic trends amongst immigrants and sojourners. As noted in Chapter 7, the vast majority of adult individuals analyzed in this dissertation displayed local oxygen and radiogenic strontium isotope values in bone, while a relatively large proportion of individuals spent their late childhood or adolescence nonlocally. Comparative data from other locations within the city display the same pattern. Table 8.3 summarizes information from published studies using either radiogenic strontium or stable oxygen isotope information to infer geographic mobility within a Teotihuacan residential sample (studies involving burials from monumental architecture are excluded here due to suggestions that some subset of individuals may have been captives rather than residents of the city). We gain the picture from both the results of this dissertation and the comparative data set that most geographic mobility occurred amongst younger people, many of whom then resided in the city for long periods prior to their death. While nontrivial portions of individuals interred in both the Oaxaca Barrio and non-enclave residential contexts display evidence that some portion of their childhood or adolescence was spent nonlocally, it is much rarer to see an isotopic pattern that would suggest that someone spent significant portions of

Context	Molar Values Local	Molar Values Nonlocal
Upper Status Residential (n=11)	73% (n=8)	27% (n=3)
Middle Status Residential (n=11)	91% (n=10)	9% (n=1)
Oaxaca Barrio (n=11)	27% (n=3)	73% (n=8)

Table 8.2 Distribution of local and nonlocal strontium and/or oxygen isotope values in 3rd molar dental enamel among different ethnic and status groupings.

Context	Subadult Nonlocal	Subadult Local	Adult Nonlocal	Adult Local	Reference
Oztoyahualco	50% (1/2)	50% (1/2)	0% (0/6)	100% (6/6)	Price et al. 2000
Tlajinga 33	38% (5/13)	62% (8/13)	11% (2/18)	89% (16/18)	White et al. 2004a; White et al. 1998
Teopancazco	49% (24/49)	51% (25/49)	0% (0/22)	100% (22/22)	Schaaf et al. 2012; Morales Puente et al. 2012
Oaxaca Barrio	66% (19/29)	34% (10/29)	6% (1/17)	94% (16/17)	Price et al. 2000; White et al. 2004b
Merchants' Barrio	81% (13/16)	19% (3/16)	20% (5/25)	80% (20/25)	Stuart-Williams et al. 1996; Price et al. 2000; Spence et al. 2005
TOTAL	57% (62/109)	43% (47/109)	9% (8/88)	91% (80/88)	

Table 8.3 Comparative data concerning the frequency of nonlocal residence during different portion of the lifecourse of individuals interred at Teotihuacan. Assessments of "local" or "nonlocal" isotope signatures was made through comparison of the raw data provided in each of these publications to the local ranges of $\delta^{18}O$ = 14-16‰ for oxygen isotope data produced at the University of Western Ontario and of $^{87}Sr/^{86}Sr$ = 0.7046-0.7052 for strontium isotope data produced elsewhere. In cases where multiple teeth were analyzed, an individual was classified as nonlocal if at least one tooth showed a nonlocal value.

their adult life in a geographic region that is geologically or meteorologically dissimilar to the Basin of Mexico.

This pattern seems to suggest that mobility was highly demographically structured at Teotihuacan, with people moving into and out of Teotihuacan via immigration and sojouring during their youth before settling down and experiencing long-term residence in Teotihuacan through their adulthood. The relative paucity of nonlocal isotope values within the somatic bone of adult individuals suggests that it would have been quite rare for an individual to have initially immigrated into Teotihuacan as a mid-aged or older adult. This demographic structure of migration is similar to what we observe in rural-urban migration among modern groups worldwide, as young people seek the economic or educational opportunities available to them in cities, while older individuals who have established families and responsibilities in their home communities are much less likely to migrate into or out of an urban center. Such a pattern has been described for contemporary rural villages in the Andes (Allen 2002), Mesoamerica (Sandstrom 1991:359-361), and elsewhere (Mills 1997). Many urban-rural migrants ultimately return to their home villages after a period in the city, while others stay, giving up their rural identity to build a life for themselves in the urban environment.

While many examples within modern Latin America focus on the rural-urban migration of young men to the exclusion of young women, this gender pattern is far from universal, and particular context-specific labor opportunities or intermarriage patterns will tend to structure the gender distribution of urban-rural immigrants (Mahler and Pessar 2006). Within the sexed sample from this dissertation, males and females are represented in equal proportions among those individuals who resided nonlocally during their late childhood or adolescence (6/12 (50%) males, 6/12 (50%) females), though the relatively small sample sizes involved here make it difficult to assess how representative any sex-based patterns observed here might be of underlying populational trends. A 95% confidence interval around these proportions at the current sample sizes suggests that the true population proportions of nonlocal males and females could be anywhere between approximately 25% and 75% for both groups. The sex-distribution of individuals displaying nonlocal residence during late childhood or early adolescence does differ between the Oaxaca Barrio (75% male, n=6; 25% female, n=2) and high-status residential contexts (100% female, n=4), a difference that reaches statistical significance at the α=0.10 level (Fisher's Exact Test, p=0.06). However, we cannot assess based on isotopic evidence alone the reasons that individuals may have moved into and out of Teotihuacan, nor can we speculate about whether or not males and females may have had different, gender-specific reasons for geographic mobility.

Diet, Socioeconomic Status, and Social Identity

This dissertation provides new information concerning subsistence practices at Teotihuacan and supplies details about status- or wealth-based differentiation in dietary practices among residents of the pre-Hispanic metropolis. The specific ways in which socioeconomic differences in diet appear in bone chemistry seem to deviate from traditional assumptions about diet and status in Mesoamerica, an observation that is elaborated further below. Beyond simply reflecting and reinforcing social differences in the economic realm, however, food and cuisine served to underline a range of social identity differences throughout this cosmopolitan society. While the sample sizes in this dissertation do not allow a full exploration of the complexities inherent in the relationship of many of these social identities to diet, the research has identified some initial patterns that warrant further investigation. By far the best characterized prehispanic Mesoamerican group in terms of isotopic paleodietary information is the Classic-period Maya, and for this reason, many of the dietary observations made about Teotihuacan in this chapter will be compared to Maya dietary practices. As we will see, both overall diets and the specific way in which food was put to social uses in distinguishing between groups is quite different between the two regions.

Subsistence Practices at Teotihuacan

Taken as a whole, diet at Teotihuacan is consistent with what one would expect based on the resource base and agricultural practices of a society located in the Basin of Mexico. Like other isotopic analyses of paleodiet at Teotihuacan (Casar et al. 2017; Morales Puente et al. 2012; White et al. 2004a, 2004b), this study demonstrates that individuals belonging to all socioeconomic status groups consumed a diet based heavily on C_4 or CAM-based carbohydrates such as maize, amaranth, and cactus products, as well as on C_4 or CAM-based proteins such as maize-fed animals. As in other highland Mexican contexts (see Warinner et al. 2013), the extensive overlap in the Teotihuacan Valley of the carbon isotope values characteristic of C_4 and CAM plants does not allow us to reliably distinguish between consumption of these two categories of plants using carbon isotope analysis (Lounejeva Baturina et al. 2006; Morales Puente et al. 2012).

While subtle and socially meaningful intrasocietal variation in diet certainly existed, as discussed further below, all individuals analyzed within this dissertation cluster closely toward the "100% C_4 or marine diet" end of the "C_4/marine protein" regression line within the simple carbon isotope model (Figure 8.2). Translated into plain language, this means that the vast majority of the food ingested by residents was either a C_4 or CAM plant product derived from maize, maguey, or nopal or was an animal that had itself consumed these specific types of plants. A linear mixing model suggests that, on average, around 80% of the total dietary carbon consumed by residents of Teotihuacan came directly or indirectly from C_4 or CAM sources (Schwarcz 1991). This number is quite high when compared to 54% of total dietary carbon among Classic Maya commoners and between 51-63% total dietary carbon among Maya elites (Somerville et al. 2013; see also Figure 8.2).

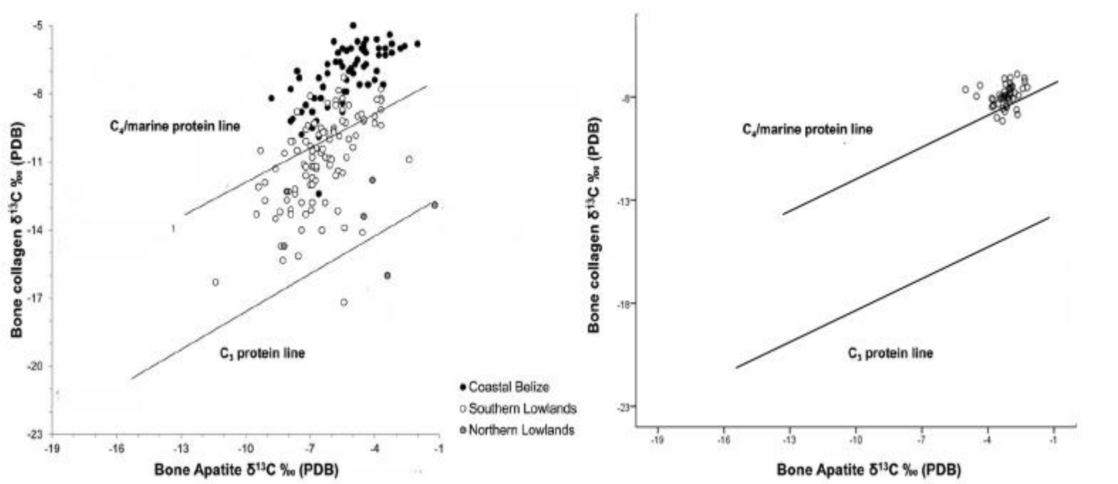

Figure 8.2 Carbonate and collagen carbon isotope variation across multiple regions of the Maya area (left) and all status groups at Teotihucan (right). Image at the left adapted from Somerville et al. (2013). The regression lines, based on data from Froehle et al. (2010), incorporate an adjustment to the underlying carbon isotope data to reflect preindustrial atmospheric carbon levels.

Both ecological and cultural factors can explain this comparatively heavy reliance on C_4 or CAM carbon sources. First, while maize was a staple crop in both the Maya area and the central Mexican plateau, a greater proportion of non-maize plants that were consumed by people in central Mexico fall into the CAM or C_4 category than in the Maya area. The ecology of the central Mexican highlands lends itself well to the cultivation and consumption of a range of CAM cactus products, such as the fruits and paddles of the nopal cactus (*Opuntia* sp.) and the sap of the maguey cactus (*Agave americana*), consumed either as *aguamiel* or fermented *pulque*. Cultivation of cactus products in the central Mexican highlands appears to have great time depth (see discussion in Parsons and Parsons 1990), and the paleobotanical record confirms that nopal and maguey were present in domestic contexts at Teotihuacan (Casales and Tavera 1995; González 1993, McClung de Tapia 1987). Ceramic residue analysis additionally confirms that at least some of the households within Teotihuacan consumed CAM products in the form of *pulque* (Correa-Ascencio et al. 2014; Robertson and Cabrera 2017). While the consumption of cactus products is also attested amongst conquest-period documents in the Maya area, these plants do not seem to receive the same dietary emphasis as in the central highlands and are instead simply one of a diverse assemblage of cultivated and wild vegetables and fruits consumed in the region (Coe 1994:161-168). Amaranth and chenopodium species, which follow the C_4 photosynthetic pathway, were also cultivated within prehispanic central Mexico, though seemingly not in the Maya area (Coe 1994; Ortiz de Montellano 1990). Amaranth in particular assumed ritual importance among the Aztecs, and figurines made of amaranth dough were incorporated into a number of ceremonies, ranging from highly public to private domestic ritual practices (Coe 1994:90-91).

Another source of ingested carbon came from the animal foods consumed by Teotihuacanos. While Starbuck (1987) postulates a heavy reliance for all residents on deer meat, suggesting a strong emphasis on hunting rather than on the consumption of domesticated animals, isotopic evidence produced during the current study suggests that the primary types of animal foods consumed by individuals interred in residential contexts consisted of C_4-fed animal species rather than C_3-consuming browsers such as deer, which can often but not exclusively be expected to display isotope values indicative of a heavily C_3 diet (White et al. 2001a). While deer are opportunistic feeders who will engage in crop raiding, Cormie and Schwarcz (1994) document $\delta^{13}C_{collagen}$ values only as high as -17.8‰ among modern deer engaging in crop-raiding in areas where maize is a dominant crop, still far below the values seen among C_4-provisioned deer of approximately -13.3‰. Similarly, the collagen carbon isotope values found within analyses of archaeological deer from the Maya area range from -17.5‰ to -22.1% (Emery et al. 2000), well below the carbon isotope values found among heavily C_4-consuming animal species. A recent synthetic analysis of faunal remains from a variety of residential locations throughout the city corresponds well with this isotopic assessment by confirming that deer form a relatively minor portion of the faunal record at Teotihuacan, though prevalence does vary by location (Sugiyama et al. 2017).

In contrast, Somerville et al. (2016) have documented that rabbits raised within the middle-status Oztoyahualco compound were provisioned with C_4 resources, and it is likely that any other human managed species such as turkey may have been similarly fed.

Stable isotope analysis of faunal remains within the Moon and Sun Pyramids suggest that even captive carnivorous animals were provisioned with maize-fed meat sources and potentially even supplemented directly with maize (Sugiyama et al. 2015). This emphasis on the widespread provisioning of animal species with C_4 resources, such that individuals across all socioeconomic groups at Teotihuacan display evidence of consuming C_4-derived protein sources, is another point of difference from the Maya area, where the consumption of heavily maize-fed animals may have been the purview exclusively of elites within Maya society (White 2005; White et al. 2001b, 2004c).

While carbon isotopes from collagen can provide some insight into the types of protein sources that were exploited by the residents of Teotihuacan, particularly in terms of whether the plant and/or animal proteins consumed derive ultimately from C_3 or C_4 sources, they cannot speak to the relative proportions of plant vs. animal proteins within the diet. Generally speaking, nitrogen isotope values characteristic of the Teotihuacan population suggest an omnivorous diet based on the consumption of primarily terrestrial animal species. While significant room exists for nitrogen isotope baselines in the central Mexican highlands to be elaborated through further research, Morales Puente et al. (2012) report nitrogen isotope values ranging from -1.99‰ to 8.58‰ for a range of modern plants collected from both wild and cultivated settings within the Basin of Mexico. The analysis of archaeological faunal remains from the Teopancazco compound suggests ranges of 2.47‰ to 8.02‰ within the somatic bones of terrestrial herbivore species such as rabbit (*Sylvilagus floridanus*) and hare (*Lepus sp.*) (Morales Puente et al. 2012), a range very similar to the range of 2.9‰ to 7.7‰ reported for provisioned rabbits and hares from the Oztoyahualco compound (Somerville 2015). The archaeological faunal remains of omnivorous or insectivorous species such as opossum (*Didelphis marsupialis*), turkey (*Meleagris gallopavo*), and domestic dog (*Canis familiaris*) found in the Teopancazco compound feature a slightly higher nitrogen isotope range of 5.36‰ to 9.32‰, though it is unclear how closely the diet of these individual animals may have approximated the diet of their wild counterparts, as, like other managed species at Teotihuacan, they appear based on carbon isotope evidence to have been heavily provisioned with C_4 or CAM plant products (Morales Puente et al. 2012). Large carnivores such as canids and felids interred in the Sun and Moon pyramids have a nitrogen isotope range of 6.0‰ to 11.8‰ that overlaps with that of the omnivorous animals listed above, though here again, the likelihood of human provisioning of these captive carnivores raises the possibility that the diet of at least some of these individuals was not exclusively carnivorous (Sugiyama et al. 2015).

The mean nitrogen isotope value from local human individuals within the sample from this dissertation was δ^{15}N=9.2‰, though values ranged from 8.1‰ to 11.5‰. Numbers in the higher portion of this range are relatively uncommon within the sample, and only 15.8% of individuals featured a nitrogen isotope value above 10‰. Based on the general schema outlined above, these individuals fit comfortably within the range for omnivores consuming terrestrial foods, though a few individuals with higher nitrogen isotope ratios may have supplemented their diet with lake or imported marine fish, as discussed further below.

Several ecological and cultural factors could shift the nitrogen isotope values found in the bones of human consumers away from these expected nitrogen isotope rungs, and these potential sources of variation must be explored for Teotihuacan. First, given the position of cultivated beans within the Mesoamerican agricultural triumvirate of maize, beans, and squash, the effect of consuming leguminous plant products on nitrogen isotope values in human bone must be taken into account. As mentioned in Chapter 4, leguminous plants derive nitrogen in part from nitrogen-fixing bacteria with which they maintain a symbiotic relationship, in contrast with most non-leguminous plants which rely more heavily on nitrogen compounds within the soil. Due to this difference, wild nitrogen-fixing plants such as beans are expected to have lower $\delta^{15}N$ values than do non-nitrogen-fixing pants (DeNiro and Epstein 1981; Virginia and Delwiche 1982). Theoretically, this difference should travel up the food chain, resulting in lower nitrogen isotope values in the bone of humans regularly consuming wild leguminous plants as compared to humans who subsist on non-leguminous plants, other factors held constant.

However, research suggests that agricultural practices may alter the nitrogen uptake pathways of leguminous plants such that, unlike their wild counterparts, no nitrogen isotope differences should be expected between agricultural legumes and other cultivated plants. Cultivation practices may alter local nitrogen cycles through such factors as the introduction of chemical or natural nitrogen-containing fertilizers and changes to the nitrogen-fixing bacteria colonies in soils (Biesboer et al. 1999). The availability of soil nitrates resulting from agricultural practices may cause leguminous plants to minimize direct nitrogen-fixation in favor of the uptake of nitrogen compounds from soil (Liu et al. 2011; Shearer et al. 1983). This suggestion has been supported through the analysis of modern-day agricultural products. For example, Warinner et al. (2013) found little distinction between the nitrogen-isotope composition of cultivated leguminous and non-leguminous plants obtained from a modern Oaxacan market setting. This result echoes that of Spielmann et al. (1990), who documented nitrogen isotope values among modern cultivated beans (*Phaseolus vulgaris*) from the Southwest that suggest the incorporation of soil nitrogen rather than atmospheric nitrogen.

While agricultural practices in the past were certainly different from those employed today, there is reason to believe that they would have had similar nitrogen-cycle effects. *Chinampa* agriculture, in particular, may be expected to impact the nitrogen content and isotopic composition of soils, as they are fertilized with nitrogen-rich lake sediments (Biesboer et al. 1999; Coe 1964). Fertilization of soils with animal dung or guano (such as from domestic turkeys or waterbirds) also appears to increase soil nitrogen uptake among leguminous plants (Szpak et al. 2014). Given the likelihood that one or both of *chinampa* agriculture and some form of manure fertilization was occurring during the Teotihuacan period, it is not necessarily warranted to assume that the consumption of cultivated beans would have impacted the nitrogen isotope values in the bones of the city's population (cf. Warinner et al. 2013).

The ready availability of lake-based food resources within the Central Mexican plateau provides another consideration for understanding both carbon and nitrogen isotope values within the Teotihuacan population, particularly given Widmer's (1987:347) suggestion that fish obtained from the lake system within the Basin of Mexico may have played a relatively large role in the diet consumed by Teotihuacanos. Due partially to the fact that the lake system within the central Mexican plateau has been extensively drained and filled in through modern urban expansion, modern baseline isotopic analyses of lake resources from this particular ecological region have not been published. However, we can make informed hypotheses about the likely effect of the consumption of lake fish on the bone chemistry of Teotihuacan residents based on published isotopic data from other lacustrine systems. It should be noted here that while some forms of blue-green algae fix nitrogen, and therefore are relevant to our understanding of nitrogen food webs, the specific form of lake algae present in the lake system of the Basin of Mexico (*Spirulina geitleri*) is not a nitrogen-fixing species (Ciferri 1983).

While marine fish are typically expected to have carbon isotope values similar to those found in C_4-based protein sources (Schoeninger and DeNiro 1984; Sealy and van der Merwe 1986), the carbon isotope values of lacustrine fish instead tend to resemble those of C_3-based protein sources or to be intermediate between C_3 and C_4 resources (Katzenberg 1989; Katzenberg and Weber 1999; Schoeninger and DeNiro 1984). Different lake systems do have slightly different characteristic carbon isotope ranges for fish, however, due to ecologically different carbon inputs into the foodweb (Dufour et al. 1999). Fish derived from in particularly deep lakes more closely resemble those from marine foodwebs isotopically because, as in marine settings, a greater proportion of carbon inputs in deep lakes come from dissolved atmospheric CO_2 (Dufour et al. 1999; see also Miller et al. 2010). Lakes with high levels of dissolved inorganic carbon from carbonate-rich rocks may also have carbon isotope values similar to marine fish or C_4 plants (see Day 1996). However, the lake system in the Basin of Mexico was reportedly shallow for much of the year (Parsons 2006:11-26), and while the saline waters of part of the lake system contained salts that may contain some inorganic carbon from the natural weathering of surrounding rocks, high levels of dissolved inorganic carbon would not be expected in the primarily andesitic volcanic geology of the Basin of Mexico (Parsons 2001:148). Consequently, it is likely that the carbon isotope values of fish from this lake system would have been more isotopically depleted than those of C_4 resources in the region.

Nitrogen isotope values in lacustrine food webs tend to be intermediate between those in the marine ecosystem and those of terrestrial herbivores due to the generally shorter food chains within a lacustrine system as compared to the ocean (Schoeninger and DeNiro 1984). Globally, freshwater fish display a mean nitrogen isotope value of 9‰ +/- 3‰ (France 1995), though, as with carbon isotopes, these values can vary between different species and lake systems depending on the length of food chains within that system and the position of different fish species within the food chain (Dufour et al. 1999; Miller et al. 2010). Humans believed to be consuming a mix of both terrestrial herbivores and lacustrine fish have demonstrated nitrogen isotope values in the range of 10.7- 14.6‰ in Southern Ontario (Schwarcz et al. 1985) and 10.1-14.4‰ in the Cis-Baikal region of Siberia (Katzenberg and Weber 1999).

In general, few individuals at Teotihuacan show nitrogen isotope ratios in this range, suggesting that lake fish, while potentially incorporated into the diet of Teotihuacanos, do not seem to have been a large portion of the diet. Several individuals do, however, show high nitrogen isotope ratios that could conceivably be linked to lake fish consumption. Particularly, individual ACL-3063 TEO-LV8 from the La Ventilla Frente 2 compound displays a nitrogen isotope value of 11.45‰, well above the mean for the sample, and features a collagen carbon isotope value that, while still pointing to the predominance of C_4-based protein sources in the diet, is displaced toward the lower end of the Teotihuacan range. Additional high nitrogen isotope values are found among individuals interred within the Zacuala (ACL-5200 TEO-ZAC13; δ^{15}N=10.42‰), Tetitla (ACL-5183 TEO-TET12; δ^{15}N=10.67), and La Ventilla B (ACL-5162 TEO-LVB56; δ^{15}N=10.53) compounds, though these individuals display collagen carbon isotope values above the mean for Teotihuacan, making extensive lake fish consumption a seemingly unlikely cause of these nitrogen isotope values.

Elevated nitrogen isotope values in the range of 11-15‰ have been noted in dentinal collagen samples from the Teopancazco apartment compound (Casar et al. 2017; Morales Puente et al. 2012), though similarly high values have not been found in any of the somatic bone samples analyzed in any context within Teotihuacan. Morales Puente et al. (2012) attribute these high nitrogen isotope values to imported marine fish consumption, due to faunal evidence that suggests that elites within this compound engaged in unique exchange relationships with coastal areas. Both the faunal evidence and elevated nitrogen isotope values do not appear in other contexts that have been explored throughout the city.

It is worth noting that many of the fish referred to in postconquest records are said to be quite small, and therefore perhaps in a relatively low position within the lacustrine trophic system (Parsons 2006:43). Additionally, not all of the lake resources available to the residents of Teotihuacan were fish. During the postconquest period, lake food also included resources such as lake insects (*axaxayacatl*) dried cakes of *Spirulina geitleri* (*tecuitlatl*), water fowl, and amphibians such as frogs or salamanders (*axolotl*) (Parsons 2006). The nitrogen isotope results do not therefore rule out general lake resource consumption, though large quantities of lake fish consumption seem unlikely for all but a few individuals, as noted above.

However, perhaps the most convincing indication that lake resources did not play a large role in the diet of most Teotihuacanos lies in the overwhelming dominance of C_4 carbon inputs into both the protein and total diet components of diet. Were lake resources to have formed a large part of the diet, we should see this reflected in more intermediate δ^{13}C values that would shift individuals downward and to the left from the upper right corner of the C_4/marine protein regression line in Figure 8.2. This general lack of evidence for the exploitation of C_3 lake resources is perhaps a bit surprising given the diverse protein resources available within the lake system that were used as food at the time of conquest. Though lake resources do not seem to have been a large component of the diet, results are not inconsistent with the idea that smaller quantities of fish or other lake resources may have been eaten on occasion by residents to supplement the main dietary protein sources. Such a practice may potentially have contributed to some of the differences in carbon isotope values in bone collagen seen between groups within Teotihuacan. Therefore, though the overall level of consumption of these resources may have been low, it is possible that their consumption by different categories of people groups may nevertheless have been of social significance.

Diet and Socioeconomic Status

More interesting than simply the content of diet at Teotihuacan, however, are the implications of dietary differences in reinforcing social and economic distinctions amongst community members. To review, the isotopic data produced in this dissertation identified qualitatively different forms of dietary difference that appear to distinguish the three status groups analyzed in this dissertation from one another. Starting with the low status group, the urban poor at San José 520 consumed lower quantities of meat or other sources of animal protein, such as turkey eggs (cf. Widmer 1987:347), as compared to the remainder of society. This difference was reflected in their significantly lower nitrogen isotope values as compared to other groups. However, once people obtained a certain threshold level of socioeconomic status, overall levels of animal protein consumption no longer appear to have correlated with wealth and status. The mid and high status groups analyzed in this dissertation displayed small Cohen's *d* effect sizes and no statistically significant differences in mean nitrogen isotope values, statistics that jointly suggest that differences in animal food consumption between these groups were of little practical or statistical significance. The high status group may, however, have had access to a greater diversity of types of animal proteins (i.e., high-calcium animal protein food sources vs. low-calcium ones) among which to choose than did members of the middle status group, as indicated in the greater variability that high status individuals displayed in stable strontium isotope values. This outcome may explain some of the equivocal results that have been reported in the Teotihuacan literature regarding the relationship between animal-derived proteins and socioeconomic status, as reviewed in Chapter 5.

The distinctiveness in the plant component of the diet of the middle status group was highlighted by the meaningful differences between groups in carbonate carbon isotope, indicating total dietary carbon inputs, in conjunction with the lack of meaningful differences between groups in collagen carbon isotope values, reflecting the dietary carbon inputs primarily from protein sources. If a hypothetical average individual were to rise from the low status category into the broad middle status category, the low-protein plant component of his or her diet would become more intensively dominated by C_4 and CAM species as compared to other members of the urban poor. If this hypothetical average individual were to continue to rise from the middle status category into the high status category, his or her plant consumption would swing back to once again include a greater relative proportion of level of C_3 plant consumption.

I would like to caution here that simply because the diets of low and high status groups are isotopically more similar to one another within the carbon isotope system, this does not necessarily mean that these two groups were eating the same foods. While both groups are distinguished from the middle status group based on the incorporation of a slightly greater proportion of C_3 plant foods into their diets, the specific C_3 foods that were consumed by one group may have been very different from those consumed by another group. The economic or social reasons for consuming these foods may have been very different, as well.

For example, facing economic limitations that hindered their ability to fully participate in the market system circulating most agricultural goods, the urban poor at Teotihuacan may have relied more heavily than did other socioeconomic groups on supplementing their diets with foraged resources from the surrounding environment, some of which were likely to be C_3 plants afforded low symbolic value within the Teotihuacan cuisine system. Such a situation is known in modern contexts among Mexican *campesino* households who lack the economic resources to provision their households entirely using market means (DeWalt 1983a, 1983b). Simultaneously, the elevated economic standing of the members of the high socioeconomic group may have allowed them to enjoy greater quantities of highly valued imported foods, such as cacao, that also happened to be C_3 plants. The systematically different radiogenic strontium isotope values observed among individuals interred in high-status residential contexts that are likely related to the consumption of imported foods would support such a scenario for the high status group included here, though the radiogenic strontium isotope results do not bear directly on the issue of whether imported foods had a C_3 or C_4 carbon isotopic composition. Despite the consumption of very different food resources for very different economic reasons, the abovementioned scenario would result in relative isotopic equifinality of poor and elite diets in the carbon isotope system.

These results suggest two basic considerations that are currently only infrequently incorporated into isotopic models of diet and status: 1) the relationship between diet and status need not be continuous or linear throughout the socioeconomic hierarchy, and 2) gradations of status matter in fully characterizing the relationship between diet and status in a particular context. With respect to the first point, while theoretical discussions of the relationship between diet and status continue to become more sophisticated through time (e.g., Cuellar 2013; Curet and Pestle 2010; deFrance 2009; Twiss 2012), many isotope publications continue to feature an explicit or implicit assumption that increasing wealth should be more-or-less continuously related to increased consumption of certain highly-valued or expensive foodstuffs throughout the entire wealth spectrum. Where these highly-valued or expensive foodstuffs can be isotopically distinguished from other foods in some way, then isotope values should also move in a relatively continuous, unidirectional fashion as wealth and status increase. Common expectations within the

Precolumbian New World are that people consume greater quantities of animal protein and/or maize as their social position increases (e.g., Emery 2003; Somerville et al. 2013; Turner et al. 2010). While this expectation makes intuitive sense, it ignores the complexity of factors influencing food-choice within complex societies as reviewed in Chapter 3, not all of which may operate equally on individuals occupying different positions within the social landscape.

As we have seen in this dissertation, qualitatively different kinds of distinctions, rather than a linear trend, can differentiate between groups at different points in the socioeconomic hierarchy. My results do suggest that consumption of both animal-derived proteins and maize or other C_4/CAM plants were indicators of socioeconomic status differences within Teotihuacan society, though not in the expected or linear ways. First, overall levels of animal protein consumption appear to operate roughly in a threshold manner, whereby levels of animal protein consumption no longer increase after one reaches a certain threshold level of socioeconomic status. At Teotihuacan, this threshold effect occurred between the low and middle status groups at Teotihuacan. While nitrogen isotopes indicated a meaningful increase in animal protein consumption in the middle status group as compared to the low status group, levels of animal protein consumption did not continue to increase as we move up the status hierarchy to the high status group. While some threshold effects are currently recognized in the paleodiet literature, they usually are discussed only in the context of sumptuary foods that are limited via societal rules to elite individuals and that distinguish elite from nonelite diets (Curet and Pestle 2010). My results suggest that threshold effects need not be limited to distinguishing elite from nonelite groups; instead, the salient animal-protein distinction observed at

Teotihuacan took place between different subsets of commoners. Elites do not appear to be distinguished by any special access to different quantities of animal protein, though certainly it is possible that different species of animals or cuts of meat may have been restricted in a sumptuary fashion to elite individuals. Within Mesoamerica, the lack of a clear, linearly increasing relationship between animal food consumption and elevated status within the higher part of the social hierarchy may not be specific to Teotihuacan. Indeed, stable carbon and nitrogen isotopes in bone collagen from individuals interred at the site of Monte Alban also fail to demonstrate differences in nitrogen isotope values between presumed elite and non-elite burials (Blitz 1995).

Consumption of maize also does appear to vary according to socioeconomic status. However, the isotopic differences seen between groups are again anything but linear, with both the lowest and highest groups showing similar relative levels of consumption of C_3 and C_4/CAM plant products. This observation leads me to my second conclusion surrounding paleodiet and status: gradations of status matter. Perhaps because of the general assumption of a unilinear directionality to socioeconomic dietary differentiation, many studies of diet and socioeconomic status rely on a more-or-less dichotomous distinction between "elite" and "nonelite" in order to elucidate wealth or status-based differences in diet (e.g., Ambrose et al. 2003; Somerville et al. 2013; White 2005; though see Scherer et al. 2007). Admittedly, the tendency to dichotomize status is based both on the practical difficulties in clearly and precisely identifying the socioeconomic status of the deceased in many archaeological contexts (see Parker Pearson 1999) as well as on ethnohistoric analogy with later Mesoamerican societies, which held a strong cognitive distinction between the noble (*pipiltin* in Nahuatl; *al* *mehenob* in Yucatec Maya; *ajawab* in Quiche Maya) and the commoner estate (*macehualtin* in Nahuatl; *yalba uinic* in Yucatec Maya; *al c'ajol* in Quiche Maya) (Lockhart 1992; Marcus 1992), divisions that did, in many cases, correspond to differences not only in social status but also in wealth (see Chapter 2).

While this elite-nonelite distinction forms a valid, broad-scale division across ancient states in terms of status and wealth, finer-scale distinctions between individuals also existed within the noble and commoner estates that could also have had socioeconomically based dietary implications. While Spanish accounts of Zapotec society do attest to the existence of a divisions between hereditary nobles and commoners, there were also socially salient divisions within each of these strata, including royals, major, and minor nobles, landed commoners, landless serfs, and slaves (Flannery and Marcus 2012:376). In Aztec society, distinctions were drawn between ordinary hereditary nobles (*pipiltin*), major nobles who had earned offices (*tecuhtin*), and the ruler (*tlatoani*), as well as between *calpolli* heads, ordinary members of *calpolli*, landless serfs (*mayeque*), and slaves. The heads of *calpolli* had privileges not granted to other commoners, and were often wealthy enough to support multiple wives (Flannery and Marcus 2012:514-517).

Greater attention to such smaller-scale socioeconomic distinctions when possible could help to refine our understanding of socioeconomically-based dietary differentiation in premodern states. This is particularly true for divisions within the nonelite or commoner stratum, which comprised the vast majority of the population in most premodern states. While precise estimates vary, an elite socioeconomic stratum in a premodern state typically consists of a very small proportion of individuals, often estimated at roughly two percent of the population (Hicks 1999; Lenski 1966:219; Smith and Hicks 2016). By focusing only on the distinction between elites and nonelites, we may be ignoring the more subtle differences in diet among the vast majority of the population. These distinctions, whether based primarily on economic or social concerns, may arguably have been more readily apparent and socially salient to people within their everyday lives than those maintained between elite and nonelite individuals, as most social interactions would likely have occurred between commoners of different status and wealth levels, rather than between commoners and members of the elite.

Granted, the ability to detect socioeconomic distinctions at a smaller scale than an elite-nonelite dichotomy may be easier in certain contexts than in others. This dissertation project, for example, has undoubtedly benefitted from the relatively continuous and unconcentrated distribution of wealth across the Teotihuacan hierarchy as noted by a number of scholars (e.g., Manzanilla 1996, 2004, 2009; Smith et al. 2014). However, Smith and Olson (2016) have provided evidence that at least some variation within the commoner estate can be detected archaeologically within Postclassic Central Mexican contexts, and Scherer et al. (2007) provide criteria that may be used to distinguish among multiple status groupings in the mortuary record of the Classic Maya.

While there is still significant room to refine and test the ability of different archaeological lines of evidence to distinguish among smaller-scale socioeconomic groupings within past societies, this effort may be rewarded with greater understandings of socioeconomically based dietary differentiation. In the instance of Teotihuacan, the simple addition of a third status group shed light on dietary patterns that would not have been detected had the project compared only two of the three groups with one another. For example, had I sampled only the intermediate elite and the urban poor, no status-related differences in the consumption of C_4 or CAM resources would have been detected within the sample, and overall levels of animal food consumption would have been identified as the primary facet of diet that was related to status, with no recognition that this relationship held true only up to a certain threshold level of socioeconomic status. Similarly, had only the middle status and intermediate elite groups been compared, the resulting conclusions would have been exactly the opposite: differential consumption of C_4 or CAM resources was the only point of dietary distinction between elites and commoners, who uniformly consumed greater relative quantities of maize, cactus products, or other resources than did the elite. Incorporating more than two status groupings into the analysis allowed the recognition that both of these apparently conflicting interpretations were, to an extent, true.

An expectation concerning wealth-based differentiation in diet that does seem to be upheld within the results of this dissertation is the idea that the diets of wealthier individuals should be characterized by greater dietary diversity than those of less wealthy individuals due to the greater range of food resources that are within the range of economic possibility for individuals with greater economic means. Increased dietary diversity accompanying increased wealth has been demonstrated for the Classic Maya through both paleobotanical and biogeochemical studies (Lentz 1991; Whittington and Reed 1997) and in the prehispanic Malpaso Valley through paleobotanical remains within elite middens (Turkon 2004). In this dissertation, diversity within elite diets emerges primarily from the analysis of stable strontium isotope values, which show a much greater variation in values within the high status group as compared to other socioeconomic groupings, despite the smaller sample size of individuals incorporated into this grouping as compared to the broad middle status group.

Diet and Gender

As reviewed in Chapter 5, the study of gender at Teotihuacan has faced many interpretive difficulties through the years. Mortuary studies have repeatedly found only ambiguous differences in grave goods or funeral treatment between the sexes, and iconography at the site rarely portrays individuals who are easy for an outside observer to interpret through a gendered lens. There do appear to be, however, intriguing sex-based differences in diet that, on the whole, do not appear to correspond to systematic differential status between males and females.

At least within the middle and upper status portions of the social hierarchy, females at Teotihuacan were consuming slightly different protein sources than were their male counterparts. Specifically, the statistically lower $\delta^{13}C_{collagen}$ values of the females compared to the males within the sample suggest that women at Teotihuacan consumed protein sources that were more heavily based on C_3 inputs than did men. However, there is no evidence from stable nitrogen isotopes that women and men consumed different overall levels of animal-based protein. The differences between men and women in type (but not extent) of protein sources consumed are a qualitatively different kind of dietary distinction than those described above as characteristic of socioeconomic status differences in diet, which instead were based on differences primarily in the dietary energy sources (carbohydrates and lipids) or in overall levels of animal protein consumption. It also questions gendered expectations that women cross-culturally consume lower quantities of animal protein than men, whether due to a lower social status or to biological tendencies for females to seek out energy-dense carbohydrates (Cook and Hunt 1998).

While the overall extent of animal food consumption does not differentiate male and female diets at Teotihaucan, relative differences in the species of animal foods consumed seems to have taken on gendered significance. While the specific varieties of protein resources that appear to have been differentially associated with females are a matter of speculation, they seem to include some protein resources with a carbon isotope composition more heavily based on C_3 inputs than those consumed by males. Among other possibilities, these could include hunted rather than raised terrestrial animals or a range of different protein resources derived from the lacustrine system in the Basin of Mexico. Though the lack of statistically significant differences in nitrogen isotope values between males and females argues against the idea that differential lake fish consumption was exclusively responsible for these carbon isotope differences, gendered patterns in diet could have combined protein resources from a range of trophic levels within the lacustrine system, as has been previously described. Regardless, the manner of gendered dietary differentiation seen at Teotihuacan differs in type and seemingly extent from that seen among the Classic and Postclassic Maya, where males were distinguished from females based on greater animal protein consumption, greater direct consumption of C_4 foods, and greater consumption of C_4-fed animals (White 2005).

Socioeconomic status does appear to introduce additional complexities into the relationship between gender and diet. While the type of protein source was the only variable that distinguished the diet of intermediate elite males and females, both protein source and overall dietary carbon inputs as indicated by $\delta^{13}C_{carbonate}$ values differed between males and females within the broad middle-status group. As discussed above, isotopic differences in total dietary carbon were also one aspect of socioeconomic status-based differentiation in diet. However, if we are to interpret the overall dietary carbon differences between males and females in the middle-status group through the lens of status inequality, it is the females within this group who maintained a diet chemically more similar to that of the high status group than did the middle-status males. Here again, the issue of isotopic equifinality must be considered, as the specific foods that were differentially consumed by males and females in the middle-status group need not be the same exact foods that distinguished the diets of middle- and upper-status socioeconomic groups. Indeed, people attribute social meaning to specific foodstuffs, not to the underlying chemical sources of carbon contained within those foods, of which they were almost certainly not even aware.

This difference in gendered dietary patterns between socioeconomic groups is consistent with studies at Teotihuacan that suggest intrasocietal differences in gender ideology or roles within different segments of society (Clayton 2011). The broader literature on intersectionality in archaeology and elsewhere argues that the inseparability of gender from other social characteristics precludes a uniform valuation or treatment of members of the same broad gender category throughout the entire social landscape (e.g., Gilchrist 1999; Meskell 1999; Silverblatt 1987). Class and socioeconomic status have been regular foci of variation within this literature, due to ideas that the existence of a gendered division of labor inherently produces an overlap between gender systems and economic structures that may take different forms at different positions within a socioeconomic hierarchy (Baxter and Western 2002; Wright 2000; Zavella 1991).

Though diet does appear to be one way in which gender ideologies were performed in everyday life at Teotihuacan, like other indicators of gender difference at Teotihuacan, we are not able to read indicators of gender hierarchy or inequality into the evidence. Indeed, the dietary data produced in this dissertation support the idea that while consumption patterns may have differed between males and females due to any number of ideological factors, the differences between male and female diets do not map onto broader societal socioeconomic patterns that would suggests systematic greater access to particular status-related food resources among males as compared to females. This fact need not be surprising, given our understanding of the ways in which prehispanic gender systems operated within Mesoamerica. Numerous scholars have identified aspects of prehispanic or contact-period Mesoamerican cultures that indicate strong aspects of gender complementarity accompanying or supplanting gender inequality in contextually-specific ways (Ardren 2008; Joyce 2000b; McCafferty and McCafferty 1988). In the spiritual realm, for example, Joyce (2000b) notes that the Aztec pantheon includes numerous examples of paired male and female deities with strongly complementary roles, while in the more secular realm, McCafferty and McCafferty (1988) suggest that women played important roles in the economic realm in contact period Central Mexico as members of the *pochteca*, market administrators, and priestesses. While this tradition of gender complementarity does not rule out the possibility of unequal gendered power structures throughout time and space within Mesoamerica, it also provides us with a lens through which to understand other times and places that do not appear to provide firm evidence of this inequality.

Diet and Ethnicity

Food and cuisine frequently serve as a symbol of ethnic identification, both today and in the past (Barrett et al. 2001; Franklin 2001; Shuman 2008). In the case of Teotihuacan, Spence et al. (2005) have hypothesized that residents of the city's ethnic enclaves maintained differing dietary practices from the general residential population as seen in aspects of material culture such as the use of traditional Zapotec domestic ceramic forms in the Oaxaca Barrio or the lack of *comales* found in the ceramic assemblage of the Merchants' Barrio. However, previous isotopic analyses of paleodiet have not identified differences in the stable carbon or nitrogen isotope values characteristic of enclave residents as compared to other areas of the site (White et al. 2004b, 2008-2009).

The results of this dissertation project confirm that carbon and nitrogen isotopes do not appear to capture ethnic differences in cuisine between Oaxaca Barrio residents and other intermediate-status residents of Teotihuacan. This broad isotopic similarity speaks to a generally similar consumption of C_4 or CAM plants and similar overall levels of animal food consumption between Oaxaca Barrio and non-enclave residents of the site. However, it need not mean that meaningful culinary differences did not exist between the groups. Indeed, using a contemporary example, differences in the way that the same basic set of ingredients is prepared can mean the difference between a French baguette, Jewish challa, and Mediterranean pita. In a Mesoamerican context, different preparations of maize into such dishes as tortillas, atole, tamales, or posole are numerous and may have taken on ethnic significance at different times in the past.

However, this dissertation did identify other isotopic distinctions in the diet of Oaxaca Barrio residents compared to the non-enclave residential population. Statistically significant differences in stable strontium isotope values existed between the groups, with Oaxaca Barrio residents displaying values suggestive of greater levels of consumption of calcium-rich protein sources. While it is tempting to attribute the relatively low stable strontium isotope ratios found among a number of barrio residents to the consumption of lake fish, the nitrogen and carbon isotope values of these individuals do not differ from the norm in a way that would make this attribution unambiguous. Rather, while isotopic differences in diet are apparent between Oaxaca Barrio and non-enclave residents, a fuller exploration of the meaning behind these differences awaits the establishment of a baseline of stable strontium isotope values for the Basin of Mexico.

An additional question that can unfortunately not be answered directly here is to what degree the distinctive dietary practices followed within the Oaxaca Barrio mimicked culinary practices in the Zapotec homeland and to what degree they may instead represent a unique Oaxaca barrio culture that emerged within Teotihuacan in reference to non-barrio residents. Certainly, other cultural practices occurring within the Oaxaca Barrio, such as the continued use of distinctive Zapotec greyware pottery after these same styles had fallen out of fashion within the Oaxaca Valley, reflected but did not perfectly replicate practices from the Zapotec homeland (Spence 2002). Biogeochemical studies of diet within Classic-period Oaxaca are unfortunately sparse (but see Blitz 1995), and stable strontium isotope analysis remains an infrequently utilized paleodietary tool compared to the more established carbon and nitrogen isotope systems. Therefore, whether or not people from the Zapotec homeland were also consuming foods that would differentiate their stable strontium isotope values from those of non-enclave dwelling Teotihuacanos remains an open question.

Not only did the frequencies of consumption of different qualitative types of foods differ between Oaxaca Barrio and non-enclave residential groups, but as mentioned previously, radiogenic strontium isotopes also indicate that individuals living in the Oaxaca Barrio also seem to have consumed greater quantities of imported foods compared to the rest of the non-elite residential population of the site. This is not the first suggestion that residents of ethnic enclaves within the city may have obtained some portion of their foods nonlocally. White et al. (2008-2009), for example, hypothesize that residents of the Merchants' Barrio may have had greater dietary flexibility due to external connections with other regions. However, we cannot know whether or not the imported foods consumed by residents were the same types of foods that resulted in isotopic differences between groups in the stable strontium isotope system. Either one or both of these distinctive dietary practices could have helped to reinforce a sense of ethnic identity within the Oaxaca Barrio.

Diet and Subestate

While the effect on diet of prestige-based social categories linked to economic activities or roles is only rarely explored within the archaeological literature, the results of this dissertation suggest that, at least in certain cases, distinctive diets may have existed among subestate social categories that contribute to our overall understanding of group differentiation through foodways. As reviewed in Chapter 5, the symbolic salience of military status within Teotihuacan society is suggested by frequent depictions of a distinctive military costume in murals (Headrick 2007:72-74). Some researchers have also speculated that spaces within at least some barrio centers may have been used by a garrisoned military guard (Manzanilla 2009), and some murals have been interpreted to depict insignias that suggest the existence of military orders that transcend the household as a locus of identification (Headrick 2007:96-102; C. Millon 1988). Analogy with later central Mexican cultures would also suggest the salience of a military social category. While most common soldiers in the Aztec Empire did not have a fulltime military specialization, the high ranks of accomplished warriors do appear to have formed a distictive social group of individuals with specific costumes, titles, and social and economic privileges (Durán 1971:194-202; Hassig 1988, 1992). At the highest level, commoners who had been designated as minor lords based on accomplishments in warfare, called the *cuauhpipiltin*, served a specialized role during peacetime that included policing and executioner duties, roles in as military trainers in the *telpochcalli* schools, and a place in the war council (Hassig 1988:29; Hicks 1999). That there may have been at least some dietary distinctions involving the *cuauhpipiltin* is suggested by the right granted to these individuals by the king to consume human flesh and to drink *pulque* in public (Hassig 1988:45).

The sacrificial victims interred in the offering complex of the Feathered Serpent Pyramid have been interpreted as possible members of a military organization or elite guard (Cowgill 1997, 2015:97; Spence et al. 2004; White et al. 2002), though this interpretation has not been without critique (see Manzanilla 2001:392; Sugiyama 2005). While we should not assume that the Teotihuacan military system functioned in the same way as the later Aztec one, it is certainly interesting to note that the individuals interred in the Feathered Serpent Pyramid offering complex did have distinctive costumes and dietary patterns that seem to differentiate them from the general residential occupation of the site. The individuals interred within this offering complex consumed a diet that does not appear to correspond to that consumed by any of the residential groups so far analyzed, either within the current study or within the broader published literature. As mentioned in Chapter 7, the primary dietary differences that distinguished the members of the Feathered Serpent Pyramid sacrificial complex from individuals interred in residential contexts was a greater reliance on C_3-based proteins matched with isotopically depleted nitrogen isotope values that speak to low levels of animal protein consumption. While the urban poor interred at the San José 520 site consumed similarly low levels of animal protein, they were not similarly reliant on C_3-based proteins. Similarly, while females across all status groups relied on C_3-based proteins to a greater degree than did males, these females did not display the low average nitrogen isotope values found in the Feathered Serpent Pyramid sample. Therefore, the combination of these two measures is unique to the individuals interred in the Feathered Serpent Pyramid.

There is some possibility, however, that this distinctive diet may be related to temporal differences between the Feathered Serpent Pyramid sample and other individuals incorporated into this dissertation. As mentioned previously, individuals interred within the Feathered Serpent Pyramid offering complex were deposited at some point during the construction of the pyramid structure during the Miccaotli and Early

Tlamimilolpa phases (A.D. 150-250), while individuals from the residential contexts were buried during the Tlamimilolpa, Xolalpan, and Metepec ceramic phases. Consequently, while there is likely temporal overlap between the sample from the Feathered Serpent Pyramid and the sample from the residential contexts, the residential samples also include individuals living and buried during later periods of occupation at the site. The likelihood that changes through time in the diet of Teotihuacan's general residential population are responsible for the apparent distinctiveness in the diet of the Feathered Serpent Pyramid sample may, however, be lessened somewhat by the fact that no temporal trends in stable carbon or nitrogen isotope values were observed within the multi-phase samples from the residential sites (see Chapter 7).

If individuals interred within this sacrificial deposit do indeed represent soldiers, it may be the case that the distinct military occupation of these individuals required them to consume a diet different from that consumed by the majority of civilians. Though the oxygen isotope values in the bones of the sacrificed individuals suggest primarily local residence during the last years of their lives, it is possible that they may nevertheless have been deployed for certain periods of time relatively locally within the Basin of Mexico if not farther afield (cf. Spence et al. 2004). Consequently, their diet may have emphasized rations that were easily portable and avoided spoilage (e.g., C_3 protein-rich legumes such as beans) or that could be easily obtained from local environments (e.g., locally hunted C_3-consumers such as deer). Low trophic-level lake resources such as *tecuitlatl* or *axaxayácatl* are another possibility. Similarly, the relatively low animal-protein consumption observed amongst these individuals could also be due to a diet that emphasized portable rations such as maize tortillas over animal-protein foods that would be subject to spoilage. Therefore, the dietary regime seen among these individuals could reflect their social role as soldiers over their economic status within Teotihuacan society.

Socioeconomic Mobility in the Archaeological Record

The multifaceted relationships between dietary practices and social and economic identities at Teotihuacan allow the use of dietary indicators to explore issues of socioeconomic mobility within the archaeological record. This dissertation project has delineated a model for the archaeological study of social mobility that relies on two basic steps: 1) the identification of isotopic paleodietary patterns that vary with socioeconomic status but that can be distinguished from other dietary patterns associated with characteristics such as age, gender, ethnicity, or occupation and 2) the comparison of dietary history between different points in a single individual's life to identify lifetime dietary change consistent with movement among socioeconomic groups. While I have also delineated a number of ways in which the archaeological identification of socioeconomically mobile individuals could shed light on the structure and distribution of socioeconomic mobility opportunities within past societies, the limited sample size of individuals identified as socioeconomically mobile within this project prevented me from being able to address these issues with the data at hand. A full reflection on the limitations of the methodological approach developed within this dissertation and suggestions for moving forward with an archaeology of social mobility are included within the concluding chapter of this dissertation. However, despite these limitations, the dissertation has also produced some notable successes.

My results suggest that dietary patterns at Teotihuacan were ideal to allow lifetime dietary change to serve as a proxy for socioeconomic mobility within this archaeological context. As delineated above, clear isotopic patterns exist that distinguish socioeconomic groupings within the Teotihuacan social landscape. With the exception of a slight overlap with gendered distinctions in diet specific to the middle status grouping, the type and combinations of isotope systems involved in socioeconomic status-based dietary patterns were qualitatively different from those that distinguished individuals based on ethnicity, gender, or subestate. Additionally, only minimal age-related effects to diet were demonstrated between the two portions of the lifecourse represented by the third molar and rib samples used to assess lifetime dietary change.

The incorporation of information from radiogenic strontium and stable oxygen isotopes allowed me to screen all individuals for nonlocal residence during these two portions of life in question in order to account for the ecological, economic, or social impacts of nonlocal residence on diet during one or both of the periods of life represented by the skeletal elements being compared. Following this initial screening, one individual (ACL-5170/5171 TEO-LVB101) stood out as experiencing the type and extent of dietary change that would be consistent with downward mobility between an intermediate elite and middle status group. While gender was implicated above as one potential confounding factor in attributing changes in total dietary carbon composition to social mobility, this individual consumed a diet early in his life that fell well outside of the values characteristic of either sex in the middle status compounds in which he was ultimately interred.

The small sample size of individuals who could be evaluated for lifetime dietary change after controlling for nonlocal residence was relatively low, at only 18 individuals. One individual, therefore, represents a nontrivial proportion at roughly 6% of the total sample, though the degree to which this proportion is representative of broader trends in socioeconomic mobility is, of course, unknown. A 95% confidence interval produces a range for the true population proportion of socioeconomic mobility from roughly zero to 30% of the population. As mentioned above, larger intrasocietal patterns with respect to the age, gender, or ethnicity of socioeconomically mobile individuals cannot be delineated with the current dataset, due to the small sample size of individuals who could be evaluated for lifetime dietary change.

A contextual understanding of the single individual who was identified as socioeconomically mobile based on dietary indicators can nevertheless provide a perspective on topics of interest. Particularly, we may be interested in whether or not this individual was in any way treated differently from other individuals within the mortuary record of the residential compound in which he was finally interred. Due to suggestions that burial practices at Teotihuacan varied at least in part based on residential compound (Clayton 2011), I evaluate the characteristics of individual ACL-5170/5171 TEO-LVB101 and his mortuary treatment with reference to the other individuals interred within La Ventilla B. I focus here on the positioning and orientation of the body, which have been suggested to hold social significance within the Teotihuacan mortuary program (Clayton 2011), and on associated mortuary offerings.

The individual designated as ACL-5170/5171 TEO-LVB 101 was an adult male interred in a single primary burial within the Cuarto Muro Blanco of the La Ventilla B compound. He displayed full eruption of the third molar and completely fused epiphyses where preserved, indicating full skeletal maturity. However, no age diagnostic elements of the skeleton remained that could have been used to provide a more specific age estimate for this individual. The individual in Burial 101 was uncovered in a flexed dorsal body posture, oriented along an east-west axis with his head pointed to the west (Serrano and Lagunas 1999). While a flexed body positioning is not unusual within the entire mortuary program of this apartment compound, it is not particularly common within adult male burials. Among 35 adult male primary burials in La Ventilla B, the majority (74%, n=26) were instead interred in a vertical, seated position, while only 14% (n=5) of the adult males buried in the compound were interred in a flexed dorsal position. Instead, this flexed dorsal positioning was much more common among subadult individuals (n=19) within La Ventilla B, with 63% (n=12) of juvenile and infant individuals interred on their back (Serrano and Lagunas 1999). Burial along the east-west axis is typical of dorsal flexed internments, and roughly equal proportions of the individuals interred on their backs oriented with their heads toward the west and toward the east. Most seated burials are oriented with their faces to the east. The combination of body positioning and orientation seen in individual ACL-5170/5171 TEO-LVB 101 only appeared in 11% (n=4) of adult males excavated from La Ventilla B, in contrast with the more normative practice of burying adult male individuals in a seated, flexed position facing the east (74% of adult males). Unfortunately, no other individuals with a similar body positioning and orientation to individual ACL-5170/5171 TEO-LVB 101 were chemically analyzed within this project.

This individual had only a single polychrome pot sherd as a burial offering (Sempowski 1994) and remains unphased due to the lack of accompanying phase-diagnostic burial offerings. While it is not unheard of for individuals within the La Ventilla B compound to be buried with minimal or no burial offerings (26% of 154 burials), only 20% (n=7) of adult male primary burials within La Ventilla B received less than an entire ceramic vessel in their associated burial offerings (Sempowski 1994). While there are many aspects of the mortuary program within specific compounds at Teotihuacan that still elude our full understanding, it does appear that individual ACL-5170/5171 TEO-LVB 101 received mortuary treatment that was distinct from the dominant practice within La Ventilla B of interring adult males in a seated, flexed position facing the east and with multiple associated burial goods. While we can only speculate about the underlying reasons for this burial treatment, it may be the case that due to this individual's downward socioeconomic mobility, he was not as integrated into the social life of the residential group as firmly as other individuals who had been born and raised within a middle socioeconomic status grouping.

The results of this project have provided substantial new data about both diet and geographic mobility at Teotihuacan and have allowed for the identification of an individual from the La Ventilla B compound who likely experienced downward social mobility from a high to a mid status group. In the concluding chapter of this dissertation, I reflect on both the successes and limitations of this research in developing and piloting the use of an isotopic approach to socioeconomic mobility in the archaeological record.

CHAPTER 9: CONCLUSION

This research has addressed the way in which multiple isotopic systems can be productively combined in order to investigate socioeconomic mobility in archaeological cases. The data presented in this dissertation paint a picture of a highly socially diverse urban society, containing many individuals who had spent some portion of their lives gaining experience with people and places outside of the city proper. Faced with diverse dietary resources found in the lakes, agricultural fields, animal pens, and wilderness surrounding their homes, people used foodways to make sense of the many different categories of people around them and to reinforce their own belonging into certain social groups. Occasionally, people were able to leave the economic or social categories in which they spent their early lives to create a different life in a different social milieu. When this happened, traces of this earlier identity remained within their bones and, perhaps, impacted the way in which they were viewed and treated within their new social and economic setting. In concluding this dissertation, I reflect on the factors that limited this project from fulfilling its full objectives and to suggest future directions for research into socioeconomic mobility in the archaeological record.

As previously reviewed, this research has demonstrated that, given certain conditions, it is possible to study socioeconomic mobility using isotopic paleodietary indicators. Despite the potential for diet to pattern in complicated and overlapping ways with different social identities, it was possible in the case of Teotihuacan to pick out differences related to socioeconomic status from differences linked to other social identities. The existence of subfloor burials within residential space allowed the socioeconomic status of an individual at the time of his or her death to be identified within a broad categorization scheme, and comparisons of the paleodietary information encapsulated within bones and teeth allowed the identification of instances in which an individual's diet during the early portion of his or her life was outside of the range of variation that would be expected given his or her socioeconomic group membership at the time of death. These two factors, namely the existence of a mortuary program that facilitates the identification of an individual's socioeconomic status at the time of death and strong socioeconomically-based dietary differentiation, allowed the first identification using isotopic data of a specific individual as socially mobile during his lifetime.

Despite these successes, however, several factors worked together to limit the degree to which this particular study was able to address broader societal patterns in the extent and distribution of socioeconomic mobility opportunities. In Chapter 2, I developed a model that aimed to characterize mobility along both the overall prevalence of social mobility and the distribution of mobility opportunities across social and economic categories. Because of the small sample size of individuals who could be assessed for lifetime dietary change after controlling for nonlocal residence, I was not able to address these issues with the specificity that I would have liked. Two major factors worked together to cause this to be the case in this dissertation: 1) poor skeletal preservation and 2) a relatively high rate of geographic mobility among individuals during the period of life represented by third molar samples.

While I had initially aimed to sample paired bone and tooth samples for 150 individuals, the final sample numbered 81 individuals, only 39 of whom were represented by both a rib and third molar sample due to preservational conditions at Teotihuacan. Frequently, rib samples were friable and highly fragmented, and burials at Teotihuacan do not always include a full dentition due either to poor preservation or to instances of secondary burial within the mortuary program. Therefore, at the outset of the analysis, the subset of individuals who could be evaluated for lifetime dietary change had already been reduced to 48% of the total sample. After starting with this limited subset, the relatively high frequency within the sample of individuals who had resided nonlocally during at least one of the relevant periods of life removed many more samples from consideration. By the end of the process, only 18 individuals could be assessed for lifetime dietary change, a much smaller sample than the 150 individuals planned in the original project design. While a more minor contributor, the unexpected systematic variation of stable strontium isotope values with tissue type also reduced the toolkit through which to evaluate instances of lifetime dietary change in the Teotihuacan sample.

Far from being an indication that the issues of the prevalence and distribution of mobility opportunities in ancient states are not feasible subjects for investigation, the limitations of this dissertation serve as lessons that point a way forward for the archaeological study of socioeconomic mobility. Particularly, they emphasize that the potential to elaborate the methodological approach developed in this dissertation may lie in specific world regions where skeletal preservation and high rates of geographic mobility pose less of a problem than in Central Mexico. The Andean region may represent a particularly promising area for future research, given 1) the range of complex, and at times urban, societies that arose across the region throughout its history, 2) the frequently excellent skeletal preservation found in large skeletal collections throughout the region, 3) expectations that diet may vary isotopically with socioeconomic status based on cultural emphasis on the high status of maize and on ritual feasting centered around maize beer, or *chicha*, consumption (Bray 2003b; Cuellar 2013; Ubelaker et al. 1995), and 4) well-studied mortuary practices that, while variable in time and place, can at times include burial in association with residential space, in multiple cemeteries that are sometimes interpretable in socioeconomic terms, or with a variety of well-preserved mortuary remains and personal artifacts such as textiles that may shed light on socioeconomic distinctions between individuals (Isbell and Korpisaari 2015; Toohey et al. 2016; Torres-Rouff et al. 2015).

This is not to say that future analyses at Teotihuacan cannot expand upon the results presented here in order to provide a more comprehensive picture of socioeconomic mobility processes at Teotihuacan. Indeed, there are a number of skeletal collections from the site that were not incorporated into this dissertation due to funding or other practical constraints, and even more that continue to be uncovered as excavations continue at the site. Future research aimed at social mobility processes at Teotihuacan may be particularly interesting given some evidence for civil unrest surrounding the decline of the urban center (Cowgill 2015:233), as social mobility available to some groups but not to others may have been a point of contention among members of Teotihuacan society.

In sum, the potential exists for the methodology developed in this dissertation to continue to inform analyses of socioeconomic mobility in a range of geographic areas and time periods. The general methodological approach is not necessarily limited to the socioeconomic realm and could easily be adapted to address other lifetime shifts in social identities, such as ethnic acculturation or changes in lineage or faction membership. The only requirement for such an adjustment would be that such social identities pattern strongly enough with dietary differentiation within the particular cultural context in question for lifetime dietary change to be able to serve as a proxy for changes in social identity. Given the decades of research on the relationship of diet to a variety of social identities (Gumerman 1997; Mintz and DuBois 2002; Twiss 2012), we are now in a position where isotopic studies of paleodiet can become a tool to understand not only how social identities and economic status were expressed through daily behaviors but also to investigate flexibility and change in how people related to their broader social landscape.

REFERENCES

Åberg, Gören, Gunnar Jacks, and P. Joseph Hamilton
1989 Weathering Rates and $^{87}Sr/^{86}Sr$ Ratios: an Isotopic Approach. *Journal of Hydrology* 109:65-78.

Adriano-Morán, Carmen Cristina, and Emily McClung de Tapia
2008 Trees and Shrubs: The Use of Wood in Prehispanic Teotihuacan. *Journal of Archaeological Science* 35:2927-2936.

Allen, Catherine J.
2002 *The Hold Life Has: Coca and Cultural Identity in an Andean Community*. Smithsonian Institution Press, Washington, D.C.

Althusser, Louis
1969 *Reading Capital*. New Left Books, London.
1970 *For Marx*. Penguin, London.
1984 *Essays on Ideology*. Verso, London.

Altschul, Jeffrey H.
1987 Social Districts of Teotihuacan. In *Teotihuacan: nuevos datos, nuevas sintesis, nuevos problemas*, edited by Emily McClung de Tapia and Evelyn Rattray, pp. 197-217. Universidad Autónoma de Mexico, Mexico City.

Ambrose, Stanley H.
1990 Preparation and Characterization of Bone and Tooth Collagen for Isotopic Analysis. *Journal of Archaeological Science* 17:431-451.
1991 Effects of Diet, Climate, and Physiology on Nitrogen Isotope Abundances in Terrestrial Foodwebs. *Journal of Archaeological Science* 18:293-317.
2000 Controlled Diet and Climate Experiments on Nitrogen Isotope Ratios of Rats. In *Biogeochemical Approaches to Paleodietary Analyses*, edited by Stanley H. Ambrose and M. Anne Katzenberg, pp. 243-259. Plenum Press, New York.

Ambrose, Stanley H., and Michael J. DeNiro
1986 The Isotopic Ecology of East African Mammals. *Oecologia* 69:395-406.
1987 Bone Nitrogen Isotope Composition and Climate. *Nature* 325:201.

Ambrose, Stanley H., and Lynette Norr
1993 Experimental Evidence for the Relationship of the Carbon Stable Isotope Ratios of Whole Diet and Dietary Protein to those of Bone Collagen and Carbonate. In *Prehistoric Human Bone: Archaeology at the Molecular Level*, edited by Joseph B. Lambert and Gisela Grupe, pp. 1-38. Springer-Verlag, Berlin.

Ambrose, Stanley J., Jane Buikstra, and Harold W. Krueger
2003 Status and Gender Differences in Diet at Mound 72, Cahokia, Revealed by Isotopic Analysis of Bone. *Journal of Anthropological Archaeology* 22:217-226.

Ames, Kenneth
2008 The Archaeology of Rank. In *Handbook of Archaeological Theories*, edited by R. Alexander Bentley, Herbert D.G. Maschner, and Christopher Chippindale, pp. 487-513. AltaMira Press, Lanham, Maryland.

Amundson, Ronald, A.T. Austin, E.A.G. Schuur, K. Yoo, V. Matzek, C. Kendall, A. Uebersax, D. Brenner, and W.T. Baisden
2003 Global Patterns of the Isotopic Composition of Soil and Plant Nitrogen. *Global Biogeochemical Cycles* 17:1031.

Anawalt, Patricia R.
1993 Rabbits, *Pulque*, and Drunkenness: A Study of Ambivalence in Aztec Society. In *Current Topics in Aztec Studies: Essays in Honor of H.B. Nicholson*, edited by Alana Cordy-Collins and Douglas Sharon, pp. 17-38. Papers of the San Diego Museum, San Diego.

Anderson, Eugene N.
1982 'Heating' and 'Cooling' Foods in Hong Kong and Taiwan. *Social Science Information* 19:237-268.
2010 Food and Feasting in the Zona Maya of Quintana Roo. In *Pre-Columbian Foodways: Interdisciplinary Approaches to Food, Culture, and Markets in Ancient Mesoamerica,* edited by John E. Staller and Michael D. Carrasco, pp. 441-465. Springer, New York.

Anderson, D.L., G.W. Thompson, and F. Popovich
1976 Age of Attainment of Mineralization Stages of the Permanent Dention. *Journal of Forensic Sciences* 21:191-200.

Angulo Villaseñor, Jorge
1987 Nuevas consideraciones sobre los llamados conjuntos departamentales especialmente Tetitla. In *Teotihuacan: nuevos datos, nuevas síntesis, nuevos problemas*, edited by Emily McClung de Tapia and Evelyn Childs Rattray, pp. 275-315. Universidad Nacional Autónoma de México, Mexico City.

Appadurai, Arjun
1981 Gastropolitics in Hindu South Asia. *American Ethnologist* 8:494-511.
1986 Introduction: Commodities and the Politics of Value. In *The Social Life of Things: Commodities in Cultural Perspective*, edited by Arjun Appadurai, pp. 3-63. Cambridge University Press, Cambridge.

Arber, Sara
2005 Inequalities in Later Life: Gender, Marital Status, and Health Behaviors. In *Analyzing Inequality: Life Chances and Social Mobility in Comparative Perspective*, edited by Stefan Svallfors, pp. 129-164. Stanford University Press, Stanford, California.

Archer Velasco, Jorge N.
2012 Practicas Funerarias y Condiciones de Vida en el Barrio Oaxaqueño de la Ciudad Prehispánica de Teotihuacan. Tesis de Licenciatura, Escuela Nacional de Antropología e Historia, Mexico City.

Ardren, Traci
2008 Studies of Gender in the Prehispanic Americas. *Journal of Archaeological Research* 16:1-35.

Arnold, Philip P.
1999 *Eating Landscape: Aztec and European Occupation of Tlalocan*. University Press of Colorado, Boulder, Colorado.

Ash, Major M., and Stanley J. Nelson
2003 *Wheeler's Dental Anatomy, Physiology, and Occlusion*. W.B. Saunders, Philadelphia.

Atalay, Sonya, and Christine A. Hastorf
2006 Food, Meals, and Daily Activities: Food *Habitus* at Neolithic Çatalhöyük. *American Antiquity* 71:283-230.

Aveni, Anthony F.
1980 *Skywatchers of Ancient Mexico*. University of Texas Press, Austin.

Avila Serratos, M.A.
2012 *Recetario Tradicional del Distrito Federal*. Cocina Indígena y Popular 58. Conaculta, Mexico City.

Babić, Staša
2005 Status Identity and Archaeology. In *The Archaeology of Identity: Approaches to Gender, Age, Status, Ethnicity and Religion*, edited by Margarita Díaz-Andreu, Sam Lucy, Staša Babić, and David N. Edwards, pp. 67-85. Routledge, London.

Balasse, Marie
2003 Potential Biases in Sampling Design and Interpretation of Intra-Tooth Isotope Analysis. *International Journal of Osteoarchaeology* 13:3-10.

Barba, Luis, Jorge Blancas, Linda R. Manzanilla, Agustin Ortiz, Donatella Barca, Gino M. Crisci, Domenico Miriello, and Alessandra Pecci
2009 Provenance of the Limestone Used in Teotihuacan (Mexico): A Methodological Approach. *Archaeometry* 51:525-545.

Barker, Lewis M., editor
1982 *The Psychobiology of Human Food Selection*. Avi, Westport, Connecticut.

Barlow, K. Renee
2002 Predicting Maize Agriculture among the Fremont: An Economic Comparison of Farming and Foraging in the American Southwest. *American Antiquity* 67:65-88.

Barnes, Barry
1988 *The Nature of Power*. Polity, Cambridge.

Barrett, James H., Roelf P. Beukens, and Rebecca A. Nicholson
2001 Diet and Ethnicity during the Viking Colonization of Northern Scotland: Evidence from Fish Bones and Stable Carbon Isotopes. *Antiquity* 75:145-154.

Barth, Frederik
1969 *Ethnic Groups and Boundaries: The Social Organization of Culture Difference*. Waveland Press, Prospect Heights, Illinois.

Baxter, Janeen, and Mark Western, editors
2001 *Reconfigurations of Class and Gender*. Stanford University Press, Stanford, California.

Beauchamp, Gary K.
1981 Ontogenesis of Taste Preferences. In *Food, Nutrition, and Evolution: Food as an Environmental Factor in the Genesis of Human Variability*, edited by Dwain N. Walcher and Norman Kretchmer, pp. 49-57. Masson, New York.

Beard, Brian L., and Clark M. Johnson
2000 Strontium Isotope Composition of Skeletal Material Can Determine the Birth Place and Geographic Mobility of Humans and Animals. *Journal of Forensic Sciences* 45:1049-1061.

Beck, Brenda E.F.
1969 Colour and Heat in South Indian Ritual. *Man* 4:553-572.

Becker, Howard S., and James W. Carper
1956 The Development of Identification with an Occupation. *The American Journal of Sociology* 61:289-298.

Bennett, John W.
1943 Food and Social Status in a Rural Society. *American Sociological Review* 8:561-569.

Bentley, R. Alexander
2006 Strontium Isotopes from the Earth to the Archaeological Skeleton: A Review. *Journal of Archaeological Method and Theory* 13:135-187.

Berdan, Frances F.
1982 *The Aztecs of Central Mexico: An Imperial Society*. Holt, Rinehart, and Winston, New York.

Berlo, Janet Catherine
1992 Icons and Ideologies at Teotihuacan: The Great Goddess Reconsidered. In *Art, Ideology, and the City of Teotihuacan*, edited by Janet Catherine Berlo, pp. 129–168. Dumbarton Oaks, Washington, D.C.

Berna, Francesco, Alan Matthews, and Stephen Weiner
2004 Solubilities of Bone Mineral from Archaeological Sites: The Recrystallization Window. *Journal of Archaeological Science* 31: 867-882.

Berreman, Gerald D.
1981 Social Inequality: A Cross-Cultural Analysis. In *Social Inequality: Comparative and Developmental Approaches*, edited by Gerald D. Berreman, pp. 59-80. Academic Press, New York.

Berrin, Kathleen, editor.
1988 *Feathered Serpents and Flowering Trees: Reconstructing the Murals of Teotihuacan*. Fine Arts Museums of San Francisco, San Francisco.

Bertrand, Marianne, and Sendhil Mullainathan
2003 Are Emily and Greg More Employable Than Lakisha and Jamal? A Field Experiment on Labor Market Discrimination. *American Economic Review* 2004: 991-1013.

Biesboer David, Michael Binford, and Alan Kolata
1999 Nitrogen Fixation in Soils and Canals of Rehabilitated Raised-Fields of the Bolivian Altiplano. *Biotropica* 31: 255-267.

Biskowski, Martin F.
1997 The Adaptive Origins of Prehispanic Markets in Central Mexico: The Role of Maize-Grinding Tools and Related Staple Products in Early State Economies. Ph.D. dissertation, The University of California, Los Angeles.
2017 Staple Food Preparation at Teotihuacan. *Anthropological and Archaeological Sciences* 9:29-38.

Blanton, Richard E., and Lane F. Fargher
2008 *Collective Action in the Formation of Pre-Modern States*. New York: Springer.

Blau, Peter, and Joseph E. Schwartz
1984 *Crosscutting Social Circles*. Academic Press, New York.

Blitz, Jennifer Ayn
1995 Dietary Variability and Social Inequality at Monte Albán, Oaxaca, Mexico. Ph.D. dissertation, The University of Wisconsin, Madison.

Bliege Bird, Rebecca, and Douglas W. Bird
1997 Delayed Reciprocity and Tolerated Theft. *Current Anthropology* 38:49-78.

Blucher, Darlena K.
1971 Late Preclassic Cultures in the Valley of Mexico: Pre-Urban Teotihuacan. Ph.D. dissertation, Brandeis University, Waltham, Massachusetts.

Blum, Joel D., E. Hank Taliaferro, Marie T. Weisse, and Richard T. Holmes
2000 Changes in Sr/Ca, Ba/Ca, and $^{87}Sr/^{86}Sr$ Ratios Between Trophic Levels in Two Forest Ecosystems in the Northeastern USA. *Biogeochemistry* 49:87-101.

Bocherens, Hervé, Marilyn L. Fogel, Noreen Tuross, and Melinda Zeder
1995 Trophic Structure and Climatic Information from Isotopic Signatures in Pleistocene Cave Fauna of Southern England. *Journal of Archaeological Science* 22:327-340.

Bourdieu, Pierre
1984 *Distinction: A Social Critique of the Judgment of Taste*. Harvard University Press, Cambridge, Massachusetts.

Bowen, Joanne
1992 Faunal Remains and Urban Household Subsistence in New England. In *The Art and Mystery of Historical Archaeology*, edited by Anne Elizabeth Yentsch and Mary C. Beaudry, pp. 267-281. CRC Press, Boca Raton, Florida.

Bowen, Gabriel J., and Bruce Wilkinson
2002 Spatial Distribution of $\delta^{18}O$ in Meteoric Precipitation. *Geology* 30:315-318.

Branca, Francesco, and Simon P. Robins
1992 Bone Turnover in Malnourished Children. *Lancet* 340:1493-1497.

Braswell, Geoffrey E., editor
2003 *The Maya and Teotihuacan: Reinterpreting Early Classic Interaction*. University of Texas Press, Austin, Texas.

Bray, Tamara L., editor
2003a *The Archaeology and Politics of Food and Feasting in Early States and Empires*. Kluwer Academic/Plenum, New York.

Bray, Tamara L.
2003b Inka Pottery as Culinary Equipment: Food, Feasting and Gender in Imperial State Design. *Latin American Antiquity* 14:3-28.

Breen, Richard, and Jan O. Jonsson
2005 Inequality of Opportunity in Comparative Perspective: Recent Research on Educational Attainment and Social Mobility. *Annual Review of Sociology* 31:223-243.

Brill, Winston J.
1977 Biological Nitrogen Fixation. In *Human Nutrition: Readings from Scientific American*, edited by Norman Kretchmer and William Robertson, pp. 18-27. W.H. Freeman and Company, San Francisco.

Brooks, Sheilagh, and Judy M. Suchey
1990 Skeletal Age Determination Based on the Os Pubis: A Comparison of the Acsádi-Nemeskéri and Suchey-Brooks Methods. *Human Evolution* 5:227-238.

Brown, Clifford T., April A. Watson, Ashley Gravlin-Beman, and Larry S. Liebovitch
2014 Poor Mayapan. In *The Ancient Maya of Mexico: Reinterpreting the Past of the Northern Maya Lowlands*, edited by Geoffrey E. Braswell, pp. 306-324. Routledge, New York.

Brown, Donald E.
1988 *Hierarchy, History, and Human Nature: The Social Origins of Historical Consciousness*. The University of Arizona Press, Tucson, Arizona.

Brown, Tom A., D. Erie Nelson, John S. Vogel, and John R. Southon
1988 Improved Collagen Extraction by Modified Longin Method. *Radiocarbon* 30:171-177.

Brubaker, Rogers, and Frederick Cooper
2000 Beyond "Identity". *Theory and Society* 29:1-47.

Brumfiel, Elizabeth M., and Timothy K. Earle
1987 Specialization, Exchange and Complex Societies: An Introduction. In *Specialization, Exchange, and Complex Societies*, edited by Elizabeth M. Brumfiel and Timothy K. Earle, pp. 1-9. Cambridge University Press, New York.

Brumfiel, Elizabeth M., and John W. Fox, editors
1994 *Factional Competition and Political Development in the New World*. Cambridge University Press, New York.

Bryant, J. Daniel, and Philip N. Froelich
1995 A Model of Oxygen Isotope Fractionation in Body Water of Large Mammals. *Geochimica et Cosmochimica Acta* 59:4523–4537.

Budd, Paul, Janet Montgomery, A. Cox, P. Krause, Barbara Barreiro, and Richard G. Thomas
1998 The Distribution of Lead Within Ancient and Modern Human Teeth: Implications for Long-Term and Historical Exposure Modeling. *The Science of the Total Environment* 220:121-136.

Budd, Paul, Janet Montgomery, Barbara Barreiro, and Richard G. Thomas
2000 Differential Diagenesis of Strontium in Archaeological Human Dental Tissues. *Applied Geochemistry* 15:687-694.

Buikstra, Jane E., and Douglas H. Ubelaker
1994 *Standards for Data Collection from Human Skeletal Remains*. Arkansas Archaeological Survey, Fayetville, Arkansas.

Burton, James H.
2008 Bone Chemistry and Trace Element Analysis. In *Biological Anthropology of the Human Skeleton*, edited by M. Anne Katzenberg and Shelley R. Saunders, pp. 443-460. Wiley-Liss, Hoboken, New Jersey.

Burton, James H., and Lori E. Wright
1995 Nonlinearity in the Relationship between Bone Sr/Ca and Diet: Paleodietary Implications. *American Journal of Physical Anthropology* 96:273-282.

Burton, James H., and T. Douglas Price
2013 Seeking the Local $^{87}Sr/^{86}Sr$ Ratio to Determine Geographic Origins of Humans. In *Archaeological Chemistry VIII*, edited by Ruth Ann Armitage and James H. Burton, pp. 309-320. University of Wisconsin-Madison, Madison, Wisconsin.

Burton, James H., T. Douglas Price, and William D. Middleton
1999 Correlation of Bone Ba/Ca and Sr/Ca Due to Biological Purification of Calcium. *Journal of Archaeological Science* 26:609-616.

Burton, James H., T. Douglas Price, Laura Cahue, and Lori E. Wright
2003 The Use of Barium and Strontium Abundances in Human Skeletal Tissues to Determine their Geographic Origins. *International Journal of Osteoarchaeology* 13:88-95.

Butler, Judith
1990 *Gender Trouble: Feminism and the Subversion of Identity*. Routledge, New York.
1993 *Bodies that Matter: On the Discursive Limits of "Sex"*. Routledge, New York.

Cabrera Cortés, M. Oralia
2006 Craft Production and Socio-economic Marginality: Living on the Periphery of Teotihuacán, Mexico. Report submitted to the Foundation for the Advancement of Mesoamerican Studies, Inc.

2011 Craft Production and Socio-economic Marginality: Living on the Periphery of Urban Teotihuacan. Ph.D. dissertation, Arizona State University, Tempe, Arizona.

Cabrera Castro, Rubén

1995 Atetelco. In *La pintura mural prehispánica en Mexico, I, Teotihuacán, Tomo 1, Catálogo*, edited by Beatriz de la Fuente, pp. 202-256. Mexico City: Instituto de Investigaciones Estéticas, Universidad Nacional Autónoma de México, Mexico City.

1996 Las excavaciones en La Ventilla, un barrio Teotihuacano. In *Revista Mexicana de estudios antropológicos*, Vol. XLII, pp. 5-30. Sociedad Mexicana de Antropología, Mexico City.

1998 El urbanismo y la arquitectura en La Ventilla. Un barrio en la ciudad de Teotihuacán. In *Antropología e historia del occidente de México: XXIV mesa redonda de la Sociedad Mexicana de Antropología*, pp. 1523-1547. Mexico City: Sociedad Mexicana de Antropología and Universidad Nacional Autónoma de México, Mexico City

2000 Teotihuacan Cultural Traditions Transmitted into the Postclassic According to Recent Excavations. In *Mesoamerica's Classic Heritage: from Teotihuacan to the Aztecs*, edited by David Carrasco, Lindsay Jones, and Scott Sessions, pp. 195-218. University of Colorado Press, Boulder, Colorado.

2002 La expresión pictórica de Atetelco, Teotihuacan. Su significado con el militarismo y el sacrificio humano. In *Ideología y política a través de materials, imagines y símbolos: memoria de la primera mesa redonda de Teotihuacan*, edited by María Elena Ruiz Gallut, pp. 137-164. Universidad Nacional Autónoma de México and Instituto Nacional de Antropología e Historia, Mexico City.

Cabrera Castro, Rubén, and Sergio Gómez Chávez

2008 La Ventilla: A Model for a Barrio in the Urban Structure of Teotihuacan. In *Urbanism in Mesoamerica/El Urbanismo en Mesoamérica, vol. II*, edited by Alba Guadalupe Mastache, Robert H. Cobean, Ángel García Cook, and Kenneth G. Hirth, pp. 37-83. Instituto Nacional de Antropología e Historia and The Pennsylvania State University, Mexico City and University Park, Pennsylvania.

Cabrera Castro, Rubén, and Enrique Soruco S.

1982 Pequeños basamentos habitacionales en la Calle de los Muertos. In *Memoria del Proyecto Arqueológico Teotihuacan 80-82*, edited by Rubén Cabrera Castro, Ignacio Rodríguez G., and Noel Morelos G., pp. 217-224. Mexico City: Instituto Nacional de Antropología e Historia.

Cabrera Castro, Rubén, Saburo Sugiyama, and George L. Cowgill

1991 The Temple of Quetzalcoatl Project at Teotihuacan: A Preliminary Report. *Ancient Mesoamerica* 2:77-92.

Carballo, David M.
2007 Implements of State Power: Weaponry and Martially Themed Obsidian Production Near the Moon Pyramid, Teotihuacan. *Ancient Mesoamerica* 18:173-190.

Carr, T.E.F., G.E. Harrison, John F. Loutit, and Alice Sutton
1962 Movement of Strontium in the Human Body. *British Medical Journal* 2:773-775.

Calvin, Melvin
1962 The Path of Carbon in Photosynthesis. *Science* 135:879-889.

Calvin, Melvin, and Andrew A. Benson
1948 The Path of Carbon in Photosynthesis. *Science* 107:476-480.

Capo, Rosemary C., Brian W. Stewart, and Oliver A. Chadwick
1998 Strontium Isotopes as Tracers of Ecosystem Processes: Theory and Methods. *Geoderma* 82:197-225.

Casales, Margarito, and Josefina Tavera
1995 Informe general de los análisis botánicos realizados a materiales asociados a entierros y elementos. Report submitted to the archive of the Proyecto La Ventilla, Teotihuacan.

Casar, Isabel, Pedro Morales, Linda R. Manzanilla, Edith Cienfuegos, and Francisco Otero
2017 Dietary Differences in Individuals Buried in a Multiethnic Neighborhood in Teotihuacan: Stable Dental Isotopes from Teopancazco. *Archaeological and Anthropological Sciences* 9:99-115.

Castro, Alfonso, N. Thomas Hakansson, and David Brokensha
1981 Indicators of Rural Inequality. *World Development* 9:401-427.

Caut, Stéphane, Elena Angulo, and Franck Courchamp
2009 Variation in Discrimination Factors ($\Delta^{15}N$ and $\Delta^{13}C$): The Effect of Diet Isotopic Values and Applications for Diet Reconstruction. *Journal of Applied Ecology* 46:443-453.

Cavero Carrasco, Ranulfo
1986 *Maíz, chicha y religiosidad andina*. Universidad Nacional de San Cristobal de Huamanga, Ayacucho.

Chadwick, Oliver A., Louis A. Derry, Peter M. Vitousek, B.J. Huebert, and L.O. Hedin
1999 Changing Sources of Nutrients During Four Million Years of Ecosystem Development. *Nature* 397:491-497.

Charlton, Thomas H.
1977 Report on a Prehispanic Canal System, Otumba, Estado de Mexico: Archaeological Investigations, August 10-19, 1977. Report submitted to the Instituto Nacional de Antropología e Historia, Mexico City.
1978 Investigaciones arqueológicas en el Municipio de Otumba, primera parte: resultos preliminaries de los trabajos de campo, 1978. Report submitted to the Consejo de Arqueología, Instituto Nacional de Antropología e Historia, Mexico City.

Cheetham, David
2010 Corn, Colanders, and Cooking: Early Maize Processing in the Maya Lowlands and Its Implications. In *Pre-Columbian Foodways: Interdisciplinary Approaches to Food, Culture, and Markets in Ancient Mesoamerica*, edited by John E. Staller and Michael Carrasco, pp. 345-368. Springer, New York.

Chilcote, Celise
2010 Inferring Activity Patterns from Human Skeletal Morphological Variations at Teotihuacan. M.A. thesis, Trent University, Peterborough, Ontario, Canada.

Child, Angela M.
1995 Towards an Understanding of the Microbial Decomposition of Archaeological Bone in the Burial Environment. *Journal of Archaeological Science* 22:165-174.

Chisholm, Brian S., D. Erle Nelson, and Henry P. Schwarcz
1982 Stable Carbon Isotope Ratios as a Measure of Marine Versus Terrestrial Protein in Ancient Diets. *Science* 216:1131-1132.

Chisholm, Brian S., D. Erle Nelson, Keith A. Hobson, Henry P. Schwarcz, and Martin Knyf
1983 Carbon Isotope Measurement Techniques for Bone Collagen: Notes for the Archaeologist. *Journal of Archaeological Science* 10:355-360.

Christenson, Andrew L.
1980 Change in the Human Food Niche in Response to Population Growth. In *Modeling Change in Prehistoric Subsistence Economies*, edited by Timothy K. Earle and Andrew L. Christenson, pp. 31-71. Academic Press, New York.

Christie, Maria E.
2008 *Kitchenspace: Women, Fiestas, and Everyday Life in Central Mexico*. University of Texas Press, Austin.

Cid Beziez, José Rodolfo, and Liliana Torres Sanders
1997 El sacrificio infantil, su contexto y evidencia. In *Estudios de antropología biológica*, vol. VIII, pp. 83-96. Universidad Nacional Autónoma de México, Mexico City.

1999 El sacrificio humano y la sacralización de espacios y elementos arquitectónicos en Teotihuacan. *Anales de Antropología 1995* 32:53-71.
2004 El traumatismo en el simbolismo ritual en el Clásico Teotihuacano. In *Perspectiva tafonómica: evidencias de alteraciones en restos* óseos *del México prehispánico*, edited by Carmen Pijoan and Xabier Lizarraga, pp. 129-144. Instituto Nacional de Antropología e Historia, Mexico City.

Ciferri, Orio.
1983 *Spirulina*, the Edible Microorganism. *Microbiological Reviews* 47:551-578.

Civera, Magalí
1993 Análisis osteológico de los entierros de Oztoyahualco. In *Anatomía de un conjunto residencial Teotihuacano en Oztoyahualco*, vol. 2, edited by Linda Manzanilla, pp. 832-859. Universidad Nacional Autónoma de México, Mexico City.
1997 La población prehispánica de Teotihuacan a través de sus entierros. *Estudios de Antropología Biológica* 6:309-321.

Clark, John E., and Michael Blake
1994 The Power of Prestige: Competitive Generosity and the Emergence of Rank Societies in Lowland Mesoamerica. In *Factional Competition and Political Development in the New World*, edited by Elizabeth M. Brumfiel and John W. Fox, pp. 17-32. Cambridge University Press, Cambridge.

Clayton, Sarah C.
2005 Interregional Relationships in Mesoamerica: Interpreting Maya Ceramics at Teotihuacan. *Latin American Antiquity* 16:427-448.
2009 Ritual Diversity and Social Identities: A Study of Mortuary Behaviors at Teotihuacan. Ph.D. dissertation, Arizona State University, Tempe, Arizona.
2011 Gender and Mortuary Ritual at Ancient Teotihuacan, Mexico: A Study of Intrasocietal Diversity. *Cambridge Archaeological Journal* 21:31-52.

Cobb, Charles R.
1996 Specialization, Exchange, and Power in Small-Scale Societies and Chiefdoms. *Research in Economic Anthropology* 17:251-294.

Coe, Michael D.
1964 The Chinampas of Mexico. *Scientific American* 2010-2011: 90-98.

Coe, Sophie D.
1994 *America's First Cuisines*. University of Texas Press, Austin.

Coe, Sophie D., and Michael D. Coe
1996 *The True History of Chocolate*. Thames and Hudson, London.

Cohen, Jacob
1988 *Statistical Power Analysis for the Behavioral Sciences.* Lawrence Earlbaum Associates, Hillsdale, New Jersey.
1992 A Power Primer. *Psychological Bulletin* 112:155-159.

Coleman, James S.
1990 *Foundations of Social Theory*. Harvard University Press, Cambridge, Massachusetts.

Collins, Patricia Hill
2000 *Black Feminist Thought: Knowledge, Consciousness, and the Politics of Empowerment*. Routledge, New York.

Collins, Matthew J., Michael S. Riley, Angela M. Child, and Gordon Turner-Walker
1995 A Basic Mathematical Simulation of the Chemical Degradation of Ancient Collagen. *Journal of Archaeological Science* 22:175-183.

Collins, Matthew J., Christina M. Nielsen-Marsh, Jennifer Hiller, Colin I. Smith, J.P. Roberts, Richard V. Prigodich, Tim J. Wess, J. Csapó, Andrew R. Millard, and Gordon Turner-Walker
2002 The Survival of Organic Matter in Bone: A Review. *Archaeometry* 44:383-394.

Comar, C., R. Scott Russell, and Robert H. Wasserman
1957 Stontium-Calcium Movement from Soil to Man. *Science* 126:485-492.

Conkey, Margaret W., and Janet D. Spector
1984 Archaeology and the Study of Gender. *Advances in Archaeological Method and Theory* 7:1-38.

Cook, Della Collins, and Kevin D. Hunt
1998 Sex Differences in Trace Elements: Status or Self-Selection? In *Sex and Gender in Paleopathological Perspective*, edited by Anne L. Grauer and Patricia Stuart-Macadam, pp. 64-78. Cambridge University Press, New York.

Cook de Leonard, Carmen
1957 Proyecto del CIAM en Teotihuacan. Excavaciones en la Plaza 1, 'Tres Palos,' Teotihuacan. *Boletín del Centro de Invesitgaciones Antropológicas de México*, núm 4.

Cooper, Cyrus, and Richard Eastell
1993 Bone Gain and Loss in Premenopausal Women. *British Medical Journal* 306:1357-1359.

Coplen, Tyler B.
1994 Reporting of Stable Hydrogen, Carbon, and Oxygen Isotope Abundances. *Pure and Applied Chemistry* 66:271-276.

Coplen Tyler B., Carol Kendall, and Jessica Hopple
1983 Comparison of Stable Isotope Reference Samples. *Nature* 302:236-238.

Corcoran, Mary and Terry Adams
1997 Race, Sex, and the Intergenerational Transmission of Poverty. In *Consequences of Growing Up Poor*, edited by Greg J. Duncan and Jeanne Brooks-Gunn, pp. 461-517. Russell Sage Foundation, New York.

Córdova F., Carlos, Ana Lillian Martín de Pozzo, and Javier López Camacho
1994 Paleolandforms and Volcanic Impact on the Environment of Prehistoric Cuicuilco, Southern Mexico City. *Journal of Archaeological Science* 21:585-596.

Cormie, Allison B. and Henry P. Schwarcz
1994 Stable Isotopes of Nitrogen and Carbon of North American White-Tailed Deer and Implications for Paleodietary and Other Food Web Studies. *Palaeogeography, Palaeoclimatology, Palaeoecology* 107:227-241.

Correa-Ascencio, Marisol, Ian G. Robertson, Oralia Cabrera-Cortés, Rubén Cabrera-Castro, and Richard P. Evershed
2014 Pulque Production from Fermented Agave Sap as a Dietary Supplement in Prehispanic Mesoamerica. *Proceedings of the National Academy of Sciences* 111:14223-14228.

Cowgill, George L.
1983 Rulership and the Ciudadela: Political Inferences from Teotihuacan Architecture. In *Civilization in the Ancient Americas*, edited by Richard M. Leventhal and Alan Kolata, pp. 313-343. University of New Mexico Press, Albuquerque.
1992a Social Differentiation at Teotihuacan. In *Mesoamerican Elites: An Archaeological Assessment*, edited by Diane Z. Chase and Arlen F. Chase, pp. 206-220. University of Oklahoma Press, Norman, Oklahoma.
1992b Toward a Political History of Teotihuacan. In *Ideology and Pre-Columbian Civilizations*, edited by Arthur A. Demarest and Geoffrey W. Conrad, pp. 87-114. School of American Research Press, Santa Fe, New Mexico.
1993 Comments on Andrew Sluyter: Long-Distance Staple Transport in Western Mesoamerica: Insights through Quantitative Modeling. *Ancient Mesoamerica* 4:201-203.
1997 State and Society at Teotihuacan, Mexico. *Annual Reviews of Anthropology* 26:129-161.

2003 Teotihuacan: Cosmic Glories and Mundane Needs. In *The Social Construction of Ancient Cities*, edited by Monica L. Smith, pp. 37-55. Smithsonian Institution Press, Washington, D.C.

2007 The Urban Organization of Teotihuacan, Mexico. In *Settlement and Society: Essays Dedicated to Robert McCormick Adams*, edited by Elizabeth C. Stone, pp. 261-295. Cotsen Institute of Archaeology, University of California, Los Angeles and the Oriental Institute of the University of Chicago, Chicago.

2008 Teotihuacan as an Urban Place. In *El Urbanismo en Mesoamérica/Urbanism in Mesoamerica*, edited by William T. Sanders, Alba Guadelupe Mastache, and Robert H. Cobean, pp. 85-112. Instituto Nacional de Antropología e Historia and Pennsylvania State University, Mexico City and University Park, Pennsylvania.

2015 *Ancient Teotihuacan: Early Urbanism in Central Mexico*. New York: Cambridge University Press, New York.

Cowgill, George L., Jeffrey H. Altschul, and Rebecca S. Sload

1984 Spatial Analysis of Teotihuacán: A Mesoamerican Metropolis. In *Intrasite Spatial Analysis in Archaeology*, edited by Harold J. Hietula, pp. 154-195. Cambridge University Press, Cambridge.

Craig, Harmon

1961 Standards for Reporting Concentrations of Deuterium and Oxygen-18 in Natural Waters. *Science* 133:1833-34.

Craig, Harmon, and Louis I. Gordon

1965 Deuterium and Oxygen-18 Variations in the Ocean and Marine Atmosphere. In *Stable Isotopes in Oceanographic Studies and Paleo-Temperatures*, edited by Ezio Tongiorgi, pp. 9-130. Laboratorio di Geologia Nucleare, Pisa, Italy.

Crane, Cathy J., and H. Sorayya Carr

1994 The Integration and Quantification of Economic Data from a Late Preclassic Maya Community in Belize. In *Paleonutrition: The Diet and Health of Prehistoric Americans*, edited by Kristin D. Sobolik, pp. 66-79. Center for Archaeological Investigations Occasional Paper No. 22. Southern Illinois University at Carbondale, Carbondale, Illinois.

Crenshaw, Kimberlé

1989 Demarginalizing the Intersection of Race and Sex: A Black Feminist Critique of Antidiscrimination Doctrine, Feminist Theory and Antiracist Politics. *The University of Chicago Legal Forum* 140:139-167.

Crespo Oviedo, Ana María, and Alba Guadelupe Mastache
1981 La presencia en el area Tula, Hidalgo, de grupos relacionados con el Barrio de Oaxaca en Teotihuacan. In *Interacción cultural en Mexico central*, edited by Evelyn Rattray, Jaime Litvak, and Clara Diaz, pp. 99-106. Instituto de Investigaciones Antropológicas, Universidad Nacional Autónoma de México, Mexico City.

Croissier, Michelle M.
2007 The Zapotec Presence at Teotihuacan, Mexico: Political Ethnicity and Domestic Identity. Ph.D. dissertation, University of Illinois at Urbana-Champaign, Urbana-Champaign, Illinois.

Crone, Patricia
1989 *Pre-Industrial Societies*. Blackwell, Oxford.

Crumley, Carole L.
1995 Heterarchy and the Analysis of Complex Societies. In *Heterarchy and the Analysis of Complex Societies*, edited by Robert M. Ehrenreich, Carole L. Crumley, and Janet E. Levy, pp. 1-5. Archaeological Papers of the American Anthropological Association, No. 6., American Anthropological Association, Washington, D.C.

Cuellar, Andrea M.
2013 The Archaeology of Food and Social Inequality in the Andes. *Journal of Archaeological Research* 21:123-174.

Curet, L. Antonio, and William J. Pestle
2010 Identifying High-Status Foods in the Archaeological Record. *Journal of Anthropological Archaeology* 29:413-431.

D'Altroy, Terence N., and Timothy K. Earle
1985 Staple Finance, Wealth Finance, and Storage in the Inka Political Economy. *Current Anthropology* 26:187-206.

D'Ortenzio, Lori, Megan Brickley, Henry Schwarcz, and Tracy Prowse
2015 You Are Not What You Eat During Physiological Stress: Isotopic Evaluation of Human Hair. *American Journal of Physical Anthropology* 157:374-388.

Dansgaard, Willi
1964 Stable Isotopes in Precipitation. *Tellus* 16:436-468.

Davis, Dona Lee
1986 Occupational Community and Fishermen's Wives in a Newfoundland Fishing Village. *Anthropological Quarterly* 59:129-142.

Davis, Kingsley, and Wilbert E. Moore
1945 Some Principles of Stratification. *American Sociological Review* 10:242-249.

Day, S.P.
1996 Dogs, Deer and Diet at Star Carr: A Reconsideration of C-isotope Evidence from Early Mesolithic Dog Remains from the Vale of Pickering, Yorkshire, England. *Journal of Archaeological Science* 23:783-787.

de Souza, Gregory F., Ben C. Reynolds, Mirjam Kiczka, and Bernard Bourdon
2010 Evidence for Mass-dependent Isotopic Fractionation of Strontium in a Glaciated Granitic Watershed. *Geochimica et Cosmochimica Acta* 74:2596-2614.

de Vries, David
1997 National Construction of Occupational Identity: Jewish Clerks in British-Ruled Palestine. *Comparative Studies in Society and History* 39:373-400.

deFrance, Susan D.
2009 Zooarchaeology in Complex Societies: Political Economy, Status, and Ideology. *Journal of Archaeological Research* 17:105-168.

DeGarine, Igor
1993 Coping Strategies in Case of Hunger of the Most Vulnerable Groups among the Massa and Mussey of Northern Cameroon. *GeoJournal* 30:159-166.

DeGarine, Igor, and Claude M. Hladik
1990 Nutritional Concepts: Perception, Food Prohibitions and Prescriptions. In *Food and Nutrition in the African Rainforest*, edited by Claude M. Hladik, Serge Bahuchet, and Igor DeGarine, pp. 92-94. UNESCO, Paris.

Deines, Peter
1980 The Isotopic Composition of Reduced Organic Carbon. In *Handbook of Environmental Isotope Geochemistry: I. The Terrestrial Environment*, edited by Peter Fritz, and Jean-Charles Fontes, pp. 329– 406. Elsevier, Amsterdam.

DeNiro, Michael J.
1985 Postmortem Preservation and Alteration of *in vivo* Bone Collagen Isotope Ratios in Relation to Palaeodietary Reconstruction. *Nature* 317:806-809.
1987 Stable Isotopy and Archaeology. *American Scientist* 75:182-191.

DeNiro, Michael J., and Samuel Epstein
1978 Influence of Diet on the Distribution of Carbon Isotopes in Animals. *Geochimica et Cosmochimica Acta* 42:495-506.
1981 Influence of Diet on the Distribution of Nitrogen Isotopes in Animals. *Geochimica et Cosmochimica Acta* 45:341-351.

DeNiro, Michael J., and Christine A. Hastorf
1985 Alteration of $^{15}N/^{14}N$ and $^{13}C/^{12}C$ Ratios of Plant Matter During the Initial Stages of Diagenesis: Studies Utilizing Archaeological Specimens from Peru. *Geochimica et Cosmochimica Acta* 49:97-115.

DeNiro, Michael J., Margaret J. Schoeninger, and Christine A. Hastorf
1985 Effect of Heating on the Stable Carbon and Nitrogen Isotope Ratios of Bone Collagen. *Journal of Archaeological Science* 12:1-7.

Desor, J.A., Lawrence S. Greene, and Owen Maller
1975 Preference in Sweet and Salty in 9- to 15-Year-Old and Adult Humans. *Science* 190:686-687.

DeWalt, Kathleen M.
1983a Income and Dietary Adequacy in an Agricultural Community. *Social Science and Medicine* 17:1877-1886.
1983b *Nutritional Strategies and Agricultural Change in a Mexican Community*. UMI Research Press, Ann Arbor, Michigan.

Diaz, Clara
1981 Chingú y la expansión Teotihuacana. In *Interacción cultural en Mexico central*, edited by Evelyn Rattray, Jaime Litvak, and Clara Diaz, pp. 106-112. Instituto de Investigaciones Antropológicas, Universidad Nacional Autónoma de México, Mexico City.

Díaz-Andreu, Margarita, and Sam Lucy
2005 Introduction. In *The Archaeology of Identity: Approaches to Gender, Age, Status, Ethnicity, and Religion*, edited by Margarita Díaz-Andreu, Sam Lucy, Staša Babic, and David N. Edwards, pp. 1-12. Routledge, London.

Diener, Paul, and Eugene E. Robkin
1978 Ecology, Evolution and the Search for Cultural Origins: The Question of Islamic Pig Prohibition. *Current Anthropology* 19:493-540.

Dietler, Michael
1996 Feasts and Commensal Politics in the Political Economy: Food, Power, and Status in Prehistoric Europe. In *Food and the Status Quest: An Interdisciplinary Perspective*, edited by Polly Wiessner and Wulf Schiefenhövel, pp. 87-125. Berghahn Books, Oxford.
2001 Theorizing the Feast: Rituals of Consumption, Commensal Politics, and Power in African Contexts. In *Feasts: Archaeological and Ethnographic Perspectives on Food, Politics, and Power*, edited by Michael Dietler and Brian Hayden, pp. 65-114. Smithsonian Institution Press, Washington, D.C.

Dobberstein, Reimer C., Matthew J. Collins, Oliver E. Craig, G. Taylor, K.E.H. Penkman, and Stefanie Ritz-Timme
2009 Archaeological Collagen: Why Worry About Collagen Diagenesis. *Archaeological and Anthropological Sciences* 1:31-42.

Doolittle, William E.
1990 *Canal Irrigation in Prehistoric Mexico: The Sequence of Technological Change*. University of Texas Press, Austin.

Douglas, Mary
1966 *Purity and Danger: An Analysis of Concepts of Pollution and Taboo*. Penguin Books, Baltimore, Maryland.
1984 *Food and the Social Order: Studies of Food and Festivities in Three American Communities.* Russell Sage Foundation, New York.

Dow, James W.
1967 Astronomical Orientations at Teotihuacan: A Case Study in Astro-Archaeology. *American Antiquity* 32:326-334.

Drennan, Robert D.
1984 Long-Distance Movement of Goods in the Mesoamerican Formative and Classic. *American Antiquity* 49:27-43.

Drewitt, Bruce
1987 Measurement Units and Building Axes at Teotihuacan. In *Teotihuacan: nuevos datos, nuevas síntesis, nuevos problemas,* edited by Emily McClung de Tapia and Evelyn C. Rattray, pp. 389-398. Instituto de Investigaciones Antropológicas, Universidad Nacional Autónoma de México, Mexico City.

Drewnowski, Adam, and M.R. Greenwood
1983 Cream and Sugar: Human Preferences for High-fat Foods. *Physiology & Behavior* 30:629-633.

Dufour, Elise, Hervé Bocherens, and André Mariotti
1999 Paleodietary Implications of Isotopic Variability in Eurasian Lacustrine Fish. *Journal of Archaeological Science* 26:617-627.

Duncan, Otis Dudley, and Robert W. Hodge
1963 Education and Occupational Mobility: A Regression Analysis. *American Journal of Sociology* 68:629-644.

Durán, Fray Diego
1971 *Book of the Gods and Rites and the Ancient Calendar*. Translated by Fernando Horcasitas and Doris Heyden. University of Oklahoma Press, Normal, Oklahoma.
1994 *The History of the Indies of New Spain*. Translated by Doris Hayden. University of Oklahoma Press, Norman, Oklahoma.

Earle, Timothy
1997 *How Chiefs Come to Power: The Political Economy in Prehistory*. Stanford University Press, Stanford, California.

Eby, G. Nelson
2004 *Principles of Environmental Geochemistry*. Brooks/Cole, Belmont, California.

Elias, Robert W., Y. Hirao, and Claire C. Patterson
1982 The Circumvention of the Natural Biopurification of Calcium along Nutrient Pathways by Atmospheric Inputs of Industrial Lead. *Geochimica et Cosmochimica Acta* 46: 2561-2580.

Elson, Christina M., and R. Alan Covey
2006 Intermediate Elites in New World States and Empires. In *Intermediate Elites in Pre-Columbian States and Empires*, edited by Christina M. Elson and R. Alan Covey, pp. 3-20. The University of Arizona Press, Tucson, Arizona.

Emberling, Geoff
1997 Ethnicity in Complex Societies: Archaeological Perspectives. *Journal of Archaeological Research* 5:295-344.

Emery, Kitty F.
2003 The Noble Beast: Status and Differential Access to Animals in the Maya World. *World Archaeology* 34:498-515.

Emery, Kitty F., Lori E. Wright, and Henry Schwarcz
2000 Isotopic Analysis of Ancient Deer Bone: Biotic Stability in Collapse Period Maya Land-Use. *Journal of Archaeological Science* 27:537-550.

Epstein, Samuel, and T. Mayeda
1953 Variation of O^{18} Content of Waters from Natural Sources. *Geochimica et Cosmochimica Acta* 4:213-224.

Erikson, Robert
1990 Politics and Class Mobility: Does Politics Influence Rates of Social Mobility? In *Generating Inequality in the Welfare State*, edited by Inga Persson, pp. 247-266. Norewegian University Press, Oslo, Norway.

Erikson, Robert and John H. Goldthorpe
1992 *The Constant Flux: A Study of Class Mobility in Industrial Societies*. Clarendon Press, Oxford.

Ervynck, Anton, Wim Van Neer, Heide Hüster-Plogmann, and Jörg Schibler
2003 Beyond Affluence: The Zooarchaeology of Luxury. *World Archaeology* 34:428-441.

Fabre-Vassas, Claudine
1997 *The Singular Beast: Jews, Christians, and the Pig*. Columbia University Press, New York.

Faure, Gunter
1986 *Principles of Isotope Geology*. John Wiley, New York.

Faure, Gunter, and James L. Powell
1972 *Strontium Isotope Geology*. Springer-Verlag, New York.

Featherman, David L., F. Lancaster Jones, and Robert M. Hauser
1978 Assumptions of Social Mobility Research in the U.S.: The Case of Occupational Status. In *Social Mobility in Comparative Perspective*, edited by Włodzimierz Wesołowski, Kazimierz M. Słomczyński, and Bogdan W, Mach, pp.81-109. The Polish Academy of Sciences Press, Warsaw, Poland.

Fenner, Jack N., and Lori E. Wright
2014 Revisiting the Strontium Contribution of Sea Salt in the Human Diet. *Journal of Archaeological Science* 44:99-103.

Feinman, Gary M., and Joyce Marcus, editors
1998 *Archaic States*. School of American Research Press, Santa Fe, New Mexico.

Fisher, Genevieve, and Diana DiPaolo Loren
2003 Special Section, Embodying Identity in Archaeology: Introduction. *Cambridge Archaeological Journal* 13:225-230.

Flannery, Kent V.
1972 The Cultural Evolution of Civilizations. *Annual Review of Ecology and Systematics* 3:399-426.
1998 The Ground Plans of Archaic States. In *Archaic States*, edited by Gary M. Feinman and Joyce Marcus, pp. 15-57. School of American Research Press, Santa Fe, New Mexico.

Flannery, Kent, and Joyce Marcus
2012 *The Creation of Inequality: How our Prehistoric Ancestors Set the Stage for Monarchy, Slavery, and Empire*. Harvard University Press, Cambridge, Massachusetts.

Foucault, Michel
1970 *The Order of Things*. Tavistock, London.
1977 *Discipline and Punish: The Birth of the Prison*. Allen Lane, London.
1980 *Power/Knowledge*. Pantheon, New York.

Form, William
1979 Comparative Industrial Sociology and the Convergence Hypothesis. *Annual Review of Sociology* 5:1-25.

France, Robert
1995 Stable Nitrogen Isotopes in Fish: Literature Synthesis on the Influence of Ecotonal Coupling. *Estuarine, Coastal, and Shelf Science* 41:737-742.

Frankenstein, Susan, and Michael J. Rowlands
1978 The Internal Structure and Regional Context of Early Iron-Age Society in South-Western Germany. *Bulletin of the London University Institute of Archaeology* 15:73-112.

Franklin, Maria
2001 The Archaeological and Symbolic Dimensions of Soul Food: Race, Culture, and Afro-Virginian Identity. In *Race, Material Culture, and the Archaeology of Identity*, edited by Charles E. Orser, pp. 88-107. Salt Lake City: University of Utah Press.

Fried, Morton H.
1967 *The Evolution of Political Society: An Essay in Political Anthropology*. Random House, New York.

Friedlander, Judith
1975 *Being Indian in Hueyapan: A Study of Forced Identity in Contemporary Mexico*. Saint Martin's Press, New York.

Froehle, Andrew W., Corina M. Kellner, and Margaret J. Schoeninger
2010 FOCUS: Effect of Diet and Protein Source on Carbon Stable Isotope Ratios in Collagen: Follow up to Warinner and Tuross (2009). *Journal of Archaeological Science* 37:2662-2670.

Fukumoto, Ivan K., and David B. Grusky
1993 Social Mobility and Class Structure in Early-Industrial France. In *Building European Society: Occupational Change and Social Mobility in Europe, 1840-1940*, edited by Andrew Miles and David Vincent, pp. 40-67. Manchester University Press, Manchester, United Kingdom.

Fuller, Benjamin T., James L. Fuller, Nancy E. Sage, David A. Harris, Tamsin C. O'Connell, and R.E.M. Hedges
2004 Nitrogen Balance and δ^{15}N: Why You're Not What You Eat During Pregnancy. *Rapid Communications in Mass Spectrometry* 18:2889-2896.

Gamboa Cabezas, Luis M.
1995 Proyecto San Juan Teotihuacan: drenaje sanitario. Report submitted to the Departamento de Protección Técnica y Legal de la Zona de Monumentos Arqueológicos de Teotihuacan, Estado de México.

Garraty, Christopher P.
2000 Ceramic Indices of Aztec Eliteness. *Ancient Mesoamerica* 11:323-340.

Gat, Joel R.
1996 Oxygen and Hydrogen Isotopes in the Hydrologic Cycle. *Annual Review of Earth and Planetary Sciences* 24:225-262.

Geller, Pamela L.
2005 Skeletal Analysis and Theoretical Complications. *World Archaeology* 37:597-609.
2008 Conceiving Sex: Fomenting a Feminist Bioarchaeology. *Journal of Social Archaeology* 8:113-138.

Giddens, Anthony
1979 *Central Problems in Social Theory: Action, Structure and Contradiction in Social Analysis*. Macmillan, London.

Gilchrist, Roberta
1999 *Gender and Archaeology: Contesting the Past*. Routledge, New York.
2000 Archaeological Biographies: Realizing Human Lifecyles, -courses, and –histories. *World Archaeology* 31:325-328.
2004 Archaeology and the Life Course: A Time and Age for Gender. In *A Companion to Social Archaeology*, edited by Lynn Meskell and Robert W. Preucel, pp. 142-160. Blackwell, Oxford.

Gillette, Maris Boyd
2005 Children's Food and Islamic Dietary Restrictions in Xi'an. In *The Cultural Politics of Food and Eating: A Reader*, edited by James L. Watson and Melissa L. Caldwell, pp.106- 121. Blackwell, Oxford.

Ginn, Jay, and Sara Arber
1995 "Only Connect": Gender Relations and Ageing. In *Connecting Gender and Ageing: A Sociological Approach*, edited by Sara Arber and Jay Ginn, pp. 1-14. Open University Press, Buckingham, United Kingdom.

Glander, Kenneth E.
1982 The Impact of Plant Secondary Compounds on Primate Feeding Behavior. *Yearbook of Physical Anthropology* 25:1-18.

Goldstein, Paul S.
2000 Exotic Goods and Everyday Chiefs: Long-Distance Exchange and Indigenous Sociopolitical Development in the South Central Andes. *Latin American Antiquity* 11:335-361.

Goldstein, David J., Robin C. Coleman Goldstein, and Patrick R. Williams
2009 You Are What You Drink: A Sociocultural Reconstruction of Pre-Hispanic Fermented Beverage Use at Cerro Baúl, Moquegua, Peru. In *Drink, Power, and Society in the Andes*, edited by Justin Jennings and Brenda J. Bowser, pp. 133-166. University Press of Florida, Gainesville, Florida.

Gómez Chávez, Sergio
1996 Unidades de producción artesanal y residencia en un conjunto arquitectónico de Teotihuacan: arqueología y resultados de las exploraciones del Frente 3 en La Ventilla. In *Teotihuacán, XXIV mesa redonda de la Sociedad Mexicana de Antropología*, Vol. II. Sociedad Mexicana de Antropología and Universidad Nacional Autónoma de México, Mexico City.
1998 Nuevos datos sobre la relación entre Teotihuacan y el occidente de México. In *Antropología e historia del occidente de México: XXIV mesa redonda de la Sociedad Mexicana de Antropología, vol. 3*, pp. 1461-1493. Sociedad Mexicana de Antropología, Mexico City
2000 La Ventilla: un barrio de la antigua ciudad de Teotihuacán. Tesis de Licenciatura, Escuela Nacional de Antropología e Historia, Mexico City.
2002 Presencia del occidente de México en Teotihuacan. Aproximaciones a la política exterior del estado Teotihuacano. In *Ideología y política a través de materiales, imágenes y símbolos: memoria de la primera mesa redonda de Teotihuacan*, edited by María Elena Ruiz Gallut, pp. 563-625. Universidad Nacional Autónoma de México and Instituto Nacional de Antropología e Historia, Mexico City.
2012 Structure and Organization of Neighborhoods in the Ancient City of Teotihuacan. In *The Neighborhood as a Social and Spatial Unit in Mesoamerican Cities*, edited by M. Charlotte Arnauld, Linda R. Manzanilla, and Michael E. Smith, pp. 74-101. The University of Arizona Press, Tucson, Arizona.

Gómez Chávez, Sergio, and Julie Gazzola
2004 Una propuesta sobre el proceso, factores y condiciones del colapso de Teotihuacan. *Dimensión Antropológica* 31:7-58.
2011 La producción lapidaria y malacológica en la mítica Tollan-Teotihuacan. In *Producción artesanal y especializada en Mesoamérica: áreas de actividad y procesos productivos*, edited by Linda R. Manzanilla and Kenneth G. Hirth, pp. 87-130. Instituto Nacional de Antropología e Historia and Universidad Nacional Autónoma de México, Mexico City.

Gómez Chávez, Sergio, and Jaime Núñez Hernández
1999 Análisis preliminar del patrón y la distribución espacial de entierros en el barrio de La Ventilla. In *Prácticas funerarias en la Ciudad de los Dioses: entierros humanos de la antigua ciudad de Teotihuacán*, edited by Linda Manzanilla and Carlos Serrano, pp. 81-148. Universidad Nacional Autónoma de México, Mexico City.

Gómez Chávez, Sergio, and Román Padilla Rodríguez
1998 Correlación cronológica de la pintura mural en tres conjuntos arquitectónicos de La Ventilla, Teotihuacán. In *Los ritmos de cambio en Teotihuacan: reflexiones y discusiones de su cronología*, edited by Rosa Brambila and Rubén Cabrera, pp. 201-221. Instituto Nacional de Antropología e Historia, Mexico City.

González, Javier
1993 Macrofósiles botánicos, fitolitos y polen: estudio del material arqueobotánico de Oztoyahualco. In *Anatomía de un conjunto residencial Teotihuacano en Oztoyahualco*, vol. 2, edited by Linda Manzanilla, pp. 661-673. Universidad Nacional Autónoma de México, Mexico City.

González, Roberto J.
2001 *Zapotec Science: Farming and Food in the Northern Sierra of Oaxaca*. University of Texas Press, Austin.

González Miranda, Luis Alfonso
2009 *Entierros de Teotihuacan explorados de 1980 a 1982*. Instituto Nacional de Antropología e Historia, Mexico City.

González Miranda, Luis Alfonso, and David Fuentes González
1982 Informe de labores realizadas por la sección de antropología física en el Proyecto Arqueológico Teotihuacan. In *Memoria del Proyecto Arqueológico Teotihuacan 80-82*, edited by Rubén Cabrera Castro, Ignacio Rodríguez G., y Noel Morelos G., pp. 421-449. Instituto Nacional de Antropología e Historia, Mexico City.

González Miranda, Luis Alfonso, and Maria Elena Salas Cuesta
1990 Nuevas perspectivas de interpretación que proporcionan los entierros del centro politico-religioso de Teotihuacan. In *La epoca Clasica: nuevos hallazgos, nuevas ideas*, edited by Amalia Cardos de Mendez, pp. 163-179. Instituto Nacional de Antropología e Historia, Mexico City.

Goode, Judith G., Karen Curtis, and Janet Theophano
1984 Meal Formats, Meal Cycles, and Menu Negotiation in the Maintenance of an Italian-American Community. In *Food in the Social Order: Studies of Food and Festivities in Three American Communities*, edited by Mary Douglas, pp. 143-218. Russell Sage Foundation, New York.

Goodman, Alan H., and Jerome C. Rose
1990 Assessment of Systemic Physiological Perturbations from Dental Enamel Hypoplasias and Associated Histological Structures. *Yearbook of Physical Anthropology* 33:59-110.

Goody, Jack
1982 *Cooking, Cuisine and Class: A Study in Comparative Sociology*. Cambridge University Press, Cambridge.

Gowland, Rebecca
2006 Ageing the Past: Examining Age Identity from Funerary Evidence. In *Social Archaeology of Funerary Remains*, edited by Rebecca Gowland and Christopher Knüsel, pp. 143-154. Oxbow Books, Oxford.

Graham, Margaret A.
2003 Food, Health, and Identity in a Rural Andean Community. In *Medical Pluralism in the Andes*, edited by Joan D. Koss-Chioino, Thomas Leatherman, and Christine Greenway, pp. 148-165. Routledge, New York.

Graustein, William C.
1989 $^{87}Sr/^{86}Sr$ Ratios Measure the Sources and Flow of Strontium in Terrestrial Ecosystems. In *Stable Isotopes in Ecological Research*, edited by Philip W. Rundel, James R. Ehleringer, and Kenneth A. Nagy, pp. 491-512. Springer-Verlag, New York.

Graustein, William C., and Richard L. Armstrong
1983 The Use of $^{87}Sr/^{86}Sr$ Ratios to Measure Atmospheric Transport into Forested Watersheds. *Science* 219:289-292.

Grusky, David B.
2001 The Past, Present, and Future of Social Inequality. In *Social Stratification: Class, Race, and Gender in Sociological Perspective*, edited by David B. Grusky, pp. 3-51. 2nd edition. Westview Press, Boulder, Colorado.

Gumerman, George, IV
1997 Food and Complex Societies. *Journal of Archaeological Method and Theory* 4:105-139.

Halicz, Ludwik, Irina Segal, Noa Fruchter, Mordechai Stein, and Boaz Lazar
2008 Strontium Stable Isotopes Fractionate in the Soil Environments? *Earth and Planetary Science Letters* 272:406-411.

Harbottle, Lynn
1997 Taste and Embodiment: The Food Preferences of Iranians in Britain. In *Food Preferences and Taste: Continuity and Change*, edited by Helen Macbeth, pp. 175-185. Berghahn, Oxford.

Harris, Marvin
1985 *Good to Eat: Riddles of Food and Culture*. Simon and Schuster, New York.

1987 Foodways: Historical Overview and Theoretical Prolegomenon. In *Food and Evolution: Toward a Theory of Human Food Habits,* edited by Marvin Harris and Eric B. Ross, pp. 57-90. Temple University Press, Philadelphia, Pennsylvania.

Hartman, Gideon
2011 Are Elevated δ^{15}N Values in Herbivores in Hot and Arid Climates Caused by Diet or Animal Physiology? *Functional Ecology* 25:122-131.

Hassig, Ross
1981 The Famine of One Rabbit: Ecological Causes and Social Consequences of a Pre-Columbian Calamity. *Journal of Anthropological Research* 37:172-182.
1988 *Aztec Warfare: Imperial Expansion and Political Control*. University of Oklahoma Press, Norman, Oklahoma.
1992 *War and Society in Ancient Mesoamerica*. University of California Press, Berkeley, California.
2016 *Polygamy and the Rise and Demise of the Aztec Empire*. University of New Mexico Press, Albuquerque, New Mexico.

Hastorf, Christine A.
1990 The Effect of the Inka State on Sausa Agricultural Production and Crop Consumption. *American Antiquity* 55:262-290.

Hastorf, Christine A., and Sissel Johannessen
1993 Pre-Hispanic Political Change and the Role of Maize in the Central Andes of Peru. *American Anthropologist* 95:115-138.

Hatch, James W., and Richard A. Geidel
1985 Status-Specific Dietary Variation in Two World Cultures. *Journal of Human Evolution* 14: 469-476.

Hatch, Marshall D., C.R. Slack, and Hilary S. Johnson
1967 Further Studies on a New Pathway of Photosynthetic Carbon Dioxide Fixation in Sugarcane, and its Occurrence in Other Species. *Biochemical Journal* 102:417-422.

Hawkes, Kristen, Kim Hill, and James F. O'Connell
1982 Why Hunters Gather: Optimal Foraging and the Ache of Eastern Paraguay. *American Ethnologist* 9:379-398.

Headrick, Annabeth
2007 *The Teotihuacan Trinity: The Sociopolitical Structure of an Ancient Mesoamerican City.* University of Texas Press, Austin.

Heaton, Tim H. E.
1987 The $^{15}N/^{14}N$ Ratios of Plants in South Africa and Namibia: Relationship to Climate and Coastal/Saline Environments. *Oecologia* 74:236-246.

Heaton, Tim H. E., John C. Vogel, Gertrud von la Chevallerie, and Gill Collett
1986 Climatic Influence on the Isotopic Composition of Bone Nitrogen. *Nature* 322:822-823.

Hedges, Robert E.M.
2002 Bone Diagenesis: An Overview of Processes. *Archaeometry* 44:319-328.

Hedges, Robert E.M., John G. Clement, David L. Thomas, and Tamsin C. O'Connell
2007 Collagen Turnover in the Adult Femoral Mid-Shaft Modeled from Anthropogenic Radiocarbon Tracer Measurements. *American Journal of Physical Anthropology* 133:808-816.

Hernández, Francisco
1959 *História natural de Nueva España*. Universidad Autónoma Nacional de México, Mexico City.

Heuser, Alexander, Thomas Tütken, Nikolaus Gussone, and Stephen J.G. Galer
2011 Calcium Isotopes of Fossil Bones and Teeth – Diagenetic Versus Biogenic Origin. *Geochimica et Cosmochimica Acta* 75:3419-3433.

Hicks, Frederic
1999 The Middle Class in Ancient Central Mexico. *Journal of Anthropological Research* 55:409-427.

Hillson, Simon
1996 *Dental Anthropology*. Cambridge University Press, Cambridge.

Hirth, Kenneth
1978 Teotihuacan Regional Population Administration in Eastern Morelos. *World Archaeology* 9:320-333.
1992 Interregional Exchange as Elite Behavior: An Evolutionary Perspective. In *Mesoamerican Elites: An Archaeological Assessment*, edited by Diane Z. Chase and Arlen F. Chase, pp. 18-29. Norman: University of Oklahoma Press, Norman, Oklahoma.

Hirth, Kenneth, and Jorge Angulo Villasenor
1981 Early State Expansion in Central Mexico. *Journal of Field Archaeology* 8:135-150.

Hladik, Claude Marcel
1990 Gustatory Perception and Food Taste. In *Food and Nutrition in the African Rain Forest*, edited by Claude Marcel Hladik, Serge Bahuchet and Igor de Garine, pp. 67-68. UNESCO, Paris.
1997 Primate Models for Taste and Food Preferences. In *Food Preferences and Taste: Continuity and Change*, edited by Helen Macbeth, pp. 15-26. Berghahn, Oxford.

Hobson, Keith A., and Robert G. Clark
1992 Assessing Avian Diets Using Stable Isotopes II: Factors Influencing Diet-Tissue Fractionation. *Condor* 94:187-195.

Hobson, Keith A., Ray T. Alisauskas, and Robert G. Clark
1993 Stable Nitrogen Isotope Enrichment in Avian Tissues due to Fasting and Nutritional Stress: Implications for Isotopic Analyses of Diet. *Condor* 95:388-394.

Hodder, Ian
1982 *Symbols in Action: Ethnoarchaeological Studies of Material Culture.* Cambridge University Press, Cambridge.
Hodell, David A., Rhonda L. Quinn, Mark Brenner, and George Kamenov
2004 Spatial Variation of Strontium Isotopes ($^{87}Sr/^{86}Sr$) in the Maya Region: A Tool for Tracking Ancient Human Migration. *Journal of Archaeological Science* 31:585–601.

Hollimon, Sandra E.
1997 The Third Gender in Native California: Two-Spirit Undertakers Among the Chumash and Their Neighbors. In *Women In Prehistory: North America and Mesoamerica*, edited by Cheryl Claasen and Rosemary A. Joyce, pp. 173-188. University of Pennsylvania Press, Philadelphia, Pennsylvania.

Hsu, Cho-yun
1971 *Ancient China in Transition: An Analysis of Social Mobility, 722-222 B.C.* Hsin yüeh tu shu fu fen yu hsien kung ssu, Taipei, Taiwan.

Huicochea, Laura, and Lourdes Márquez Morfín
2006 Diferencias sociales y salud en un grupo de pobladores del barrio de La Ventilla, Teotihuacan. In *Salud y sociedad en el México prehispánico y colonial*, edited by Lourdes Márquez Morfín and Patricia Hernández Espinoza, pp. 291-325. Escuela Nacional de Antropología e Historia, Mexico City.

Huss-Ashmore, Rebecca, and Susan L. Johnston
1997 Wild Plants as Famine Foods: Food Choice Under Conditions of Scarcity. In *Food Preferences and Taste: Continuity and Change*, edited by Helen Macbeth, pp. 83-100. Berghahn, Oxford.

Iacumin, Paola, Hervé Bocherens, André Mariotti, and Antonio Longinelli
1996 Oxygen Isotope Analyses of Co-Existing Carbonate and Phosphate in Biogenic Apatite: a Way to Monitor Diagenetic Alteration of Bone Phosphate? *Earth and Planetary Science Letters* 142:1-6.

Inkeles, Alex
1960 Industrial Man: The Relation of Status to Experience, Perception, and Values. *American Journal of Sociology* 66:29.

Insoll, Timothy
2007 Introduction: Configuring Identities in Archaeology. In *The Archaeology of Identities: A Reader*, edited by Timothy Insoll, pp. 1-18. Routledge, New York.

Isaacs, Julia B., Isabel V. Sawhill, and Ron Haskins
2008 *Getting Ahead or Losing Ground: Economic Mobility in America*. Report of The Brookings Institution and the Economic Mobility Project: An Initiative of The Pew Charitable Trusts. Retrieved from https://www.brookings.edu/research/getting-ahead-or-losing-ground-economic-mobility-in-america/.

Isbell, William H., and Antti Korpisaari
2015 Bodies of Evidence: Mortuary Archaeology and the Wari-Tiwanaku Paradox. In *Funerary Practices and Models in the Ancient Andes: the Return of the Living Dead*, edited by Peter Eeckhout and Lawrence S. Owens, pp. 137-157. Cambridge University Press, New York.

Ixtlilxochitl, Fernando de Alva
1985 *Historia de la nación Chichimeca*. Historia 16, Madrid, Spain.

Jerome, Norge W.
1977 Taste Experience and the Development of a Dietary Preference for Sweet in Humans: Ethnic and Cultural Variations in Early Taste Experience. In *Taste and Development: The Genesis of Sweet Preference*, edited by James M. Weiffenbach, pp. 235-248. US DHEW Publication No. 77-1068, Washington, D.C.

Jim, Susan, Stanley H. Ambrose, and Richard P. Evershed
2004 Stable Carbon Isotopic Evidence for Differences in the Dietary Origin of Bone Cholesterol, Collagen, and Apatite: Implications for their Use in Paleodietary Reconstruction. *Geochimica et Cosmochimica Acta* 68:61-72.

Johnson, Allen W., and Timothy K. Earle
1987 *The Evolution of Human Societies: From Foraging Group to Agrarian State*. Stanford University Press, Stanford, California.

Jonaitis, Aldona, editor
1991 *Chiefly Feasts: The Enduring Kwakiutl Potlatch*. University of Washington Press, Seattle, Washington.

Jones, Siân
1997 *The Archaeology of Ethnicity: Constructing Identities in the Past and Present*. Routledge, New York.

Joyce, Rosemary A.
1998 Performing the Body in pre-Hispanic Central America. *RES: Anthropology and Aesthetics* 33:147-165.
2000a Archaeology of the Body. *Annual Review of Anthropology* 34:139-158.
2000b *Gender and Power in Prehispanic Mesoamerica*. University of Texas Press, Austin.

Kaelble, Hartmut
1985 *Social Mobility in the 19th and 20th Centuries: Europe and America in Comparative Perspective*. Berg, Leamington Spa, United Kingdom.

Kaplan, Hillard, and Kim Hill
1992 The Evolutionary Ecology of Food Acquisition. In *Evolutionary Ecology and Human Behavior*, edited by Eric A. Smith and Bruce Winterhalder, pp. 167-202. Aldine de Gruyter, New York.

Katzenberg, M. Anne
1989 Stable Isotope Analysis of Archaeological Faunal Remains from Southern Ontario. *Journal of Archaeological Science* 16:319-329.
2008 Stable Isotope Analysis: a Tool for Studying Past Diet, Demography, and Life History. In *Biological Anthropology of the Human Skeleton*, 2nd edition, edited by M. Anne Katzenberg and Shelley R. Saunders, pp. 413-441. Wiley-Liss, Hoboken, New Jersey.

Katzenberg, M. Anne, and Jane H. Kelly
1991 Stable Isotope Analysis of Prehistoric Bone from the Sierra Blanca Region of New Mexico. In *Mogollon V: Proceedings of the 1988 Mogollon Conference*, edited by Patrick H. Beckett, pp 207-209. COAS Publishing and Research, Las Cruces, New Mexico.

Katzenberg, M. Anne, and Andrzej Weber
1999 Stable Isotope Ecology and Paleodiet in the Lake Baikal Region of Siberia. *Journal of Archaeological Science* 26:651-665.

Kelley, Jonathan, and Melvin L. Perlman
1971 Social Mobility in Toro: Some Preliminary Results from Western Uganda. *Economic Development and Cultural Change* 19:204-221.

Kellner, Corina M., and Margaret J. Schoeninger
2007 A Simple Carbon Isotope Model for Reconstructing Prehistoric Human Diet. *American Journal of Physical Anthropology* 133:1112-1127.

Knudson, Kelly J.
2009 Oxygen Isotope Analysis in a Land of Environmental Extremes: The Complexities of Isotopic Work in the Andes. *International Journal of Osteoarchaeology* 19:171-191.

Knudson, Kelly J., and Christopher M. Stojanowski
2008 New Directions in Bioarchaeology: Recent Contributions to the Study of Human Social Identities. *Journal of Archaeological Research* 16:397-432.

Knudson, Kelly J., Paul S. Goldstein, Allisen Dahlstedt, Andrew Somerville, and Margaret J. Schoeninger
2014 Paleomobility in the Tiwanaku Diaspora: Biogeochemical Analyses at Rio Muerto, Moquegua, Peru. *American Journal of Physical Anthropology* 155:405-421.

Knudson Kelly J., Hope M. Williams, Jane E. Buikstra, Paula D. Tomczak, Gwyneth W. Gordon, and Ariel D. Anbar
2010 Introducing $\delta^{88/86}$Sr Analysis in Archaeology: A Demonstration of the Utility of Strontium Isotope Fractionation in Paleodietary Studies. *Journal of Archaeological Science* 37:2352-2364.

Koch, Paul L.
1998 Isotopic Reconstruction of Past Continental Environments. *Annual Review of Earth and Planetary Sciences* 26:573-613.

Koch, Paul L., Noreen Tuross, and Marilyn L. Fogel
1997 The Effects of Sample Treatment and Diagenesis on the Isotopic Integrity of Carbonate in Biogenic Hydroxylapatite. *Journal of Archaeological Science* 24:417-429.

Kohn, Matthew J.
1996 Predicting Animal δ^{18}O: Accounting for Diet and Physiological Adaptation. *Geochimica et Cosmochimica Acta* 60:4811-4829.
2008 Models of Diffusion-Limited Uptake of Trace Elements in Fossils and Rates of Fossilisation. *Geochimica et Cosmochimica Acta* 72:3758-3770.
2010 Carbon Isotope Compositions of Terrestrial C_3 Plants as Indicators of (Paleo)ecology and (Paleo)climate. *Proceedings of the National Academy of Sciences* 107:19691-19695.

Kohn, Matthew J., Margaret J. Schoeninger, and William W. Barker
1999 Altered States: Effects of Diagenesis on Fossil Tooth Chemistry. *Geochimica et Cosmochimica Acta* 63:2737-2747.

Kohn, Matthew J., Margaret J. Schoeninger, and J.W. Valley
1996 Herbivore Tooth Oxygen Isotope Compositions: Effects of Diet and Physiology. *Geochimica et Cosmochimica Acta* 60:3889-3896.

Kriszan, Melanie, Jürgen Schellburg, Wulf Amelung, Thomas Gebbing, Erich M. Pötsch, and Walter Kühbauch
2014 Revealing N Management Intensity on Grassland Farms Based on Natural δ^{15}N Abundance. *Agriculture, Ecosystems and Environment* 184:158-167.

Krueger, Harold W., and Charles H. Sullivan
1984 Models for Carbon Isotope Fractionation Between Diet and Bone. In *Stable Isotopes in Nutrition*, edited by Judith R. Turnland and Phyllis E. Johnson, pp. 205-222. American Chemical Society, Washington, D.C.

Kulp, J. Laurence, and Arthur R. Schulert
1962 Strontium-90 in Man V. *Science* 136:619-632.

Lambert, Joseph B., Sharon M. Vlasak, Anne C. Thometz, and Jane E. Buikstra
1982 A Comparative Study of the Chemical Analysis of Ribs and Femurs in Woodland Populations. *American Journal of Physical Anthropology* 59:289-294.

Lambert, Joseph B., Liang Xue, and Jane E. Buikstra
1989 Physical Removal of Contaminative Inorganic Material from Buried Human Bone. *Journal of Archaeological Science* 16:427-436.
1991 Inorganic Analysis of Excavated Human Bone after Surface Removal. *Journal of Archaeological Science* 18:363-383.

Lambert, Paul, Kenneth Prandy, and Wendy Bottero
2007 By Slow Degrees: Two Centuries of Social Reproduction and Mobility in Britain. *Sociological Research Online* 12(1). doi: 10.5153/sro.1493.

Langley, James C.
1986 *Symbolic Notation of Teotihuacan*. British Archaeological Reports International Series 313. British Archaeological Reports, Oxford.

Lanjouw, Peter, and Nicholas Stern
2003 Opportunities Off the Farm as a Springboard Out of Rural Poverty: Five Decades of Development in an Indian Village. In *Pathways Out of Poverty: Private Firms and Economic Mobility in Developing Countries*, edited by Gary S. Fields and Guy Pfeffermann, pp. 123-154. Kluwer, Boston.

Lee-Thorp, Julia A.
2002 Two Decades of Progress towards Understanding Fossilization: Processes and Isotopic Signals in Calcified Tissue Minerals. *Archaeometry* 44:435-446.

Lee-Thorp, Julia A., and Matthew Sponheimer
2003 Three Case Studies used to Reassess the Reliability of Fossil Bone and Enamel Isotope Signals for Paleodietary Studies. *Journal of Anthropological Archaeology* 22:208-216.

Lenski, Gerhard E.
1966 *Power and Privilege: A Theory of Social Stratification*. McGraw-Hill, New York.

Lentz, David L.
1991 Maya Diets of the Rich and Poor: Paleoethnobotanical Evidence from Copan. *Latin American Antiquity* 2:269-287.

Letolle, René
1980 Nitrogen-15 in the Natural Environment. In *Handbook of Environmental Isotope Geochemistry*, edited by Peter Fritz and Jean-Charles Fontes, pp. 407-433. Elsevier, Amsterdam, the Netherlands.

Levy, Janet E.
1979 Evidence of Social Stratification in Bronze Age Denmark. *Journal of Field Archaeology* 6:49-56.

Lewis, Mary, and Charlotte Roberts
1997 Growing Pains: The Interpretation of Stress Indicators. *International Journal of Osteoarchaeology* 7:581-586.

Li, Jian Hong, and Joachim Singelmann
1998 Gender Differences in Class Mobility: A Comparative Study of the United States, Sweden, and West Germany. *Acta Sociologica* 41:315-333.

Li, Yaojun, Shun Zhang, and Jianxun Kong
2015 Social Mobility in China and Britain: A Comparative Study. *International Review of Social Research* 5:20-34.

Liden, Kerstin, Cheryl Takahashi, and D. Erle Nelson
1995 The Effects of Lipids in Stable Carbon Isotope Analysis and the Effects of NaOH Treatment on the Composition of Extracted Bone Collagen. *Journal of Archaeological Science* 22:321-326.

Lindenbaum, Shirley
1986 Rice and Wheat: The Meaning of Food in Bangladesh. In *Food, Society and Culture: Aspects in South Asia Food Systems*, edited by Ravindra S. Khare and M.S.A. Rao, pp. 253-276. Carolina Academic Press, Durham, North Carolina.

Linné, Sigvald
1934 *Archaeological Researches at Teotihuacan, Mexico*. V. Petterson, Stockholm, Sweden.
1942 *Mexican Highland Cultures: Archaeological Researches at Teotihuacan, Calpulalpan, and Chalchicomula in 1934-35*. Ethnographical Museum of Sweden, Stockholm, Sweden.

Lipset, Seymour Martin, and Reinhard Bendix
1959 *Social Mobility in Industrial Society*. University of California Press, Los Angeles.

Liu, Yanyan, Lianhai Wu, John A. Baddeley, and Christine A. Watson
2011 Models of Biological Nitrogen Fixation of Legumes: A Review. *Agronomy for Sustainable Development* 31:155-172.

Lockhart, James
1992 *The Nahuas After the Conquest: A Social and Cultural History of the Indians of Central Mexico, Sixteenth Through Eighteenth Centuries*. Stanford University Press, Stanford, California.

Longin, R.
1971 New Method of Collagen Extraction for Radiocarbon Dating. *Nature* 230:241-242.

Looper, Matthew G.
2002 Ancient Maya Women-men (and Men-women): Classic Rulers and the Third Gender. In *Ancient Maya Women*, edited by Traci Ardren, pp. 171-202. AltaMira Press, Walnut Creek, California.

Lounejeva Baturina, Elena, Pedro Morales Puente, Héctor V. Cabadas Báez, Edith Cienfuegos Alvarado, Sergey Sedov, Ernestina Vallejo Gómez, and Elizabeth Solleiro Rebolledo
2006 Late Pleistocene to Holocene Environmental Changes from $\delta^{13}C$ Determinations in Soils at Teotihuacan, Mexico. *Geofísica Internacional* 45:85-98.

Lovejoy, C. Owen, Richard S. Meindl, Thomas R. Pryzbeck, and Robert P. Mensforth
1985 Chronological Metamorphosis of the Auricular Surface of the Ilium: A New Method for the Determination of Adult Skeletal Age at Death. *American Journal of Physical Anthropology* 68:15-28.

Lowenberg, Anton D.
1989 An Economic Theory of Apartheid. *Economic Inquiry* 27:57-74.

Luz, Boaz, Yehoshua Kolodny, and Michal Horowitz
1984 Fractionation of Oxygen Isotopes Between Mammalian Bone Phosphate and Environmental Drinking Water. *Geochimica et Cosmochimica Acta* 48:1689–1693.

Longinelli, Antonio
1984 Oxygen Isotopes in Mammal Bone Phosphate: A New Tool for Paleohydrological and Paleoclimatological Research? *Geochimica et Cosmochimica Acta* 48:385-390.

Maas, Ineke, and Marco H.D. van Leeuwen
2004 Occupational Careers of the Total Male Labor Force during Industrialization: The Example of Nineteenth-Century Sweden. In *Origins of the Modern Career*, edited by David Mitch, John Brown, and Marco H.D. van Leeuwen, pp. 227-258. Ashgate, Aldershot, United Kingdom.

Macbeth, Helen M., and Sue Lawry
1997 Food Preferences and Taste: An Introduction. In *Food Preferences and Taste: Continuity and Change*, edited by Helen M. Macbeth, pp. 1-13. Berghahn Books, Providence, Rhode Island.

MacKinnon, Neil J., and Tom Langford
1994 The Meaning of Occupational Prestige Scores: A Social Psychological Analysis and Interpretation. *The Sociological Quarterly* 35:215-245.

Mahler, Sarah J., and Patricia R. Pessar
2006 Gender Matters: Ethnographers Bring Gender from the Periphery toward the Core of Migration Studies. *The International Migration Review* 40:27-63.

Malmstrom, Vincent H.
1978 A Reconstruction of the Chronology of Mesoamerican Calendrical Systems. *Journal of the History of Astronomy* 9:105-116.

Maltby, J. Mark
1985 Patterns in Faunal Assemblage Variability. In *Beyond Domestication in Prehistoric Europe: Investigations in Subsistence Archaeology and Social Complexity*, edited by Graeme Barker and Clive Gamble, pp. 33-74. Academic Press, London.

Manderson, Lenore
1981 Traditional Food Classifications and Humoral Medical Theory in Peninsula Malaysia. *Ecology of Food and Nutrition* 11:81-93.

Mann, Michael
1986 *The Sources of Social Power: A History of Power from the Beginning to A.D. 1760*. Cambridge University Press, Cambridge.

Manzanilla, Linda, editor
1993 *Anatomía de un conjunto residencial Teotihuacano en Oztoyahualco*. Universidad Nacional Autónoma de México, Mexico City.

Manzanilla, Linda
1992 The Economic Organization of the Teotihuacan Priesthood: Hypotheses and Considerations. In *Art, Ideology, and the City of Teotihuacan*, edited by Janet C. Berlo, pp. 321-338. Dumbarton Oaks, Washington, D.C.
1996 Corporate Groups and Domestic Activities at Teotihuacan. *Latin American Antiquity* 7:228-246.
1997 Teotihuacan: Urban Archetype, Cosmic Model. In *Emergence and Change in Early Urban Societies*, edited by Linda Manzanilla, pp. 109-132. Plenum Series in Fundamental Issues in Archaeology, Plenum, New York.
2001 Gobierno corporativo en Teotihuacan: una revisión del concepto “palacio” aplicado a la gran urbe prehispánica. *Anales de Antropología* 35:157-190.
2002 Living with the Ancestors and Offering to the Gods: Domestic Ritual at Teotihuacan. In *Domestic Ritual in Ancient Mesoamerica*, edited by Patricia Plunket, pp. 43-52. Cotsen Institute of Archaeology, University of California, Los Angeles.
2004 Social Identity and Daily Life at Classic Teotihuacan. In *Mesoamerican Archaeology: Theory and Practice*, edited by Julia A. Hendon and Rosemary A. Joyce, pp. 124-147. Blackwell, Oxford.
2006 Estados corporativos arcaicos: organizaciones de excepción en scenarios excluyentes. *Cuicuilco* 13:13-45.
2007 Las “casas” nobles de los barrios de Teotihuacan: estructuras exclusionistas en un entorno corporativo. *Memoria 2007*, pp. 453-470. El Colegio Nacional, Mexico City.
2009 Corporate Life in Apartment and Barrio Compounds at Teotihuacan, Central Mexico: Craft Specialization, Hierarchy, and Ethnicity. In *Domestic Life in Prehispanic Capitals: A Study of Specialization, Hierarchy, and Ethnicity*, edited by Linda R. Manzanilla y Claude Chapdelaine, pp. 21-42. Memoirs of the Museum of Anthropology, University of Michigan, No. 46, Vol VII. University of Michigan, Ann Arbor, Michigan.
2012 Neighborhoods and Elite “Houses” at Teotihuacan, Central Mexico. In *The Neighborhood as a Social and Spatial Unit in Mesoamerican Cities*, edited by M. Charlotte Arnauld, Linda R. Manzanilla, and Michael E. Smith, pp. 55-73. TThe University of Arizona Press, Tucson, Arizona.

Manzanilla, Linda, and Carlos Serrano, editors
1999 *Prácticas funerarias en la Ciudad de los Dioses: los enterramientos humanos de la antigua Teotihuacan*. Instituto de Investigaciones Antropológicas, Universidad Nacional Autónoma de México, Mexico City.

Manzanilla, Linda, Samuel Tejeda, and Juan Carlos Martínez
2000 Implicaciones del análisis de calico, estroncio, y zinc en el conocimiento de la dieta y la migración en Teotihuacan, México. *Anales de Antropología* 33:13-28.

Manzanilla, Linda, Manuel Reyes, and Judith Zurita
2006 Propuesta metodológica para el estudio de residuos químicos en metates de uso no doméstico: Teopancazco, Teotihuacan. Poster presented at the Congreso Interno del Personal Académico del Instituto de Investigaciones Antropológicas, Universidad Nacional Autónoma de México, Mexico City.

Manzanilla, Linda R., Raúl Valadez, Bernardo Rodríguez, Gilberto Pérez Roldán, Johanna Padró, Adrián Velázquez, Belem Zúñiga, and Norma Valentín
2011 Producción de atavíos y tocados en un centro de barrio de Teotihuacan: el caso de Teopancazco. In *Producción artesanal y especializada en Mesoamérica: áreas de actividad y procesos productivos,* edited by Linda R. Manzanilla and Kenneth G. Hirth, pp. 59-86. Instituto Nacional de Antropología e Historia and Universidad Nacional Autónoma de México, Mexico City.

Marcus, Joyce
1992 Royal Families, Royal Texts: Examples from the Zapotec and Maya. In *Mesoamerican Elites: An Archaeological Assessment*, edited by Diane Z. Chase and Arlen F. Chase, pp. 221-241. University of Oklahoma Press, Norman, Oklahoma.

Marcus, Joyce and Gary M. Feinman
1998 Introduction. In *Archaic States,* edited by Gary M. Feinman and Joyce Marcus, pp. 3-13. School of American Research Press, Santa Fe, New Mexico.

Martel Begun, Erica
2013 Detecting Ethnicity at Teotihuacan Through Archaeology: The West Mexican Presence at Structure N1W5:19. Ph.D. dissertation, The University of Iowa, Iowa City, Iowa.

Marx, Karl
1906 *Capital: A Critique of Political Economy*. Modern Library, New York.

Marx, Karl, and Friedrich Engels
[1846] 1970 *A Critique of the German Ideology*. International, New York.

Matos Moctezuma, Eduardo.
1995 *La Pirámide del Sol, Teotihuacan*. Artes de México y del Mundo, Mexico City

Mauss, Marcel
1954 *The Gift: Forms and Functions of Exchange in Archaic Societies*. Free Press, Glencoe, Illinois.

Mattison, Siobhán, Eric A. Smith, Mary K. Shenk, and Ethan E. Cochrane
2016 The Evolution of Inequality. *Evolutionary Anthropology* 25:184-199.

Mayer, Karl Ulrich
2005 Life Courses and Life Chances in a Comparative Perspective. In *Analyzing Inequality: Life Chances and Social Mobility in Comparative Perspective*, edited by Stefan Svallfors, pp. 17-55. Stanford University Press, Stanford, California.

McCafferty, Sharisse D., and Geoffrey G. McCafferty
1988 Powerful Women and the Myth of Male Dominance in Aztec Society. *Archaeological Review from Cambridge* 7:45-59.

McClendon, McKee J.
1977 Structural and Exchange Components of Vertical Mobility. *American Sociological Review* 42:56-74.

McClung de Tapia, Emily
1987 Patrones de subsistencia urbana en Teotihuacan. In *Teotihuacan: nuevos datos, nuevas síntesis, nuevos problemas,* edited by Emily McClung de Tapia and Evelyn C. Rattray, pp. 57-74. Universidad Nacional Autónoma de México, Mexico City.

McClung de Tapia, Emily, and Diana Martínez-Yrizar
2017 The Potential of Paleoethnobotanical Evidence for the Study of Teotihuacan Foodways. *Anthropological and Archaeological Sciences* 9:39-50.

McClung de Tapia, Emily, Elizabeth Solleiro-Rebolledo, Jorge Gama-Castro, José Luis Villalpando, and Sergey Sedov
2003 Paleosols in the Teotihuacan Valley, Mexico: Evidence for Paleoenvironment and Human Impact. *Revista Mexicana de Ciencias Geológicas* 20:270-282.

McGuire, Randall H.
1982 The Study of Ethnicity in Historical Archaeology. *Journal of Anthropological Archaeology* 1:159-178.

Mekota, Anna-Maria, Gisela Grupe, Sandra Ufer, and Ullrich Cuntz
2006 Serial Analysis of Stable Nitrogen and Carbon Isotopes in Hair: Monitoring Starvation and Recovery Phases of Patients Suffering from Anorexia Nervosa. *Rapid Communications in Mass Spectrometry* 20:1604-1610.

Melander, Lars
1960 *Isotope Effects on Reaction Rates*. Roland, New York.

Meskell, Lynn
1999 *Archaeologies of Social Life: Age, Sex, Class, etc., in Ancient Egypt*. Blackwell, Oxford.
2007 Archaeologies of Identity. In *The Archaeology of Identities: A Reader*, edited by Timothy Insoll, pp. 23-43. Routledge, New York.

Messer, Ellen
1972 Patterns of "Wild" Plant Consumption in Oaxaca, Mexico. *Ecology of Food and Nutrition* 1:325-332.
1981 Hot-Cold Classifications: Theoretical and Practical Implications of a Mexican Study. *Social Science and Medicine* 15B:133-145.

Milanovic, Branko, Peter H. Lindert, and Jeffrey G. Williamson
2011 Pre-Industrial Inequality. *The Economic Journal* 121:255-272.

Miles, Andrew
1999 *Social Mobility in Nineteenth- and Early Twentieth-Century England*. St. Martin's Press, New York.

Miles, Andrew, and David Vincent, editors
1993 *Building European Society: Occupational Change and Social Mobility in Europe, 1840-1940*. Manchester University Press, New York.

Miller, Arthur G.
1973 *The Mural Painting of Teotihuacan*. Dumbarton Oaks Research Library and Collection, Washington, D.C.

Miller, Barbara D.
1993 The Anthropology of Sex and Gender Hierarchies. In *Sex and Gender Hierarchies*, edited by Barbara D. Miller, pp. 3-31. Cambridge University Press, Cambridge.

Miller, Melanie J, José M. Capriles, and Christine A. Hastorf
2010 The Fish of Lake Titicaca: Implications for Archaeology and Changing Ecology Through Stable Isotope Analysis. *Journal of Archaeological Science* 37:317-327.

Millon, Clara
1973 Painting, Writing, and Polity in Teotihuacan, Mexico. *American Antiquity* 38:294-314.
1988 A Reexamination of the Teotihuacan Tassel Headdress Insignia. In *Feathered Serpents and Flowering Trees: Reconstructing the Murals of Teotihuacan*, edited by Kathleen Berrin, pp 114-134. The Fine Arts Museums of San Francisco, San Francisco.

Millon, René
1973 *Urbanization at Teotihuacan Mexico*. University of Texas Press, Austin.

1974 The Study of Urbanism at Teotihuacan, Mexico. In *Mesoamerican Archaeology: New Approaches,* edited by Norman Hammond, pp. 335-362. Duckworth, London.

1976 Social Relations in Ancient Teotihuacan. In *The Valley of Mexico,* edited by Eric R. Wolf, pp. 205-248. University of New Mexico Press, Albuquerque, New Mexico.

1981 Teotihuacan: City, State, and Civilization. In *Supplement to the Handbook of Middle American Indians*, vol. 1, edited by Victoria R. Bricker and Jeremy A. Sabloff, pp. 198-243. University of Texas Press, Austin.

1988a The Last Years of Teotihuacan Dominance. In *The Collapse of Ancient States and Civilizations*, edited by Norman Yoffee and George L. Cowgill, pp. 102-164. University of Arizona Press, Tucson, Arizona.

1988b Where *Do* They All Come From? The Provenance of the Wagner Murals from Teotihuacan. In *Feathered Serpents and Flowering Trees*, edited by Kathleen Berrin, pp. 78-113. Fine Arts Museums of San Francisco, San Francisco.

1993 The Place Where Time Began: An Archaeologist's Interpretation of What Happened in Teotihuacan History. In *Teotihuacan: Art from the City of the Gods*, edited by Kathleen Berrin and Esther Pasztory, pp. 17-43. Thames and Hudson and the Fine Arts Museums of San Francisco, San Francisco.

Millon, René, and James A. Bennyhoff

1961 A Long Architectural Sequence at Teotihuacan. *American Antiquity* 26:516-523.

Millon, René, Bruce Drewitt, and George L. Cowgill

1973 *Urbanization at Teotihuacan, Mexico, Vol 1, The Teotihuacan Map, Part 2: Maps*. University of Texas Press, Austin.

Mills, Mary Beth

1997 Contesting the Margins of Modernity: Women, Migration, and Consumption in Thailand. *American Ethnologist* 24:37-61.

Mintz, Sidney W.

1986 *Sweetness and Power: The Place of Sugar in Modern History*. New York: Penguin.

Mintz, Sidney W., and Christine M. Du Bois

2002 The Anthropology of Food and Eating. *Annual Reviews of Anthropology* 31:99-119.

Mishel, Lawrence, Josh Bivens, Elise Gould, and Heidi Shierholz

2012 *The State of Working America*. New York: Cornell University Press.

Molloy, John P., and William L. Rathje

1974 Sexploitation among the Late Classic Maya. In *Mesoamerican Archaeology: New Approaches*, edited by Norman Hammond, pp. 431-444. University of Texas Press, Austin.

Montgomery, Janet, Jane A. Evans, and Matthew S.A. Horstwood
2010 Evidence for Long-Term Averaging of Strontium in Bovine Enamel Usingn TIMS and LA-MC-ICP-MS Strontium Isotope Intra-Molar Profiles. *Environmental Archaeology* 15:32-42.

Monzón, Martha
1982 Exploración de dos casas habitacion. In *Memoria del Proyecto Arqueológico Teotihuacan 80-82*, edited by Rubén Cabrera Castro, Ignacio Rodríguez G., and Noel Morelos G., pp. 321-327. Instituto Nacional de Antropología e Historia, Mexico City.
1989 *Casas prehispanicas en Teotihuacan*. Instituto Mexiquense de Cultura, Toluca, Mexico.

Morales Puente, Pedro, Edith Cienfuegos, Linda R. Manzanilla, and Francisco Otero
2012 Estudio de la paleodieta empleando isótopos estables de los elementos carbono, oxígeno y nitrógeno en restos humanos y fauna encontrados en el barrio Teotihuacano de Teopancazco, Teotihuacan. In *Estudios arqueométricos del centro del barrio de Teopancazco en Teotihuacan*, edited by Linda Manzanilla, pp. 347-342. Universidad Nacional Autónoma de México, Mexico City.

Morelos García, Noel
1982 Exploraciones en el área central de la Calzada de los Muertos al norte del Río San Juan, dentro del llamado Complejo Calle de los Muertos. In *Memoria del Proyecto Arqueológico Teotihuacan 80-82*, edited by Rubén Cabrera C., Ignacio Rogdríguez G., and Noel Morelos G., pp. 145-156. Instituto Nacional de Antropología e Historia, Mexico City.
1993 *Proceso de producción de espacios y estructuras en Teotihuacan.* Instituto Nacional de Antropología e Historia, Mexico City.

Moss-Racusin, Corinne, John F. Dovidio, Victoria L. Brescoll, Mark J. Graham, and Jo Handelsman
2012 Science Faculty's Subtle Gender Biases Favor Male Students. *PNAS* 109:16474-16479.

Motolinía, Toribio de Benavente
1903 *Memoriales*. Luis García Pimentel, Mexico City.

Mulhern, Dawn M.
2000 Rib Remodeling Dynamics in a Skeletal Population from Kulubnarti, Nubia. *American Journal of Physical Anthropology* 111:519-530.

Mulhern, Dawn M., and Dennis P. Van Gerven
1997 Patterns of Femoral Bone Remodeling Dynamics in a Medieval Nubian Population. *American Journal of Physical Anthropology* 104:133-146.

Munera Bermúdez, Luís Carlos
1985 *Un taller de ceramica ritual en la Ciudadela, Teotihuacan.* Tesis de Licenciatura, Escuela Nacional de Antropología e Historia, Mexico City.

Munoz Zurita, Ricardo
2012 *Larousse Diccionario Enciclopédico de la Gastronomía Mexicana*. Mexico City: Ediciones Larousse, Mexico City.

Munro, Lisa E., Fred J. Longstaffe, and Christine D. White
2008 Effects of Heating on the Carbon and Oxygen-Isotope Compositions of Structural Carbonate in Bioapatite from Modern Deer Bone. *Palaeogeography, Palaeoclimatology, Palaeoecology* 266:142-150.

Murra, John V.
1975 *Formaciones económicas y políticas del mundo andino*. Instituto de Estudios Peruanos, Lima.

Nado, Kristin L., and Stephanie Cruz
2006 Final Report on Burials 1-3 from Proyecto San José 520, Teotihuacan, Mexico. Report submitted to Oralia Cabrera.

Nanda, Serena
1994 Hijras: An Alternative Sex and Gender Role in India. In *Third Sex, Third Gender: Beyond Sexual Dimorphism,* edited by Gilbert Herdt, pp. 372-417. Zone Books, New York.

Narayan, Deepa, and Patti Petesch, editors
2002 *Voices of the Poor: From Many Lands*. Oxford University Press for the World Bank, New York.

Neuberger Ferdinand M., Eilin Jopp, Matthias Graw, Klaus Püschel, and Gisela Grupe
2013 Signs of Malnutrition and Starvation: Reconstruction of Nutritional Life Histories by Serial Isotopic Analyses of Hair. *Forensic Science International* 226: 22-32.

Nichols, Deborah L.
1982 Results of the Excavations of the Tlajinga Canals. In *A Reconstruction of a Classic Period Landscape in the Teotihuacan Valley: Final Report to the National Science Foundation*, edited by William T. Sanders, Deborah Nichols, Rebecca Story, and Randolph Widmer, pp. 99-127. Department of Anthropology, Pennsylvania State University, University Park, Pennsylvania.
1987 Prehispanic Irrigation at Teotihuacan, New Evidence: The Tlajinga Canals. In *Teotihuacan: nuevos datos, nuevas sintesis, nuevos problemas*, edited by Emily McClung de Tapia and Evelyn Rattray, pp. 133-160. Universidad Nacional Autónoma de México, Mexico City.

Nichols, Deborah L., Michael Spence, and Mark Borland
1991 Watering the Fields of Teotihuacan: Early Irrigation at the Ancient City. *Ancient Mesoamerica* 2:119-129.

Nicholson, Henry B.
1991 The Octli Cult in Late Pre-Hispanic Central Mexico. In *To Change Place: Aztec Ceremonial Landscapes*, edited by David Carrasco, pp. 158-187. University Press of Colorado, Niwot, Colorado.

Nielsen, Jesper, and Christophe Helmke
2011 Reinterpreting the Plaza de los Glifos, La Ventilla, Teotihuacan. *Ancient Mesoamerica* 22 (2): 345-370.

Nielsen-Marsh, Christina M., and Robert E. Hedges
2000a Patterns of Diagenesis in Bone I: The Effects of Site Environments. *Journal of Archaeological Science* 27:1139-1150.
2000b Patterns of Diagenesis in Bone II: Effects of Acetic Acid Treatment and the Removal of Diagenetic CO_3. *Journal of Archaeological Science* 27:1139-1150.

Nutini, Hugo G., and Barry L. Isaac
2009 *Social Stratification in Central Mexico 1500-2000*. University of Texas Press, Austin, Texas.

O'Connell, James F., and Kristen Hawkes
1981 Alyawara Plant Use and Optimal Foraging Theory. In *Hunter-Gatherer Foraging Strategies*, edited by Bruce Winterhalder and Eric A. Smith, pp. 99-125. University of Chicago Press, Chicago.

O'Connor, Amber
2010 Maya Foodways: A Reflection of Gender and Ideology. In *Pre-Columbian Foodways: Interdisciplinary Approaches to Food, Culture, and Markets in Ancient Mesoamerica*, edited by John E. Staller and Michael D. Carrasco, pp. 487-507. Springer, New York.

O'Laughlin, Bridget
1974 Mediation of Contradiction: Why Mbum Women do not Eat Chicken. In *Women, Culture, and Society*, edited by Michelle Z. Rosaldo and Louise Lamphere, pp. 301-318. Stanford University Press, Stanford, California.

Ochoa, Enrique C.
2000 *Feeding Mexico: The Political Uses of Food Since 1910*. Scholarly Resources, Wilmington, Delaware.

Ochoa Ocaña, María Antonieta
2003 Dieta y estatus: estudio comparativo de paleonutricion en Teotihuacan. In *Contextos arqueologicos y osteologia del barrio de La Ventilla, Teotihuacan (1992-1994)*, edited by Carlos Serrano Sánchez, pp. 123-129. Universidad Nacional Autónoma de México, Mexico City.

Olsen, Karyn C., Christine D. White, Fred J. Longstaffe, Kristin von Keyking, George McGlynn, Gisela Grupe, and Frank J. Ruhli
2014 Intraskeletal Isotopic Compositions (δ^{13}C, δ^{15}N) of Bone Collagen: Nonpathological and Pathological Variation. *American Journal of Physical Anthropology* 153:598-604.

Olson, Jan Marie, and Michael E. Smith
2016 Material Expressions of Wealth and Social Class at Aztec-Period Sites in Morelos, Mexico. *Ancient Mesoamerica* 27:133-147.

Ortega Cabrera, Verónica
2009 Proyecto de Investigación Arqueológica Barrio Oaxaqueño Tlailotlacan, Teotihuacan, temporada 2008. Report submitted to the Consejo de Arqueología, INAH, Archivo Técnico, México.
2010 Proyecto de Investigación Arqueológica Barrio Oaxaqueño Tlailotlacan, Teotihuacan, temporada 2009. Report submitted to the Consejo de Arqueología, INAH, Archivo Técnico, México.

Ortega Cabrera, Veronica, and Jorge Nukyen Archer Velasco
2014 Pasado y presente de la presencia oaxaqueña en Teotihuacan, Mexico. *Cuicuilco* 21, 61:137-164.

Ortiz de Montellano, Bernard R.
1990 *Aztec Medicine, Health, and Nutrition*. Rutgers University Press, New Brunswick, New Jersey.

Ostrom, Elinor
2005 *Understanding Institutional Diversity*. Princeton University Press, Princeton, New Jersey.

Paddock, John
1983 The Oaxaca Barrio at Teotihuacan. In *The Cloud People: Divergent Evolution of the Zapotec and Mixtec Civilizations*, edited by Kent V. Flannery and J Marcus, pp. 170-175. Academic Press, New York.

Palomares Rodríguez, María T.
2003 Informe técnico: excavaciones en San Juan Evangelista, Teotihuacan de Arista. Report submitted to the Departamento de Protección Técnica y Legal de la Zona de Monumentos Arqueológicos de Teotihuacan, Estado de México.

2007 Ocupación zapoteca en Tlailotlacan Teotihuacan: estudio de identidad y ocupación en la Unidad Doméstica TL1. Tesis de Licenciatura, E.N.A.H, Mexico City.

Parfitt, A. Michael
1983 The Physiologic and Clinical Significance of Bone Histomorphometric Data. In *Bone Histomorphometry: Techniques and Interpretation*, edited by Robert R. Recker, pp 143-223. CRC Press, Inc., Boca Raton, Florida.

Parker Pearson, Mike
1999 *The Archaeology of Death and Burial*. Texas A&M University Press, College Station, Texas.

Parsons, Jeffrey R.
2001 *The Last Saltmakers of Nexquipayac, Mexico: An Archaeological Ethnography*. Anthropological Papers of the Museum of Anthropology, The University of Michigan, Ann Arbor, Michigan.
2006 *The Last Pescadores of Chimalhuacán, Mexico: An Archaeological Ethnography*. Anthropological Papers of the Museum of Anthropology No. 96., The University of Michigan, Ann Arbor, Michigan.
2008 *Prehispanic Settlement Patterns in the Northwestern Valley of Mexico: The Zumpango Region*. Memoirs of the Museum of Anthropology No. 45. The University of Michigan, Ann Arbor, Michigan.
2010 The Pastoral Niche in Pre-Hispanic Mesoamerica. In *Pre-Columbian Foodways: Interdisciplinary Approaches to Food, Culture, and Markets in Ancient Mesoamerica*, edited by John E.Staller and Michael Carrasco, pp. 109-136. Springer, New York.

Parsons, Jeffrey R., and Mary H. Parsons
1990 *Maguey Utilization in Highland Central Mexico: An Archaeological Ethnography*. The University of Michigan, Ann Arbor, Michigan.

Passey, Benjamin H., Todd F. Robinson, Linda K. Ayliffe, Thure E. Cerling, Matt Sponheimer, M. Denise Dearing, Beverly L. Roeder, and James R. Ehleringer
2005a Carbon Isotope Fractionation Between Diet, Breath CO_2, and Bioapatite in Different Mammals. *Journal of Archaeological Science* 32:1459-1470.

Passey, Benjamin H., Thure E. Cerling, Gerard T. Schuster, Todd F. Robinson, Beverly L. Roeder, and Stephen K. Krueger
2005b Inverse Methods for Estimating Primary Input Signals from Time-Averaged Isotope Profiles. *Geochimica et Cosmochimica Acta* 69:4101-4116.

Pasztory, Esther
1976 *The Murals of Tepantitla, Teotihuacan*. Garland Publishing, New York.
1983 *Aztec Art.* Harry M. Abrams, New York.

1988 A Reinterpretation of Teotihuacan and Its Mural Painting Tradition. In *Feathered Serpents and Flowering Trees: Reconstructing the Murals at Teotihuacan*, edited by Kathleen Berrin, pp. 45-77. Fine Arts Museums of San Francisco, San Francisco.
1997 *Teotihuacan: An Experiment in Living*. University of Oklahoma Press, Norman, Oklahoma.

Pate, F. Donald, and Timothy J. Anson
2008 Stable Nitrogen Isotope Values in Arid-Land Kangaroos Correlated with Mean Annual Rainfall: Potential as a Paleoclimatic Indicator. *International Journal of Osteoarchaeology* 18:317-326.

Paulinyi, Zoltán
2006 The "Great Goddess" of Teotihuacan: Fiction or Reality? *Ancient Mesoamerica* 17:1-15.

Paynter, Robert
1989 The Archaeology of Equality and Inequality. *Annual Review of Anthropology* 18:369-399.

Perlov, Diane C.
2005 Working through Daughters: Strategies for Gaining and Maintaining Social Power among the *Chicheras* of Highland Bolivia. In *Drink, Power, and Society in the Andes*, edited by Justin Jennings and Brenda J. Bowser, pp. 49-74. University Press of Florida, Gainesville, Florida.

Perry, Megan A.
2007 Is Bioarchaeology a Handmaiden to History? Developing a Historical Bioarchaeology. *Journal of Anthropological Archaeology* 26:486-515.

Pestle William J., Brooke E. Crowley, and Matthew T. Weirauch
2014 Quantifying Inter-Laboratory Variability in Stable Isotope Analysis of Ancient Skeletal Remains. *PLoS One* 9:e102844.

Plunket, Patricia, and Gabriela Uruñuela
1998 Preclassic Household Patterns Preserved Under Volcanic Ash at Tetimpa, Puebla, Mexico. *Latin American Antiquity* 9:287-309.
2005 Recent Research in Puebla Prehistory. *Journal of Archaeological Research* 13:89-127.

Poszwa, Anne, Etienne Dambrine, Benoît Pollier, and Olivier Atteia
2000 A Comparison between Ca and Sr Cycling in Forest Ecosystems. *Plant and Soil* 225:299-310.

Price, T. Douglas, Jennifer Blitz, James H. Burton, and Joseph Ezzo
1992 Diagenesis in Prehistoric Human Bone: Problems and Solutions. *Journal of Archaeological Science* 19:513-529.

Price T. Douglas, Clark M. Johnson, Joseph M. Ezzo, Jonathan Ericson, and James H. Burton
1994 Residential Mobility in the Prehistoric Southwest United States: A Preliminary Study Using Strontium Isotope Analysis. *Journal of Archaeological Science* 21:315-330.

Price, T. Douglas, Linda Manzanilla, and William D. Middleton
2000 Immigration and the Ancient City of Teotihuacan in Mexico: A Study Using Strontium Isotope Ratios in Human Bone and Teeth. *Journal of Archaeological Science* 27:903-913.

Price, T. Douglas, James H. Burton, and R. Alexander Bentley
2002 The Characterization of Biologically Available Strontium Isotope Ratios for the Study of Prehistoric Migration. *Archaeometry* 44:117-136.

Price, T. Douglas, James H. Burton, Paul D. Fullager, Lori E. Wright, Jane E. Buikstra, and Vera Tiesler
2008 $^{87}Sr/^{86}Sr$ Ratios and the Study of Human Mobility in Ancient Mesoamerica. *Latin American Antiquity* 19:167-180.

Pyke, Graham H.
1984 Optimal Foraging Theory: A Critical Review. *Annual Review of Ecology and Systematics* 15:523-575.

Quintanilla, Patricia
1982 Estructura 69. In *Memoria del Proyecto Arqueológico Teotihuacan 80-82*, edited By Ruben Cabrera, Ignacio Rodríguez, and Noel Morelos, pp.355-360. Instituto Nacional de Antropología e Historia, Mexico City.

Quiroz, Lourdes
1995 Informe del análisis de restos óseos de animales procedentes del Frente 3 de La Ventilla, Teotihuacan, México. Report submitted to the archive of the Proyecto La Ventilla, Teotihuacan.

Radosevich, Stefan C.
1993 The Six Deadly Sins of Trace Element Analysis: A Case of Wishful Thinking in Science. In *Investigations of Ancient Human Tissue: Chemical Analyses in Anthropology*, edited by Mary K. Sandford, pp. 269-332. Gordon and Breach, New York.

Rathje, William L.
1973 Models for Mobile Maya: A Variety of Constraints. In *The Explanation of Culture Change: Models in Prehistory*, edited by Colin Renfrew, pp. 731-757. University of Pittsburgh Press, Pittsburgh, Pennsylvania.

Rattray, Evelyn C.
1987 Los barrios foráneos de Teotihuacan. In *Teotihuacan: nuevos datos, nuevas síntesis, nuevos problemas,* edited by Emily McClung de Tapia and Evelyn Childs Rattray, pp. 243-273. Universidad Nacional Autónoma de México, Mexico City.
1989 El Barrio de los Comerciantes y el conjunto Tlamimilolpa: un estudio comparativo. *Arqueología* 5:105-129.
1990 The Identification of Ethnic Affiliation at the Merchants' Barrio, Teotihaucan. In *Etnoarqueología: primer coloquio Bosch-Gimpera*, edited by Yoko Sugiura and Mari Carmen Serra Puche, pp. 113-138. Instituto de Investigaciones Antropológicas, Universidad Nacional Autónoma de México, Mexico City.
1992 *The Teotihuacan Burials and Offerings: A Commentary and Inventory*. Vanderbilt University Publications in Anthropology No. 42, Nashville, Tennessee.
1993 *The Oaxaca Barrio at Teotihuacan*. Universidad de las Américas, Puebla, Mexico.
2001 *Teotihuacan: Ceramics, Chronology, and Cultural Trends*. Instituto Nacional de Antropología e Historia and University of Pittsburgh, Mexico City and Pittsburgh, Pennsylvania.
2002 The Teotihuacan-Oaxaca Relationship. In *Homenaje a John Paddock*, edited by Patricia Plunket, pp. 139-147. Universidad de las Américas, Puebla, Mexico.

Rattray, Evelyn C., and Magalí Civera
1999 Los entierros del Barrio de los Comerciantes. In *Prácticas funerarias en la Ciudad de los Dioses: los enterramientos humanos de la antigua Teotihuacan*, edited by Linda Manzanilla and Carlos Serrano, pp. 149-172. Universidad Nacional Autónoma de México, Mexico City.

Reitz, Elizabeth J.
1987 Vertebrate Fauna and Socioeconomic Status. In *Consumer Choice in Historical Archaeology*, edited by Suzanne M. Spencer-Wood, pp. 101-119. Plenum Press, New York.

Richards, Janet, and Mary Van Buren, editors
2000 *Order, Legitimacy, and Wealth in Ancient States*. Cambridge University Press, Cambridge.

Roberts, Susan B., W.A. Coward, G. Ewing, Judith Savage, Tim J. Cole, and Alan Lucas
1988 Effect of Weaning on Accuracy of Doubly Labeled Water Method in Infants. *American Journal of Physiology: Regulatory, Integrative, and Comparative Physiology* 254: 622-627.

Robertson, Ian G.
1999 Spatial and Multivariate Analysis, Random Sampling Error, and Analytical Noise: Empirical Bayesian Methods at Teotihaucan, Mexico. *American Antiquity* 64:137-152.
2001 Mapping the Social Landscape of an Early Urban Center: Socio-Spatial Variation in Teotihuacan. Ph.D. dissertation, Arizona State University, Tempe, Arizona.
2005 Patrones diacrónicos en la constitución de los vecindarios Teotihuacanos. In *Arquitectura y urbansimo: pasado y presente de los espacios en Teotihuacan: memoria de la tercera mesa redonda de Teotihuacan*, edited by María Elena Ruiz Gallut and Jesús Torres Peralta, pp. 277-294. Instituto Nacional de Antropología e Historia, Mexico City.
2007 Prehispanic Settlement at Teotihuacan. In *Archaeological Settlement Pattern Data from the Cuautitlan, Temascalapa, and Teotihuacan Regions, Mexico*, by Larry J. Gorenflo and William T. Sanders, pp. 277–279. Occasional Papers in Anthropology, No. 30. Department of Anthropology, Pennsylvania State University, University Park, Pennsylvania.
2008 'Insubstantial' Residential Structures at Teotihuacán, Mexico. FAMSI Report (http://www.famsi.org/reports/06103/index.html)
2016 Las "estructuras rudimentarias" de Teotihuacan: evidencia arqueológica de asentamientos fuera de los conjuntos departamentales. In *Teotihuacan: investigaciones recientes, centro y periferia*, edited by Sandra Riego Ruiz and Salvador Guilliem Arroyo. Instituto Nacional de Antropología e Historia, Mexico City.

Robertson, Ian G., and M. Oralia Cabrera Cortés
2017 Teotihuacan Pottery as Evidence for Subsistence Practices Involving Maguey Sap. *Archaeological and Anthropological Sciences* 9:11-27.

Robb, John, Renzo Bigazzi, Luca Lazzarini, Caterina Scarsini, and Fiorenza Sonego
2001 Social "Status" and Biological "Status": A Comparison of Grave Goods and Skeletal Indicators from Pontecagnano. *American Journal of Physical Anthropology* 115:213-222.

Rodriguez Galicia, Bernardo
2006 El uso diferencial del recurso fáunico en Teopancazco, Teotihuacan, y su importancia en las áreas de actividad. M.A. thesis, Facultad de Filosofía y Letras, Universidad Nacional Autónoma de México, Mexico City.
2010 Captura, preparación, y uso diferencial de la ictiofauna encontrada en el sitio arqueológico de Teopancazco, Teotihuacan. Ph.D. dissertation, Facultad de Filosofía y Letras de la Universidad Nacional Autónoma de México, Mexico City.

Rodríguez Galicia, Bernardo, and Raul Valadez Azúa
2013 Vestigios del recurso costero en el sitio arqueológico de Teopancazco, Teotihuacan, Estado de México. *Revista Española de Antropología Americana* 43:9–29.

Rolls, Edmund T.
1997 Neural Processing Underlying Food Selection. In *Food Preferences and Taste: Continuity and Change*, edited by Helen Macbeth, pp. 39-54. Berghahn Books, Providence, Rhode Island.

Romaniello, Stephen J., M. Paul Field, Harrison B. Smith, Gwyneth W. Gordon, M. Hwan Kim, and Ariel D. Anbar
2015 Fully Automated Chromatographic Purification of Sr and Ca for Isotopic Analysis. *Journal of Analytical Atomic Spectrometry* 30:1906-1912.

Romero, Mary, and Eric Margolis, editors
2005 *The Blackwell Companion to Social Inequalities.* Blackwell, Malden, Massachusetts.

Rosello Izquierdo, Eufrasia, Arturo Morales Muñiz, and D. Carmen Morales
1994 La Cartuja/Spain: Anthropogenic Icthyocenosis of Culinary nature in a Paleocultural Context. *Offa* 51:323-331.

Rothschild, Nan A.
1989 The Effect of Urbanization on Faunal Diversity: A Comparison between New York City and St. Augustine, Florida, in the Sixteenth to Eighteenth Centuries. In *Quantifying Diversity in Archaeology*, edited by Robert D. Leonard and George T. Jones, pp. 92-99. Cambridge University Press, Cambridge.

Rozin, Paul, and April E. Fallon
1981 The Acquisition of Likes and Dislikes for Foods. In *Criteria of Food Acceptance: How Man Chooses What He Eats*, edited by Jürg Solms and R.L. Hall, pp. 35-45. Forster, Zurich, Switzerland.

Rozin, Paul, and Deborah Schiller
1980 The Nature and Acquisition of a Preference for Chili Pepper by Humans. *Motivation and Emotion* 4:77-101.

Rubio Chacón, Alonso
2003 Los entierros y las ofrendas de las excavaciones del Frente 2 de La Ventilla: temporada 1992-1994. In *Contextos arqueológicos y osteología del barrio de La Ventilla: Teotihuacan (1992-1994)*, edited by Carlos Serrano Sánchez, pp. 43-50. Universidad Nacional Autónoma de México, Mexico City.

Ruvalcaba Mercado, Jesus
1987 *Vida cotidiana y consumo de maiz en la huasteca veracruzana*. Centro de Investigaciones y Estudios Superiores en Antropología Social, Mexico City.

Sahagún, Bernardino de
1950-1982 *Florentine Codex: General History of the Things of New Spain*. Translated by Charles E. Dibble and Arthur J.O. Anderson. School of American Research, Santa Fe, New Mexico.

Sánchez Alaniz, José Ignacio
1991 Unidades habitacionales del periodo Clásico. In *Teotihuacan 1980-1982: nuevas interpretaciones*, edited by Rubén Cabrera Castro, Ignacio Rodríguez García, and Noel Morelos García, pp. 171-182. Instituto Nacional de Antropología e Historia, Mexico City.

Sánchez Sánchez, Jesús E.
1982a Etapas y sistemas constructivos de las Estructuras 87 y 88 del Sector N2W1 y relaciones que guardan con el Conjunto NW del Rio San Juan en la zona arqueologica de Teotihuacan. In *Teotihuacan 80-82: primeros resultados*, pp. 73-81. Instituto Nacional de Antropología e Historia, Mexico City.
1982b El Conjunto NW del Rio San Juan. In *Memoria del Proyecto Arqueológico Teotihuacan 80-82*, edited by Rubén Cabrera Castro, Ignacio Rodríguez G., and Noel Morelos G., pp. 227-246. Instituto Nacional de Antropología e Historia, Mexico City.

Sanders, William T.
1965 *Cultural Ecology of the Teotihuacan Valley*. University Department of Sociology and Anthropology, The Pennsylvania State University, University Park, Pennsylvania.
1967 Life in a Classic Village. In *Teotihuacán, XI Mesa Redonda*, pp.123-148. Sociedad Mexicana de Antropología, Mexico City.
1976a The Natural Environment of the Basin of Mexico. In *The Valley of Mexico: Studies in Pre-Hispanic Ecology and Society*, edited by Eric R. Wolf, pp. 59-67. University of New Mexico Press, Albuquerque, New Mexico.
1976b The Agricultural History of the Basin of Mexico. In *The Valley of Mexico: Studies in Pre-Hispanic Ecology and Society*, edited by Eric R. Wolf, pp. 101-159. University of New Mexico Press, Albuquerque, New Mexico.
1977 Ethnographic Analogy and the Teotihuacan Horizon Style. In *Teotihuacan and Kaminaljuyú: A Study in Prehistoric Culture Contact*, edited by William T. Sanders and Joseph W. Michels, pp. 397-410. Pennsylvania State University Press, University Park, Pennsylvania.
1992 Ranking and Stratification in Prehispanic Mesoamerica. In *Mesoamerican Elites: An Archaeological Assessment*, edited by Diane A. Chase and Arlen F. Chase, pp. 278– 291. University of Oklahoma Press, Norman.

2008 Prestige, Power, and Wealth: A Perspective Based on Residential Architecture at Teotihuacan. In *El Urbanismo en Mesoamerica/Urbanism in Mesoamerica*, vol. 2, edited by Alba Guadalupe Mastache, Robert H. Cobean, Ángel Garcia Cook, and Kenneth G. Hirth, pp. 113- 131. Instituto Nacional de Antropología e Historia and Pennsylvania State University, Mexico City and University Park, Pennsylvania.

Sanders, William T., and Susan Toby Evans
2006 Rulership and Palaces at Teotihuacan. In *Palaces and Power in the Americas: From Peru to the Northwest Coast*, edited by Jessica Joyce Christie and Patricia Joan Sarro, pp. 256-284. University of Texas Press, Austin, Texas.

Sanders, William T., and Deborah L. Nichols
1988 Ecological Theory and Cultural Evolution in the Valley of Oaxaca. *Current Anthropology* 29:33-52.

Sanders, William T., Jeffrey R. Parsons, and Michael H. Logan
1976 Summary and Conclusions. In *The Valley of Mexico: Studies in Pre-Hispanic Ecology and Society*, edited by Eric R. Wolf, pp. 161-180. Albuquerque: University of New Mexico Press.

Sanders, William T., Jeffrey R. Parsons, and Robert S. Santley
1979 *The Basin of Mexico: Ecological Processes in the Evolution of a Civilization*. Academic Press, New York.

Sandford, Mary K.
1993 Understanding the Biogenic-Diagenetic Continuum: Interpreting Elemental Concentrations of Archaeological Bone. In *Investigations of Ancient Human Tissue: Chemical Analyses in Anthropology*, edited by Mary K. Sandford, pp. 3-57. Gordon and Breach, New York.

Sandstrom, Alan R.
1991 *Corn is our Blood: Culture and Ethnic Identity in a Contemporary Aztec Indian Village*. University of Oklahoma Press, Norman, Oklahoma.

Schaaf, Peter, Gabriela Solís, Linda R. Manzanilla, Teodoro Hernández, Becket Lailson, and Peter Horn
2012 Isótopos de estroncio aplicados a estudios de migración humana en el centro de barrio de Teopancazco, Teotihuacan. In *Estudios arqueométricos del centro del barrio de Teopancazco en Teotihuacan*, edited by Linda Manzanilla, pp. 425-448. Universidad Nacional Autónoma de México, Mexico City.

Scherer, Andrew K., Lori E. Wright, and Cassady J. Yoder
2007 Bioarchaeological Evidence for Social and Temporal Differences in Diet at Piedras Negras, Guatemala. *Latin American Antiquity* 18:85-104.

Schluter, Christian, and Dirk Van de Gaer
2011 Upward Structural Mobility, Exchange Mobility, and Subgroup Consistent Mobility Measurement: U.S.-German Mobility Rankings Revisited. *Review of Income and Wealth* 57:1-22.

Schoeninger, Margaret J.
1979 Diet and Status at Chalcatzingo: Some Empirical and Technical Aspects of Strontium Analysis. *American Journal of Physical Anthropology* 51:295-310.

Schoeninger, Margaret J., and Michael J. DeNiro
1984 Nitrogen and Carbon Isotopic Composition of Bone Collagen from Marine and Terrestrial Animals. *Geochimica et Cosmochimica Acta* 48:625-639.

Schoeninger, Margaret J., Michael J. DeNiro, and Henrik Tauber
1983 Stable Nitrogen Isotope Ratios of Bone Collagen Reflect Marine and Terrestrial Components of Prehistoric Human Diet. *Science* 220:1381-1383.

Schwarcz, Henry P.
1991 Some Theoretical Aspects of Isotope Paleodiet Studies. *Journal of Archaeological Science* 18:261-275.

Schwarcz, Henry P., Jerry Melbye, M. Anne Katzenberg, and Martin Knyf
1985 Stable Isotopes in Human Skeletons of Southern Ontario: Reconstructing Paleodiet. *Journal of Archaeological Science* 12:187-206.

Schweissing, Matthew M., and Gisela Grupe
2003 Stable Strontium Isotopes in Human Teeth and Bone: A Key to Migration Events of the Late Roman Period in Bavaria. *Journal of Archaeological Science* 30:1373-1383.

Sealy, Judith C.
1986 *Stable Carbon Isotopes and Prehistoric Diets in the Southwestern Cape Province, South Africa*. BAR International Series, Oxford.

Sealy, Judith C., and Nikolaas J. van der Merwe
1986 Isotope Assessment of the Seasonal Mobility Hypothesis in the Southwestern Cape, South Africa. *Current Anthropology* 27:135-50.

Sealy, Judith, Richard Armstrong, and Carmel Schrire
1995 Beyond Lifetime Averages: Tracing Life Histories through Isotopic Analysis of Different Calcified Tissues from Archaeological Human Skeletons. *Antiquity* 69:290-300.

Séjourné, Laurette
1959 *Un palacio en la Ciudad de los Dioses*. Instituto Nacional de Antropología e Historia, Mexico City.

1966a *Arquitectura y pintura en Teotihuacán*. Siglo Veintiuno, Mexico City.
1966b *Arqueología de Teotihuacan: la ceramica*. Fondo de Cultura Económica, Mexico City.

Seler, Eduard
1960-61 *Gesammelte Abhandlungen zur Amerikanischen Sprach-un Altertumskunde*. Akademische Druck – u. Verlagsanstalt, Graz.

Service, Elman R.
1971 *Primitive Social Organization: An Evolutionary Perspective*. Random House, New York.
1975 *Origins of the State and Civilization: The Process of Cultural Evolution*. W.W. Norton and Co., New York.

Sempowski, Martha L.
1987 Differential Mortuary Treatment: Its Implications for Social Status at Three Residential Compounds in Teotihuacan, Mexico. In *Teotihuacan: nuevos datos, nuevas síntesis, nuevos problemas*, edited by Emily McClung de Tapia and Evelyn Childs Rattray, pp. 115-131. Universidad Nacional Autónoma de México, Mexico City.
1992 Economic and Social Implications of Variations in Mortuary Practices at Teotihuacan. In *Art, Ideology, and the City of Teotihuacan*, edited by Janet C. Berlo, pp. 27-58. Dumbarton Oaks, Washington, D.C.
1994 Mortuary Practices at Teotihuacan. In *Mortuary Practices and Skeletal Remains at Teotihuacan*, edited by Martha L. Sempowski and Michael W. Spence, pp. 1-314. University of Utah Press, Salt Lake City, Utah.
1999 The Potential Role of Human Interment in Household Ritual at Tetitla. In *Prácticas funerarias en la Ciudad de los Dioses: los entierramientos humanos de la antigua Teotihuacan*, edited by Linda Manzanilla and Carlos Serrano, pp. 473-502. Instituto Nacional de Antropología e Historia, Mexico City.

Sempowski, Martha L., and Michael W. Spence
1994 *Mortuary Practices and Skeletal Remains at Teotihuacan*. University of Utah Press, Salt Lake City, Utah.

Serrano Sánchez, Carlos, editor
2003 *Contextos arqueológicos y osteología del barrio de La Ventilla: Teotihuacan (1992-1994)*. Instituto de Investigaciones Antropológicas, Universidad Nacional Autónoma de México, Mexico City.

Serrano Sánchez, Carlos, and Zaíd Lagunas
1974 Sistema de enterramiento y notas sobre el material osteológico de La Ventilla, Teotihuacán, México. *Anales del INAH* 7a(4):105-144.

1999 Prácticas mortuorias prehispánicas en un barrio de artesanos (La Ventilla “B”), Teotihuacan. In *Prácticas funerarias en la Ciudad de los Dioses: los enterramientos humanos de la antigua Teotihuacan*, edited by Linda Manzanilla and Carlos Serrano, pp. 35-79. Universidad Nacional Autónoma de México, Mexico City.

Serrano Sánchez, Carlos, and Alejandro Terrazas Mata
2003 El proyecto La población prehispánica de Teotihuacan: osteobiografía de los entierros humanos de La Ventilla 1992-1994. In *Contextos arqueológicos y osteología del barrio de La Ventilla: Teotihuacan (1992-1994)*, edited by Carlos Serrano Sánchez, pp. 91-94. Instituto de Investigaciones Antropológicas, Universidad Nacional Autónoma de México, Mexico City.

Serrano Sánchez, Carlos, Manuel Rivero de la Calle, and Rosaura Yépez Vázquez
2003 La deformación cefálica intencional en los habitantes prehispánicos del barrio Teotihuacano de La Ventilla: exploración 1992-1994. In *Contextos arqueológicos y osteología del barrio de La Ventilla: Teotihuacan (1992-1994)*, edited by Carlos Serrano Sánchez, pp. 103-113. Instituto de Investigaciones Antropológicas, Universidad Nacional Autónoma de México, Mexico City.

Shadowen, Steve D., Sozi Pedro Tulante, and Shara L. Alpern
2009 No Distinctions Except Those Which Merit Originates: The Unlawfulness of Legacy Preferences in Public and Private Universities. *Santa Clara Law Review* 49:51-136.

Shearer, Georgia, Daniel H. Kohl, Ross A. Virginia, Barbara A. Bryan, J.L. Skeeters, Erik T. Nilsen, M. Rasoul Sharifi and Philip W. Rundle
1983 Estimates of N_2-Fixation from Variation in the Natural Abundance of ^{15}N in Sonoran Desert Ecosystems. *Oecologia* 56:365-373.

Shuman, Aviva
2008 Foodways as a Reflection of Cultural Identity in a Roman Frontier Province: Bridging the Gap from Theory to Material. In *Food and Drink in Archaeology I: University of Nottingham Postgraduate Conference 2007*, edited by Sera Baker, Martyn Allen, Sarah Middle, and Kristopher Poole, pp. 141-148. Prospect Books, Trowbridge, United Kingdom.

Siebe, Claus
2000 Age and Archaeological Implications of Xitle Volcano, Southwestern Basin of Mexico-City. *Journal of Volcanology and Geothermal Research* 104:45-64.

Sillen, Andrew
1989 Diagenesis of the Inorganic Phase of Cortical Bone. In *The Chemistry of Prehistoric Human Bone*, edited by T. Douglas Price, pp. 211-229. Cambridge University Press, New York.

Sillen, Andrew, Grant Hall, Stephen Richardson, and Richard Armstrong
1998 $^{87}Sr/^{86}Sr$ Ratios in Modern and Fossil Food-Webs of the Sterkfontein Valley: Implications for Early Hominid Habitat Preference. *Geochimica et Cosmochimica Acta* 62:2463-2478.

Silverblatt, Irene
1987 *Moon, Sun, and Witches: Gender Ideologies and Class in Inca and Colonial Peru*. Princeton University Press, Princeton, New Jersey.

Simmons, Lisa M., Janet Montgomery, Julia Beaumont, Graham R. Davis, and Maisoon Al-Jawad
2013 Mapping the Spatial and Temporal Progression of Human Dental Enamel Biomineralization Using Synchrotron X-Ray Diffraction. *Archives of Oral Biology* 58:1726-1734.

Singer, David A.
1985 The Use of Fish Remains as a Socio-Economic Measure: An Example from 19th Century New England. *Historical Archaeology* 19:132-136.
1987 The Threshold of Affordability: Assessing Fish Remains for Socioeconomics. In *Consumer Choice in Historical Archaeology*, edited by Suzanne M. Spencer-Wood, pp. 85-99. Plenum Press, New York.

Sload, Rebecca S.
1977 Toward More Precise Status Categories at Teotihuacan, Mexico. *Newsletter of Computer Archaeology* 13:1-16.
1987 The Great Compound: A Forum for Regional Activities. In *Teotihuacan: nuevos datos, nuevas sintesis, nuevos problemas*, edited by Emily McClung de Tapia and Evelyn Rattray, pp. 219-241. Universidad Nacional Autónoma de Mexico, Mexico City.

Smith, Adam T.
2003 *The Political Landscape: Constellations of Authority in Early Complex Polities*. University of California Press, Berkeley.

Smith, Bruce N., and Samuel Epstein
1971 Two Categories of $^{13}C/^{12}C$ Ratios for Higher Plants. *Plant Physiology* 47:380-384.

Smith, Eric Alden, Monique Borgerhoff Mulder, Samuel Bowles, Michael Gurven, Tom Hertz, and Mary K. Shenk
2010 Production Systems, Inheritance, and Inequality in Premodern Societies. *Current Anthropology* 51:85-94.

Smith, Michael E.
1986 The Role of Social Stratification in the Aztec Empire: A View from the Provinces. *American Anthropologist* 88:70-91.
1987 Household Possessions and Wealth in Agrarian States: Implications for Archaeology. *Journal of Anthropological Archaeology* 6:297-335.

Smith, Michael E., and Frederic Hicks
2016 Inequality and Social Class in Aztec Society. In *Oxford Handbook of the Aztecs*, edited by Deborah L. Nichols and Enrique Rodríguez-Alegría, pp. 425-436. Oxford University Press, New York.

Smith, Michael E., and Lisa Montiel
2001 The Archaeological Study of Empires and Imperialism in Prehispanic Central Mexico. *Journal of Anthropological Archaeology* 20:245-284.

Smith, Michael E., and Juliana Novic
2012 Introduction: Neighborhoods and Districts in Ancient Mesoamerica. In *The Neighborhood as a Social and Spatial Unit in Mesoamerican Cities*, edited by M. Charlotte Arnauld, Linda R. Manzanilla, and Michael E. Smith, pp. 1-26. The University of Arizona Press, Tucson, Arizona.

Smith, Michael E., Timothy Dennehy, April Kamp-Whittaker, Emily Colon, and Rebecca Harkness
2014 Quantitative Measures of Wealth Inequality in Ancient Central Mexican Communities. *Advances in Archaeological Practice* 2:311-323.

Smith, Michael E., Barbara L. Stark, Wen-Ching Chuang, Timothy J. Dennehy, Sharon L. Harlan, April Kamp-Whittaker, Benjamin W. Stanley, and Abigail M. York
2016 Comparative Methods for Premodern Cities: Coding for Governance and Class Mobility. *Cross-Cultural Research* 50:415-451.

Smith, Robert Eliot
1987 *A Ceramic Sequence from the Pyramid of the Sun, Teotihuacan, Mexico.* Papers of the Peabody Museum of Archaeology and Ethnology, vol. 75. Harvard University, Cambridge, Massachusetts.

Smith, Colin I., Christina M. Nielsen-Marsh, Miranda M. E. Jans, and Matthew J. Collins.
2007 Bone Diagenesis in the European Holocene I: Patterns and Mechanisms. *Journal of Archaeological Science* 34:1485-1493.

Sofaer Derevenski, Joanna
1997a Age and Gender at the Site of Tiszapolgár-Basatanya, Hungary. *Antiquity* 71:875-889.

1997b Linking Age and Gender as Social Variables. *Ethnographisch-Archäologischen Zeitschrift* 38:485-493.
2000 Rings of Life: The Role of Early Metalwork in Mediating the Gendered Life Course. *World Archaeology* 31:389-406.
2005 The Materiality of Age: Osteoarchaeology, Objects, and the Contingency of Human Development. *Ethnographisch-Archäologischen Zeitschrift* 45:165-180.
2006 *The Body as Material Culture: A Theoretical Osteoarchaeology*. Cambridge University Press, New York.

Somerville, Andrew D.
2015 Leporids, Landscapes, and Social-Environmental Dynamics in Arid North America: Stable Isotope Analysis of Rabbit and Hare Bones from Modern and Archaeological Sites. Ph.D. dissertation, University of California, San Diego.

Somerville, Andrew D., Mikael Fauville, and Andrew W. Froehle
2013 Applying New Approaches to Modeling Diet and Status: Isotopic Evidence for Commoner Resiliency and Elite Variability in the Classic Maya Lowlands. *Journal of Archaeological Science* 40:1539-1553.

Somerville, Andrew D., Nawa Sugiyama, Linda R. Manzanilla, and Margaret J. Schoeninger
2016 Animal Management at the Ancient Metropolis of Teotihuacan, Mexico: Stable Isotope Analysis of Leporid (Cottontail and Jackrabbit) Bone Mineral. *PLoS ONE* 11(8):e0159982.

Sorokin, Pitirim A.
1959 *Social and Cultural Mobility*. The Free Press, Glencoe, Illinois.

Soustelle, Jacques
1970 *Daily Life of the Aztecs on the Eve of the Spanish Conquest*. Stanford University Press, Stanford, California.

Spence, Michael W.
1967 The Obsidian Industry of Teotihuacán. *American Antiqutiy* 32:507-514.
1971 Skeletal Morphology and Social Organization in Teotihuacan, Mexico. Ph.D. dissertation, Southern Illinois University, Carbondale, Illinois.
1976 Human Skeletal Material from the Oaxaca Barrio in Teotihuacan, Mexico. In *Archaeological Frontiers: Papers in Honor of J. Charles Kelley*, edited by Robert B. Pickering, pp. 129-148. Carbondale: Southern Illinois University Museum, Carbondale, Illinois.
1981 Obsidian Production and the State in Teotihuacan. *American Antiquity* 46:769-788.
1986 Locational Analysis of Craft Specialization Areas in Teotihuacan. In *Research in Economic Anthropology: Economic Aspects of Prehispanic Highland Mexico*, edited by Barry L. Isaac, pp. 75-100. JAI Press, London.

1987 The Scale and Structure of Obsidian Production in Teotihuacan. In *Teotihuacan: nuevos datos, nuevas síntesis, nuevos problemas*, edited by Emily McClung de Tapia and Evelyn C. Rattray, pp. 429-450. Universidad Nacional Autónoma de México, Mexico City.

1989 Excavaciones recientes en Tlailotlacan: el barrio Oaxaqueño de Teotihuacan. *Arqueología* 5:81-104.

1992 Tlailotlacan, a Zapotec Enclave in Teotihuacan. In *Art, Ideology, and the City of Teotihuacan*, edited by Janet C. Berlo, pp. 59-88. Dumbarton Oaks, Washington, D.C.

1994 Human Skeletal Material from Teotihuacan. In *Mortuary Practices and Skeletal Remains at Teotihuacan*, by Martha L. Sempowski and Michael W. Spence, pp. 315-411. University of Utah Press, Salt Lake City, Utah.

1996 A Comparative Analysis of Ethnic Enclaves. In *Arqueología Mesoamericana: homenaje a William T. Sanders*, edited by Alba Guadalupe Mastache, Jeffrey R. Parsons, Robert S. Santley, and Mari Carmen Serra Puche, pp. 333-353. Instituto Nacional de Antropología e Historia, Mexico City.

2002 Domestic Ritual in Tlailotlacan, Teotihuacan. In *Domestic Ritual in Ancient Mesoamerica*, edited by Patricia Plunket, pp. 53-66. The Cotsen Institute of Archaeology, University of California, Los Angeles.

2005 A Zapotec Diaspora Network in Classic Period Central Mexico. In *The Archaeology of Colonial Encounters: Comparative Perspectives*, edited by Gil Stein, pp 173-206. School of American Research Press, Santa Fe, New Mexico.

Spence, Michael W., and Luis Gamboa Cabezas

1999 Mortuary Practices and Social Adaptation in the Tlailotlacan Enclave. In *Practicas funerarias en la Ciudad de los Dioses: los enterramientos humanos de la antigua Teotihuacan, Mexico*, edited by Linda Manzanilla and Carlos Serrano, pp. 173-201. Instituto de Investigaciones Antropológicas, Universidad Nacional Autónoma de México, Mexico City.

Spence, Michael W., and Christine D. White

2004 Un análisis de las proporciones de los isótopos del oxígeno en los entierros del Barrio de los Comerciantes. In *La costa del golfo en tiempos Teotihuacanos: propuestas y perspectivas*, edited by María Elena Ruiz Gallut and Arturo Pascual Soto, pp. 469-492. Instituto Nacional de Antropología e Historia, Mexico City.

Spence, Michael W., Christine D. White, Fred J. Longstaffe, and Kimberley R. Law

2004 Victims of the Victims: Human Trophies worn by Sacrificed Soldiers from the Feathered Serpent Pyramid, Teotihuacan. *Ancient Mesoamerica* 15:1-15.

Spence, Michael W., Christine C. White, Evelyn C. Rattray, and Frederick J. Longstaffe

2005 Past Lives in Different Places: The Origins and Relationships of Teotihuacan's Foreign Residents. In *Settlement, Subsistence and Social Complexity: Essays Honoring the Legacy of Jeffrey Parsons*, edited by Richard E. Blanton, pp. 155-197. Cotsen Institute of Archaeology, University of California, Los Angeles.

Speth, John D.
1990 Seasonality, Resource Stress, and Food Sharing in So-Called “Egalitarian” Foraging Societies. *Journal of Anthropological Archaeology* 9:148-188.

Speth, John D., and Katherine A. Spielmann
1983 Energy Source, Protein Metabolism, and Hunter-Gatherer Subsistence Strategies. *Journal of Anthropological Archaeology* 2:1-31.

Spielmann, Katherine A., Margaret J. Schoeninger, and Katherine Moore
1990 Plains-Pueblo Interdependence and Human Diet at Pecos Pueblo, New Mexico. *American Antiquity* 55:745-765.

Srinivas, Mysore N.
1962 *Caste in Modern India, and Other Essays*. Asia Publishing House, New York.

Starbuck, David R.
1975 Man-Animal Relationships in Pre-Columbian Central Mexico. Ph.D. dissertation, Department of Anthropology, Yale University, New Haven, Connecticut.
1987 Faunal Evidence for the Teotihuacan Subsistence Base. In *Teotihuacan: nuevos datos, nuevas síntesis, nuevos problemas*, edited by Emily McClung de Tapia and Evelyn C. Rattray, pp. 75-90. Universidad Nacional Autónoma de México, Mexico City.

Steere, Benjamin A., and Stephen A. Kowalewski
2012 Wealth Stratification in Ancient Mesoamerica. *Social Evolution and History* 11:20-48.

Stein, Burton
1968 Social Mobility and Medieval South Indian Hindu Sects. In *Social Mobility in the Caste System in India: An Interdisciplinary Symposium*, edited by James Silverberg, pp. 78-94. Mouton, Paris.

Stein, Mordechai, Abraham Starinsky, Amitai Katz, Steven L. Goldstein, Michlus Machlus, and Alexandra Schramm
1997 Strontium Isotopic, Chemical, and Sedimentological Evidence for the Evolution of Lake Lisan and the Dead Sea. *Geochimica et Cosmochimica Acta* 61:3975-3992.

Stiglitz, Joseph E.
2012 *The Price of Inequality: How Today's Divided Society Endangers Our Future*. Norton, New York.

Stodder, Ann W., and Ann M. Palkovich, editors
2014 *The Bioarchaeology of Individuals*. University Press of Florida, Gainesville, Florida.

Stone, Andrea
1989 Disconnection, Foreign Insignia, and Political Expansion: Teotihuacan and the Warrior Stelae of Piedras Negras. In *Mesoamerica After the Decline of Teotihuacan, A.D. 700-900,* edited by Richard A. Diehl and Janet C. Berlo, pp. 153-173. Dumbarton Oaks, Washington, D.C.

Stoodley, Nick
2000 From the Cradle to the Grave: Age Organization and the Early Anglo-Saxon Burial Rite. *World Archaeology* 31:456-472.

Storey, Rebecca
1987 A First Look at the Paleodemography of the Ancient City of Teotihuacan. In *Teotihuacan: nuevos datos, nuevas síntesis, nuevos problemas*, edited by Emily McClung de Tapia and Evelyn Rattray, pp. 91-114. Universidad Autónoma de Mexico, Mexico City.
1992 *Life and Death in the Ancient City of Teotihuacan: A Modern Paleodemographic Synthesis*. The University of Alabama Press, Tuscaloosa, Alabama.

Storey, Rebecca, and Randolph J. Widmer
1989 Household and Community Structure of a Teotihuacan Apartment Compound: S3W1:33 of the Tlajinga Barrio. In *Households and Communities: Proceedings of the 21st Annual Chacmool Conference of the Archaeological Association of the University of Calgary*, edited by Scott MacEachern, David J.W. Archer, and Richard D. Garvin, pp. 407-415. The University of Calgary Archaeological Association, Calgary, Alberta, Canada.

Storey, Rebecca, Lourdes Márquez-Morfín, and Luis F. Núñez
2012 Teotihuacan Neighborhoods and the Health of Residents: The Risks of Preindustrial Urban Living. In *The Neighborhood as a Social and Spatial Unit in Mesoamerica*, edited by M. Charlotte Arnauld, Linda R. Manzanilla, and Michael E. Smith, pp. 117-131. University of Arizona Press, Tucson, Arizona.

Stuart-Williams, Hilary Le Q., Henry P. Schwarcz, Christine D. White, and Michael W. Spence
1996 The Isotopic Composition and Diagenesis of Human Bone from Teotihuacan and Oaxaca, Mexico. *Palaeogeography, Palaeoclimatology, Palaeoecology* 126:1-14.

Sugiyama, Nawa, Andrew D. Somerville, and Margaret J. Schoeninger
2015 Stable Isotopes and Zooarchaeology at Teotihuacan, Mexico Reveal Earliest Evidence of Wild Carnivore Management in Mesoamerica. *PLoS ONE* 10(9): e0135635.

Sugiyama, Nawa, Raúl Valadez Azúa, and Bernardo Rodríguez Galicia
2017 Faunal Acquisition, Maintenance, and Consumption: How the Teotihuacanos got their Meat. *Archaeological and Anthropological Sciences* 9:61-81.

Sugiyama, Saburo
1989 Burials Dedicated to the Old Temple of Quetzalcoatl at Teotihuacan, Mexico. *American Antiquity* 54:85-106.
1991 Descubrimientos de entierros y ofrendas dedicados al Templo Viejo de Quetzalcoatl. In *Teotihuacan 1980–1982: nuevas interpretaciones*, edited by Rubén Cabrera, Ignacio Rodríguez, and Noel Morelos, pp. 275-326. Instituto Nacional de Antropología e Historia, Mexico City.
1993 Worldview Materialized in Teotihuacan, Mexico. *Latin American Antiquity* 4:103-129.
2005 *Human Sacrifice, Militarism, and Rulership: Materialization of State Ideology at the Feathered Serpent Pyramid, Teotihuacan*. Cambridge University Press, Cambridge.
2010 Teotihuacan City Layout as a Cosmogram: Preliminary Results of the 2007 Measurement Unit Study. In *The Archaeology of Measurement: Comprehending Heaven, Earth and Time in Ancient Societies*, edited by Iain Morley and Colin Renfrew, pp. 130-149. Cambridge University Press, New York.

Sugiyama, Saburo, and Rubén Cabrera Castro
2007 The Moon Pyramid Project and the Teotihuacan Polity: A Brief Summary of the 1998-2004 Excavations. *Ancient Mesoamerica* 18:109-125.

Sullivan, Kristin S.
2006 Specialized Production of San Martín Orange Ware at Teotihuacan, Mexico. *Latin American Antiquity* 17:23-53.
2007 Commercialization in Early State Economies: Craft Production and Market Exchange in Classic Period Teotihuacan. Ph.D. dissertation, Arizona State University, Tempe, Arizona.

Szpak, Paul
2014 Complexities of Nitrogen Isotope Biogeochemistry in Plant-Soil Systems: Implications for the Study of Ancient Agricultural and Animal Management Practices. *Frontiers in Plant Science* 5. doi: 10.3389/fpls.2014.00288.

Szpak, Paul, Jean-François Millaire, Christine D. White, and Fred J. Longstaffe
2012 Influence of Seabird Guano and Camelid Dung Fertilization on the Nitrogen Isotopic Composition of Field-Grown Maize (*Zea mays*). *Journal of Archaeological Science* 39:3721-3740.

Szpak, Paul, Fred J. Longstaffe, Jean-François Millaire, and Christine D. White
2014 Large Variation in Nitrogen Isotopic Composition of a Fertilized Legume. *Journal of Archaeological Science* 45:72-79.

Tapper, Richard, and Nancy Tapper
1986 “Eat This, It’ll Do You a Power of Good”: Food and Commensality Among Durrani Pashtuns. *American Ethnologist* 13:62-79.

Taube, Karl A.
1983 The Teotihuacan Spider Woman. *Journal of Latin American Lore* 9:107–189.
2001 La escritura Teotihuacana. *Arqueología Mexicana* 8:58-63.
2003 Tetitla and the Maya Presence at Teotihuacan. In *The Maya and Teotihuacan: Reinterpreting Early Classic Interaction*, edited by Geoffrey E. Braswell, pp. 273-314. University of Texas Press, Austin, Texas.

Tauber, Henrik
1981 ^{13}C Evidence for Dietary Habits of Prehistoric Man in Denmark. *Nature* 292:332-333.

Taylor, William B.
1987 *Embriaguez, homicidio, y rebelión en las poblaciones coloniales Mexicanas*. Fondo de Cultura Económica, Mexico City.

Tieszen, Larry L., and Michael Chapman
1992 Carbon and Nitrogen Isotopic Status of the Major Marine and Terrestrial Resources in the Atacama Desert of Northern Chile. In *Proceedings of the I World Congress on Mummy Studies*, pp. 409-425. Museo Arqueologico y Etnografico de Tenerife, Tenerife, Canary Islands.

Tieszen, Larry L., and Tim Fagre
1993 Effect of Diet Quality and Composition on the Isotopic Composition of Respiratory CO_2, Bone Collagen, Bioapatite and Soft Tissues. In *Prehistoric Human Bone: Archaeology at the Molecular Level*, edited by Joseph B. Lambert and Gisela Grupe, pp. 121-155. Springer-Verlag, Berlin.

Tilly, Charles
2005 Historical Perspectives on Inequality. In *The Blackwell Companion to Social Inequalities*, edited by Mary Romero and Eric Margolis, pp.15-30. Blackwell, Malden, Massachusetts.
2007 Poverty and the Politics of Exclusion. In *Moving out of Poverty: Cross-Disciplinary Perspectives on Mobility*, edited by Deepa Narayan and Patti Petesch, pp. 45-76. World Bank, New York.

Toohey, Jason L., Bryn Geddes, Melissa S. Murphy, Claudia Pereyra Iturry, and Jimmy Bouroncle
2016 Theorizing Residential Burial in Cajamarca, Peru: An Understudied Mortuary Treatment in the Central Andes. *Journal of Anthropological Archaeology* 43:29-38.

Torres-Rouff, Christina, Kelly J. Knudson, William J. Pestle, and Emily M. Stovel
2015 Tiwanaku Influence and Social Inequality: A Bioarcaheological, Biogeochemical, and Contextual Analysis of the Larache Cemetery, San Pedro de Atacama, Northern Chile. *American Journal of Physical Anthropology* 158:592-606.

Torres Sanders, Liliana, and José Rodolfo Cid Beziez
1997 La decapitación: una práctica cultural Teotihuacana. In *Estudios de antropología biológica*, vol. VII, pg. 191-201. Universidad Nacional Autónoma de México, Mexico City.
2011 *Vida y salud en conjuntos habitacionales del sector oeste de Teotihuacan.* Instituto Nacional de Antropología e Historia, Mexico City.

Tricca, Aude, Peter Stille, Marc Steinmann, Bernard Kiefel, Jean Samuel, and Jost Eikenberg
1999 Rare Earth Elements and Sr and Nd Isotopic Compositions of Dissolved and Suspended Loads from Small River Systems in the Vosges Mountains (France), the River Rhine and Groundwater. *Chemical Geology* 160:139-158.

Trigger, Bruce G.
2003 *Understanding Early Civilizations: A Comparative Study*. Cambridge University Press, New York.

Trueman, Clive N.G., Anna K. Behrensmeyer, Noreen Tuross, and Steve Weiner
2004 Mineralogical and Compositional Changes in Bones Exposed on Soil Surfaces in Amboseli National Park, Kenya: Diagenetic Mechanisms and the Role of Sediment Pore Fluids. *Journal of Archaeological Science* 31:721-739.

Tung, Tiffiny, and Kelly J. Knudson
2011 Identifying Locals, Migrants, and Captives in the Wari Heartland: A Bioarchaeological and Biogeochemical Study of Human Remains from Conchopata, Peru. *Journal of Anthropological Archaeology* 30:247-261.

Turkon, Paula
2004 Food and Status in the Prehispanic Malpaso Valley, Zacatecas, Mexico. *Journal of Anthropological Archaeology* 23:225-251.

Turner, Bethany L., J.L. Edwards, E.A. Quinn, John D. Kingston, and Dennis P. van Gerven
2007 Age-Related Variation in Isotopic Indicators of Diet at Medieval Kulubnarti, Sudanese Nubia. *International Journal of Osteoarchaeology* 17:1-25.

Turner, Bethany L., John D. Kingston, and George J. Armelagos
2010 Variation in Dietary Histories among the Immigrants of Machu Picchu: Carbon and Nitrogen Isotope Evidence. *Chungara: Revista de Antropología Chilena* 42:515-534.

Turner, Margaret H.
1987 The Lapidaries of Teotihuacan. In *Teotihuacan: nuevos datos, nuevas síntesis, nuevos problemas*, edited by Emily McClung de Tapia and Evelyn C. Rattray, pp. 465-471. Instituto de Investigaciones Antropológicas, Universidad Nacional Autónoma de México, Mexico City.
1992 Style in Lapidary Technology: Identifying the Teotihuacán Lapidary Industry. In *Art, Ideology, and the City of Teotihuacán*, edited by Janet Berlo, pp. 89-112. Dumbarton Oaks, Washington, D.C.

Turner, Ralph H.
1960 Sponsored and Contest Mobility and the School System. *American Sociological Review* 25:855-862.

Tuross, Noreen, Marilyn L. Fogel, and P.E. Hare
1988 Variability in the Preservation of the Isotopic Composition of Collagen from Fossil Bone. *Geochimica et Cosmochimica Acta* 52:929-935.

Tütken, Thomas, and Torsten W. Vennemann
2011 Fossil Bones and Teeth: Preservation or Alteration of Biogenic Compositions? *Palaeogeography, Palaeoclimatology, Palaeoecology* 310:1-8.

Twiss, Katheryn C., editor
2007 *The Archaeology of Food and Identity*. Southern Illinois University Carbondale Occasional Paper No. 34. Center for Archaeological Investigations, Southern Illinois University, Carbondale, Illinois.

Twiss, Katheryn
2012 The Archaeology of Food and Social Diversity. *Journal of Anthropological Research* 20:357-395.

Tykot, Robert H.
2004 Stable Isotopes and Diet: You Are What You Eat. In *Proceedings of the International School of Physics "Enrico Fermi" Course CLIV*, edited by Marco Martini, Mario Milazzo, and Marcello Piacentini, pp. 433-444. Amsterdam: IOS Press.

Ubelaker, Douglas H., M. Anne Katzenberg, and Leon G. Doyon
1995 Status and Diet in Precontact Highland Ecuador. *American Journal of Physical Anthropology* 97:403-411.

Ugan, Andrew, and Joan Brenner Coltrain
2011 Variation in Collagen Stable Nitrogen Values in Black-Tailed Jackrabbits (*Lepus californicus*) in Relation to Small-Scale Differences in Climate, Soil, and Topography. *Journal of Archaeological Science* 38:1417-1429.

Valadez, Raúl
1993 Macrofósiles faunísticos. In *Anatomía de un conjunto residencial Teotihuacano en Oztoyahualco, Vol. 2*, edited by Linda Manzanilla, pp. 729-831. Instituto de Investigaciones Antropológicas, Universidad Nacional Autónoma de México, Mexico City.

Valadez, Raúl, and Linda Manzanilla
1988 Restos faunísticos y áreas de actividad en una unidad habitacional de la antigua ciudad de Teotihuacan. *Revista Mexicana de Estudios Antropológicos* 343:147-168.

van Leeuwen, Marco H.D. and Ineke Maas
2010 Historical Studies of Social Mobility and Stratification. *Annual Review of Sociology* 36:429-451.

Veblen, Thorstein
1899 *Theory of the Leisure Class: An Economic Study in the Evolution of Institutions*. Macmillan, New York.

Veizer, Jan
1989 Strontium Isotopes in Seawater Through Time. *Annual Review of Earth and Planetary Science* 1:141-167.

Vidarte, Juan
1966 Exploraciones arqueológicas en el Rancho "La Ventilla." Report submitted to the Departamento de Monumentos Prehispánicos, INAH.

Virginia, Ross A., and C.C. Delwiche
1982 Natural ^{15}N Abundance of Presumed N_2-fixing and Non-N_2-Fixing Plants from Selected Ecosystems. *Oecologia* 54:317-325.

Vogt, Evon Z.
1970 *The Zinacantecos of Mexico: A Modern Maya Way of Life*. Holt, Rinehart and Winston, New York.
1976 *Tortillas for the Gods: A Symbolic Analysis of Zinacanteco Rituals*. Harvard University Press, Cambridge, Massachusetts.

Waldron, H.A.
1981 Postmortem Absorption of Lead by the Skeleton. *American Journal of Physical Anthropology* 55:395-398.
1983 On the Post-Mortem Accumulation of Lead by Skeletal Tissues. *Journal of Archaeological Science* 10:35-40.

Walker, Phillip L., and Della Collins Cook
1998 Brief Communication: Gender and Sex: Vive la Difference. *American Journal of Physical Anthropology* 106:255-259.

Walker, Philip L., Rhonda R. Bathurst, Rebecca Richman, Thor Gjerdrum, and Valerie A. Andrushko
2009 The Causes of Porotic Hyperostosis and Cribra Orbitalia: A Reappraisal of the Iron-Deficiency-Anemia Hypothesis. *American Journal of Physical Anthropology* 139:109-125.

Warinner, Christina, and Noreen Tuross
2009 Alkaline Cooking and Stable Isotope Tissue-Diet Spacing in Swine: Archeological Implications. *Journal of Archaeological Science* 36:1690-1697.

Warinner, Christina, Nelly Robles Garcia, and Noreen Tuross
2013 Maize, Beans and the Floral Isotopic Diversity of Highland Oaxaca, Mexico. *Journal of Archaeological Science* 40:868-873.

Wason, Paul K.
1994 *The Archaeology of Rank*. Cambridge University Press, Cambridge.

Watson, Patty Jo
1978 Architectural Differentiation in Some Near Eastern Communities, Prehistoric and Contemporary. In *Social Archaeology: Beyond Subsistence and Dating*, edited by Charles L. Redman, Mary Jane Berman, Edward V. Curtin, William T. Langhorne, Nina M. Vergassi, and Jeffery C. Wanser, pp. 131-158. Academic Press, New York.

Weber, Max
1947 *The Theory of Social and Economic Organization*. Oxford University Press, London.
1958 *The Protestant Ethic and the Spirit of Capitalism*. New York: Charles Scribner, New York.
1968 *Economy and Society*. University of California Press, Berkeley, California.

Webster, Gary S.
1980 Labor Control and Emergent Stratification in Prehistoric Europe. *Current Anthropology* 31:337-366.

Weismantel, Mary J.
1988 *Food, Gender, and Poverty in the Ecuadorian Andes*. University of Pennsylvania Press, Philadelphia, Pennsylvania.

Welch, Paul D., and C. Margaret Scarry
1995 Status-Related Variation in Foodways in the Moundville Chiefdom. *American Antiquity* 60:397-419.

Whipkey, Charles E., Rosemary C. Capo, Oliver A. Chadwick, and Brian W. Stewart
2000 The Importance of Sea Spray to the Cation Budget of a Coastal Hawaiian Soil: A Strontium Isotope Approach. *Chemical Geology* 168:37-48.

White, Christine D.
2005 Gendered Food Behavior Among the Maya: Time, Place, Status, and Ritual. *Journal of Social Archaeology* 5:356-382.

White, Christine D., and Michael W. Spence
2008 San José 520 Oxygen Isotopes Preliminary Report. Report submitted to Oralia Cabrera.

White, Christine D., Michael W. Spence, Hilary LeQ. Stuart-Williams, and Henry P. Schwarcz
1998 Oxygen Isotopes and the Identification of Geographical Origins: The Valley of Oaxaca Versus the Valley of Mexico. *Journal of Archaeological Science* 25:643–655.

White, Christine D., Mary E.D. Pohl, Henry P. Schwarcz, and Fred J. Longstaffe
2001a Isotopic Evidence for Maya Patterns of Deer and Dog Use at Preclassic Colha. *Journal of Archaeological Science* 28:89-107.

White, Christine D., David M. Pendergast, Fred J. Longstaffe, and Kimberley R. Law
2001b Social Complexity and Food Systems at Altun Ha, Belize: The Isotopic Evidence. *Latin American Antiquity* 12:371-393.

White, Christine D, Michael W. Spence, Fred J. Longstaffe, Hilary Le-Q. Stuart-Williams, and Kimberley R. Law
2002 Geographic Identities of the Sacrificial Victims from the Feathered Serpent Pyramid, Teotihuacan: Implications for the Nature of State Power. *Latin American Antiquity* 13:217-236.

White, Christine D., Rebecca Storey, Fred J. Longstaffe, and Michael W. Spence
2004a Immigration, Assimilation, and Status in the Ancient City of Teotihuacan: Stable Isotopic Evidence from Tlajinga 33. *Latin American Antiquity* 15:176-198.

White, Christine D., Michael W. Spence, Fred J. Longstaffe, and Kimberley R. Law
2004b Demography and Ethnic Continuity in the Tlailotlacan Enclave of Teotihuacan: The Evidence of Stable Oxygen Isotopes. *Journal of Anthropological Archaeology* 23:385-403.

White, Christine D., Mary D. Pohl, Henry P. Schwarcz, and Fred J. Longstaffe
2004c Feast, Field, and Forest: Deer and Dog Diets at Lagartero and Copán. In *Maya Zooarchaeology: New Directions in Method and Theory*, edited by Kitty Emery, pp. 141-158. Cotsen Institute of Archaeology, University of California, Los Angeles, California.

White, Christine D, T. Douglas Price, and Fred J. Longstaffe
2007 Residential Histories of the Human Sacrifices at the Moon Pyramid, Teotihuacan: Evidence from Oxygen and Strontium Isotopes. *Ancient Mesoamerica* 18:159-172.

White, Christine D., Michael W. Spence, Fred J. Longstaffe, Evelyn Rattray, and Rebecca Storey
2008-2009 The Teotihuacan Dream: An Isotopic Study of Economic Organization and Immigration. *Ontario Archaeology* 85-88: 279-297.

Whitehead, Harriet
2000 *Food Rules: Hunting, Sharing and Tabooing Game in Papua New Guinea*. University of Michigan Press, Ann Arbor, Michigan.

Whittington, Stephen L., and David M Reed
1997 Commoner Diet at Copan: Insights from Stable Isotopes and Porotic Hyperostosis. In *Bones of the Maya: Studies of Ancient Skeletons*, edited by Stephen L. Whittington and David M. Reed, pp. 157-170. The University of Alabama Press, Tuscaloosa, Alabama.

Widmer, Randolph J.
1987 The Evolution of Form and Function in a Teotihuacan Apartment Compound. In *Teotihuacan: nuevos datos, nuevas síntesis, nuevos problemas*, edited by Emily McClung de Tapia and Evelyn C. Rattray, pp. 317-368. Universidad Nacional Autónoma de México, Mexico City.
1991 Lapidary Craft Specialization at Teotihuacan: Implications for Community Structure at 33:S3W1 and Economic Organization in the City. *Ancient Mesoamerica* 2:131-147.

Widmer, Randolph J., and Rebecca Storey
2012 The "Tlajinga Barrio": A Distinctive Cluster of Neighborhoods in Teotihuacan. In *The Neighborhood as a Social and Spatial Unit in Mesoamerican Cities*, edited by M. Charlotte Arnauld, Linda R. Manzanilla, and Michael E. Smith, pp. 102-116. The University of Arizona Press, Tucson, Arizona.
2017 Skeletal Health and Patterns of Animal Food Consumption at S3W1:33 (Tlajinga 33), Teotihuacan. *Archaeological and Anthropological Sciences* 9:51-60.

Wilk, Richard R.
1983 Little House in the Jungle: The Causes of Variation in House Size among Kekchi Maya. *Journal of Anthropological Archaeology* 2:99-116.

Wilkinson, Richard G., and Kate Pickett
2009 *The Spirit Level: Why Greater Equality Makes Societies Stronger*. Bloomsbury Press, New York.

Wilkinson, Richard G., and Richard J. Norelli
1981 A Biocultural Analysis of Social Organization at Monte Alban. *American Antiquity* 46:743-758.

Williams, C. Terry
1988 Alteration of Chemical Composition of Fossil Bones by Soil Processes and Groundwater. In *Trace Elements in Environmental History*, edited by Gisela Grupe and Bernd Herrmann, pp. 27-40. Springer-Verlag, Berlin.

Williams, C. Terry, and C. Amanda Marlow
1987 Uranium and Thorium Distributions in Fossil Bones from Olduvai Gorge, Tanzania and Kanam, Kenya. *Journal of Archaeological Science* 14:297-309.

Williams, C. Terry, and Philip J. Potts
1988 Element Distribution Maps in Fossil Bones. *Archaeometry* 30:237-247.

Wilson, Andrew S., Timothy Taylor, Maria Constanza Ceruti, Jose Antonio Chavez, Johan Reinhard, Vaughan Grimes, Wolfram Meier-Augenstein, Larry Cartmell, Ben Stern, Michael P. Richards, Michael Worobey, Ian Barnes, M. Thomas P. Gilbert
2007 Stable Isotope and DNA Evidence for Ritual Sequences in Inca Child Sacrifice. *Proceedings of the National Academy of Sciences* 104:16456-16461.

Wolf, Eric R.
1999 *Envisioning Power: Ideologies of Dominance and Crises*. University of California Press, Berkeley, California.

Wong, Raymond Sin-Kwok
1990 Understanding Cross-National Variation in Occupational Mobility. *American Sociological Review* 55:560-573.

Wood, Brian, and Kim Hill
2000 A Test of the "Showing Off" Hypothesis with Ache Hunters. *Current Anthropology* 41:124-125.

Wood, James W., George R. Milner, Henry C. Harpending, and Kenneth M. Weiss
1992 The Osteological Paradox: Problems of Inferring Prehistoric Health from Skeletal Samples. *Current Anthropology* 33:343-370.

Wright, Eric Olin
2000 *Class Counts*. Cambridge University Press, New York.

Wright, Lori E.
2005 Identifying Immigrants to Tikal, Guatemala: Defining Local Variability in Strontium Isotope Ratios of Human Tooth Enamel. *Journal of Archaeological Science* 32:555-566.

Wright, Lori E., and Henry P. Schwarcz
1998 Stable Carbon and Oxygen Isotopes in Human Tooth Enamel: Identifying Breastfeeding and Weaning in Prehistory. *American Journal of Physical Anthropology* 106:1-18.

Yasuda, Saburo
1964 A Methodological Inquiry in to Social Mobility. *American Sociological Review* 29:16-23.

Yoder, Cory, and Eric J. Bartelink
2010 Effects of Different Sample Preparation Methods of Stable Carbon and Oxygen Isotope Values of Bone Apatite: A Comparison of Two Treatment Protocols. *Archaeometry* 52:115-130.

Yoffee, Norman
2005 *Myths of the Archaic State: Evolution of the Earliest Cities, States, and Civilizations*. Cambridge University Press, Cambridge.

Yoneyama, Tadakatsu, Kounosuke Fujita, Tomia Yoshida, Tetsuo Matsumoto, Iwao Kambayashi, and Jinya Yazaki
1986 Variation in Natural Abundance of ^{15}N Among Plant Parts and in $^{15}N/^{14}N$ Fractionation in N_2 Fixation in the Legume-Rhizobia Symbiotic System. *Plant and Cell Physiology* 27:791-799.

Yurtsever, Yuecel and Joel R. Gat
1981 Atmospheric Waters. In *Stable Isotope Hydrology: Deuterium and Oxygen-18 in the Water Cycle*, edited by Joel R. Gat and R. Gonfiantini, pp. 103–142. Technical Report Series, No. 210. International Atomic Energy Agency, Vienna.

Zazzo, Antoine, Robin Bendrey, Dominic Vella, A.P. Moloney, Frank J. Monahan, and Olaf Schmidt
2012 A Refined Sampling Strategy for Intra-Tooth Stable Isotope Analysis of Mammalian Enamel. *Geochimica et Cosmochimica Acta* 84:1-13.

Zavella, Patricia
1991 Mujeres in Factories: Race and Class Perspectives on Women, Work, and Family. In *Gender at the Crossroads of Knowledge: Feminist Anthropology in the Postmodern Era*, edited by Micaela di Leonardo, pp. 312-336. University of California Press, Berkeley, California.

Zeder, Melinda A.
1991 *Feeding Cities: Specialized Animal Economy in the Ancient Near East*. Smithsonian Institution Press, Washington, D.C.

Zimmerman Uwe, D. Ehhalt, and Karl O. Munnich
1967 Soil Water Movement and Evapotranspiration: Changes in the Isotope Composition of Water. In *Isotopes in Hydrology*, pp. 567-584. International Atomic Energy Agency, Vienna.

APPENDIX A

AGE AND SEX ESTIMATES

Context	Laboratory Number	Skeletal Elements Sampled	Age	Sex
Conjunto Noroeste	ACL-5378 TEO-CN7	Left Rib	39-44	M
Conjunto Noroeste	ACL-5379 TEO-CN13	Right Rib	Adult	I
Conjunto Noroeste	ACL-5380 TEO-CN14	Left Rib	Adult	I
Conjunto Noroeste	ACL-5381 TEO-CN26	Right Rib	39-50	M
Conjunto Noroeste	ACL-5382/5383 TEO-CN35	Left Rib + RM^3	20-29	M
Conjunto Noroeste	ACL-5384/5385 TEO-CN38	Right Rib + LM^3	20-24	F
Conjunto Noroeste	ACL-5386 TEO-CN42	Right Rib	Adult	I
Conjunto Noroeste	ACL-5387 TEO-CN54	Left Rib	Adult	I
Conjunto Noroeste	ACL-5388/5389 TEO-CN58	Left Rib + RM_3	20-29	F
Conjunto Noroeste	ACL-5390/5391 TEO-CN65	Left Rib + LM^3	30-34	F
Conjunto Noroeste	ACL-5392 TEO-CN67	Right Rib	Adult	M
Tetitla	ACL-5180 TEO-TET8	Right Rib	Adult	M
Tetitla	ACL-5181/5182 TEO-TET11	Left Rib + RM_3	Adult	F
Tetitla	ACL-5183 TEO-TET12	Left Rib	40-49	I
Tetitla	ACL-5184/5185 TEO-TET16	Right Rib + RM_3	39-44	M
Zacuala	ACL-5194/5195 TEO-ZAC3	Left Rib + LM^3	Adult	M
Zacuala	ACL-5196/5197 TEO-ZAC4	Right Rib + RM_3	Adult	I
Zacuala	ACL-5198/5199 TEO-ZAC11	Right Rib + RM_3	39-50	F
Zacuala	ACL-5200 TEO-ZAC13	Right Rib	35-50	M
Zacuala	ACL-5201/5202 TEO-ZAC23	Left Rib + RM^3	25-34	M
Zacuala	ACL-5203/5204 TEO-ZAC28	Right Rib + LM^3	20-24	M
La Ventilla Frente 2	ACL-3063 TEO-LV8	Right Rib	Adult	I
La Ventilla B	ACL-5156 TEO-LVB16	Left Rib	Adult	F
La Ventilla B	ACL-5157 TEO-LVB22	Right Rib	Adult	F
La Ventilla B	ACL-5158 TEO-LVB24	Right Rib	Adult	M
La Ventilla B	ACL-5159/5160 TEO-LVB32	Left Rib + RM_3	35-39	M
La Ventilla B	ACL-5161 TEO-LVB47	Left Rib	30-39	F
La Ventilla B	ACL-5162/5163 TEO-LVB56	Right Rib + RM_3	Adult	M
La Ventilla B	ACL-5164/5165 TEO-LVB59	Left Rib + LM_3	20-24	M

La Ventilla B	ACL-5166 TEO-LVB67	Right Rib	Adult	M
La Ventilla B	ACL-5167/5168 TEO-LVB75B	Left Rib + RM_3	Adult	F
La Ventilla B	ACL-5169 TEO-LVB78	Right Rib	35-44	F
La Ventilla B	ACL-5170/5171 TEO-LVB101	Right Rib + LM_3	Adult	M
La Ventilla B	ACL-5172 TEO-LVB107	Left Rib	30-34	M
La Ventilla B	ACL-5173/5174 TEO-LVB116	Right Rib + LM_3	20-29	M
La Ventilla B	ACL-5175 TEO-LVBXIV	Left Rib	20-29	M
La Ventilla B	ACL-5176 TEO-LVBXVI	Right Rib	20-24	M
La Ventilla B	ACL-5177 TEO-LVBXX	Right Rib	>50	F
La Ventilla B	ACL-5178/5179 TEO-LVBXXIII	Right Rib + RM_3	>50	F
La Ventilla Frente 3	ACL-3064 TEO-LV68	Right Rib	20-29	F
La Ventilla Frente 3	ACL-3065 TEO-LV45	Right Rib	Adult	I
La Ventilla Frente 3	ACL-3066 TEO-LV54A	Left Rib	20-29	M
La Ventilla Frente 3	ACL-3069 TEO-LV224A	Left Rib	20-24	F
La Ventilla Frente 3	ACL-3070 TEO-LV227	Left Rib	20-29	F
La Ventilla Frente 3	ACL-3071 TEO-LV231	Right Rib	39-50	F
La Ventilla Frente 3	ACL-3072 TEO-LV236	Right Rib	Adult	I
San Antonio de las Palmas	ACL-5393/5394 TEO-SA125	Left Rib + LM^3	20-29	M
San Antonio de las Palmas	ACL-5395 TEO-SA126	Left Rib	20-24	M
San Antonio de las Palmas	ACL-5396/5397 TEO-SA128	Left Rib + LM^3	Adult	M
San Antonio de las Palmas	ACL-5398/5399 TEO-SA131	Right Rib + LM_3	30-34	M
San Antonio de las Palmas	ACL-5400/5401 TEO-SA136	Left Rib + RM_3	Adult	M
San José 520	ACL-2861 TEO-SJ2.2	Right Rib	Adult	I
San José 520	ACL-2862 TEO-SJ2.4	Right Rib	Adult	M
San José 520	ACL-2863 TEO-SJ2.3	Left Rib	Adult	M
San José 520	ACL-2864 TEO-SJ2.1	Left Rib	Adult	I
San José 520	ACL-2865 TEO-SJ2.5	Right Rib	25-34	F
Tlailotlacan TL1	ACL-5352/5353 TEO-BO1TL1A	Left Rib + RM^3	Adult	F
Tlailotlacan TL1	ACL-5354 TEO-BO1TL1B	Right Rib	Adult	I
Tlailotlacan TL1	ACL-5355/5356 TEO-BO2TL1	Left Rib + RM_3	Adult	M
Tlailotlacan TL1	ACL-5357/5358 TEO-BO5TL1	Left Rib + RM^3	30-34	M
Tlailotlacan TL11	ACL-5359/5360 TEO-BO2TL11	Left Rib + RM_3	25-34	M

Tlailotlacan TL11	ACL-5361/5362 TEO-BO10TL11	Right Rib + RM_3	Adult	M
Tlailotlacan TL11	ACL-5363/5364 TEO-BO20TL11	Right Rib + RM_3	35-44	F
Tlailotlacan TL11	ACL-5365/5366 TEO-BO21TL11	Right Rib + RM^3	20-29	F
Tlailotlacan TL11	ACL-5367 TEO-BO40TL11	Right Rib	Adult	M
Tlailotlacan TL11	ACL-5368/5369 TEO-BO41TL11	Right Rib + LM_3	30-39	M
Tlailotlacan TL67	ACL-5370/5371 TEO-BO1TL67	Left Rib + RM^3	39-50	F
Tlailotlacan TL67	ACL-5372/5373 TEO-BO3TL67	Left Rib + LM^3	30-34	M
Tlailotlacan TL67	ACL-5374/5375 TEO-BO4TL67	Right Rib + LM_3	21-46	M
Tlailotlacan TL67	ACL-5376 TEO-BO5TL67	Left Rib	>50	F
Tlailotlacan TL67	ACL-5377 TEO-BO6TL67	Right Rib	35-39	F
Feathered Serpent Pyramid	ACL-2866/2867 TEO-PTQ6B	Right Rib + RM^2	20-24	M
Feathered Serpent Pyramid	ACL-2868/2869 TEO-PTQ11C	Rib + M2	30-34	F
Feathered Serpent Pyramid	ACL-2870/2871 TEO-PTQ10C	Right Rib + RM_2	18-21	F
Feathered Serpent Pyramid	ACL-2872/2873 TEO-PTQ5D	Left Rib + RM^2	40-44	M
Feathered Serpent Pyramid	ACL-2874/2875 TEO-PTQ6D	Left Rib + RM^2	18-21	M
Feathered Serpent Pyramid	ACL-2876/2877 TEO-PTQ11B	Right Rib + LM_2	20-24	F
Feathered Serpent Pyramid	ACL-2878 TEO-PTQ5I	Right Rib	20-24	M
Feathered Serpent Pyramid	ACL-2879 TEO-PTQ11A	Left Rib	30-34	F
Feathered Serpent Pyramid	ACL-2880 TEO-PTQ10D	Left Rib	18-21	F
Feathered Serpent Pyramid	ACL-2881 TEO-PTQ5F	Left Rib	35-39	M
Feathered Serpent Pyramid	ACL-2882 TEO-PTQ10A	Left Rib	25-29	F
Feathered Serpent Pyramid	ACL-2883 TEO-PTQ6A	Right Rib	20-24	M

APPENDIX B

STABLE OXYGEN AND RADIOGENIC STRONTIUM ISOTOPE DATA

Context	Laboratory Number	Sample Type	Ca/P	$\delta^{18}O_{carbonate}$ (VPDB)[1]	$\delta^{18}O_{phosphate}$ (VSMOW)[2]	$^{87}Sr/^{86}Sr$
Conjunto Noroeste	ACL-5378 TEO-CN7	Rib	1.9	-8.1	13.6	0.7049
Conjunto Noroeste	ACL-5379 TEO-CN13	Rib	2.0	-8.1	13.6	0.7052
Conjunto Noroeste	ACL-5380 TEO-CN14	Rib	2.1	-8.1	13.6	0.7049
Conjunto Noroeste	ACL-5381 TEO-CN26	Rib	1.9	-9.1	12.6	0.7052
Conjunto Noroeste	ACL-5382 TEO-CN35	M3	1.9	-7.1	12.9	0.7050
Conjunto Noroeste	ACL-5383 TEO-CN35	Rib	1.9	-9.0	12.7	0.7052
Conjunto Noroeste	ACL-5384 TEO-CN38	M3	1.9	-6.4	13.6	0.7055
Conjunto Noroeste	ACL-5385 TEO-CN38	Rib	1.2	-	-	-
Conjunto Noroeste	ACL-5386 TEO-CN42	Rib	2.0	-9.1	12.6	0.7051
Conjunto Noroeste	ACL-5387 TEO-CN54	Rib	1.3	-	-	-
Conjunto Noroeste	ACL-5388 TEO-CN58	M3	1.9	-6.0	14.1	0.7056
Conjunto Noroeste	ACL-5389 TEO-CN58	Rib	1.9	-9.5	12.2	0.7050
Conjunto Noroeste	ACL-5390 TEO-CN65	M3	1.9	-7.5	12.6	0.7049
Conjunto Noroeste	ACL-5391 TEO-CN65	Rib	2.0	-7.6	14.2	0.7051
Conjunto Noroeste	ACL-5392 TEO-CN67	Rib	2.0	-9.5	12.2	0.7048
Tetitla	ACL-5180 TEO-TET8	Rib	1.2	-	-	-
Tetitla	ACL-5181 TEO-TET11	Rib	2.1	-9.1	12.6	0.7049
Tetitla	ACL-5182 TEO-TET11	M3	1.9	-7.7	12.4	0.7052
Tetitla	ACL-5183 TEO-TET12	Rib	2.1	-8.5	13.2	0.7049
Tetitla	ACL-5184 TEO-TET16	Rib	2.0	-7.2	14.5	0.7048
Tetitla	ACL-5185 TEO-TET16	M3	1.9	-6.8	13.3	0.7046
Zacuala	ACL-5194 TEO-ZAC3	Rib	2.0	-7.7	14.0	0.7048
Zacuala	ACL-5195 TEO-ZAC3	M3	1.9	-6.1	14.0	0.7048
Zacuala	ACL-5196 TEO-ZAC4	Rib	2.1	-4.1	17.6	0.7049
Zacuala	ACL-5197 TEO-ZAC4	M3	1.9	-6.0	14.1	0.7047
Zacuala	ACL-5198 TEO-ZAC11	Rib	1.9	-10.2	11.5	0.7051
Zacuala	ACL-5199 TEO-ZAC11	M3	1.9	-7.6	12.5	0.7066
Zacuala	ACL-5200 TEO-ZAC13	Rib	1.9	-10.6	11.1	0.7052
Zacuala	ACL-5201 TEO-ZAC23	Rib	2.0	-8.4	13.3	0.7047

Zacuala	ACL-5202 TEO-ZAC23	M3	1.9	-6.4	13.7	0.7047
Zacuala	ACL-5203 TEO-ZAC28	Rib	1.9	-10.3	11.4	0.7048
Zacuala	ACL-5204 TEO-ZAC28	M3	1.9	-6.6	13.4	0.7047
La Ventilla Frente 2	ACL-3063 TEO-LV8	Rib	1.9	-7.2	14.5	0.7047
La Ventilla B	ACL-5156 TEO-LVB16	Rib	2.0	-6.7	14.9	0.7049
La Ventilla B	ACL-5157 TEO-LVB22	Rib	2.0	-5.9	15.9	0.7049
La Ventilla B	ACL-5158 TEO-LVB24	Rib	2.0	-6.3	15.4	0.7048
La Ventilla B	ACL-5159 TEO-LVB32	Rib	2.0	-7.1	14.6	0.7051
La Ventilla B	ACL-5160 TEO-LVB32	M3	1.9	-6.5	13.6	0.7052
La Ventilla B	ACL-5161 TEO-LVB47	Rib	2.0	-6.4	15.4	0.7048
La Ventilla B	ACL-5162 TEO-LVB56	Rib	2.0	-9.0	12.7	0.7048
La Ventilla B	ACL-5163 TEO-LVB56	M3	1.9	-6.6	13.5	0.7048
La Ventilla B	ACL-5164 TEO-LVB59	Rib	2.0	-7.7	14.2	0.7051
La Ventilla B	ACL-5165 TEO-LVB59	M3	1.9	-6.3	13.8	0.7052
La Ventilla B	ACL-5166 TEO-LVB67	Rib	2.0	-8.5	13.2	0.7049
La Ventilla B	ACL-5167 TEO-LVB75B	Rib	1.2	-	-	-
La Ventilla B	ACL-5168 TEO-LVB75B	M3	1.9	-6.4	13.6	0.7053
La Ventilla B	ACL-5169 TEO-LVB78	Rib	2.0	-10.5	11.2	0.7048
La Ventilla B	ACL-5170 TEO-LVB101	Rib	1.9	-9.8	11.9	0.7048
La Ventilla B	ACL-5171 TEO-LVB101	M3	1.9	-6.3	13.8	0.7049
La Ventilla B	ACL-5172 TEO-LVB107	Rib	1.9	-9.8	11.9	0.7048
La Ventilla B	ACL-5173 TEO-LVB116	Rib	2.0	-8.5	13.2	0.7048
La Ventilla B	ACL-5174 TEO-LVB116	M3	1.9	-6.4	13.6	0.7048
La Ventilla B	ACL-5175 TEO-LVBXIV	Rib	1.9	-9.9	11.8	0.7050
La Ventilla B	ACL-5176 TEO-LVBXVI	Rib	2.0	-6.9	14.8	0.7049
La Ventilla B	ACL-5177 TEO-LVBXX	Rib	2.0	-9.8	11.9	0.7049
La Ventilla B	ACL-5178 TEO-LVBXXIII	Rib	1.9	-9.8	11.9	0.7047
La Ventilla B	ACL-5179 TEO-LVBXXIII	M3	1.9	-6.2	13.8	0.7051
La Ventilla Frente 3	ACL-3064 TEO-LV68	Rib	2.1	-5.8	16.0	0.7047
La Ventilla Frente 3	ACL-3065 TEO-LV45	Rib	2.1	-7.1	14.6	0.7048
La Ventilla Frente 3	ACL-3066 TEO-LV54A	Rib	1.9	-8.2	13.5	0.7047
La Ventilla Frente 3	ACL-3069 TEO-LV224A	Rib	1.9	-9.7	12.0	0.7048

La Ventilla Frente 3	ACL-3070 TEO-LV227	Rib	2.0	-9.5	12.2	0.7047
La Ventilla Frente 3	ACL-3071 TEO-LV231	Rib	1.3	-	-	-
La Ventilla Frente 3	ACL-3072 TEO-LV236	Rib	1.9	-6.6	15.1	0.7048
San Antonio de las Palmas	ACL-5393 TEO-SA125	M3	1.9	-6.1	14.0	0.7047
San Antonio de las Palmas	ACL-5394 TEO-SA125	Rib	2.1	-7.9	13.8	0.7047
San Antonio de las Palmas	ACL-5395 TEO-SA126	Rib	2.0	-8.6	13.1	0.7047
San Antonio de las Palmas	ACL-5396 TEO-SA128	M3	1.9	-6.6	13.4	0.7047
San Antonio de las Palmas	ACL-5397 TEO-SA128	Rib	1.2	-	-	-
San Antonio de las Palmas	ACL-5398 TEO-SA131	M3	1.9	-6.3	13.8	0.7047
San Antonio de las Palmas	ACL-5399 TEO-SA131	Rib	2.0	-8.5	13.2	0.7047
San Antonio de las Palmas	ACL-5400 TEO-SA136	M3	1.9	-6.7	13.4	0.7048
San Antonio de las Palmas	ACL-5401 TEO-SA136	Rib	1.9	-9.1	12.6	0.7047
San José 520	ACL-2861 TEO-SJ2.2	Rib	2.0	-7.3	14.4	0.7047
San José 520	ACL-2862 TEO-SJ2.4	Rib	2.0	-7.3	14.4	0.7046
San José 520	ACL-2863 TEO-SJ2.3	Rib	2.1	-5.7	16.0	0.7046
San José 520	ACL-2864 TEO-SJ2.1	Rib	2.0	-5.8	15.9	0.7046
San José 520	ACL-2865 TEO-SJ2.5	Rib	2.0	-7.5	14.2	0.7046
Tlailotlacan TL1	ACL-5352 TEO-BO1TL1A	M3	1.9	-7.0	13.0	0.7052
Tlailotlacan TL1	ACL-5353 TEO-BO1TL1A	Rib	2.1	-9.7	12.0	0.7055
Tlailotlacan TL1	ACL-5354 TEO-BO1TL1B	Rib	2.1	-8.5	13.2	0.7048
Tlailotlacan TL1	ACL-5355 TEO-BO2TL1	M3	1.9	-6.2	13.8	0.7056
Tlailotlacan TL1	ACL-5356 TEO-BO2TL1	Rib	2.0	-8.3	13.4	0.7050
Tlailotlacan TL1	ACL-5357 TEO-BO5TL1	M3	1.9	-6.4	13.7	0.7056
Tlailotlacan TL1	ACL-5358 TEO-BO5TL1	Rib	1.2	-	-	-
Tlailotlacan TL11	ACL-5359 TEO-BO2TL11	M3	1.9	-7.4	12.7	0.7051
Tlailotlacan TL11	ACL-5360 TEO-BO2TL11	Rib	2.0	-7.7	14.0	0.7054
Tlailotlacan TL11	ACL-5361 TEO-BO10TL11	M3	1.9	-7.6	12.4	0.7064
Tlailotlacan TL11	ACL-5362 TEO-BO10TL11	Rib	2.1	-9.2	12.5	0.7050
Tlailotlacan TL11	ACL-5363 TEO-BO20TL11	M3	1.9	-7.5	12.6	0.7059
Tlailotlacan TL11	ACL-5364 TEO-BO20TL11	Rib	2.0	-9.5	12.2	0.7051
Tlailotlacan TL11	ACL-5365 TEO-BO21TL11	M3	1.9	-7.0	13.1	0.7054
Tlailotlacan TL11	ACL-5366 TEO-BO21TL11	Rib	1.9	-9.0	12.7	0.7050

Tlailotlacan TL11	ACL-5367 TEO-BO40TL11	Rib	2.1	-7.7	14.0	0.7051
Tlailotlacan TL11	ACL-5368 TEO-BO41TL11	M3	1.9	-7.9	12.1	0.7072
Tlailotlacan TL11	ACL-5369 TEO-BO41TL11	Rib	2.1	-7.8	13.9	0.7049
Tlailotlacan TL67	ACL-5370 TEO-BO1TL67	M3	1.9	-5.1	15.0	0.7049
Tlailotlacan TL67	ACL-5371 TEO-BO1TL67	Rib	2.1	-6.9	14.8	0.7048
Tlailotlacan TL67	ACL-5372 TEO-BO3TL67	M3	1.9	-7.1	13.0	0.7066
Tlailotlacan TL67	ACL-5373 TEO-BO3TL67	Rib	2.1	-7.1	14.6	0.7050
Tlailotlacan TL67	ACL-5374 TEO-BO4TL67	M3	1.9	-7.3	12.8	0.7066
Tlailotlacan TL67	ACL-5375 TEO-BO4TL67	Rib	2.1	-7.2	14.5	0.7051
Tlailotlacan TL67	ACL-5376 TEO-BO5TL67	Rib	2.1	-7.8	13.9	0.7048
Tlailotlacan TL67	ACL-5377 TEO-BO6TL67	Rib	2.1	-6.8	14.9	0.7048
Feathered Serpent Pyramid	ACL-2866 TEO-PTQ6B	M2	2.3	-7.1	13.0	-
Feathered Serpent Pyramid	ACL-2867 TEO-PTQ6B	Rib	2.0	-9.1	12.6	0.7048
Feathered Serpent Pyramid	ACL-2868 TEO-PTQ11C	Rib	2.1	-8.9	12.8	0.7046
Feathered Serpent Pyramid	ACL-2869 TEO-PTQ11C	M2	2.1	-5.3	14.8	-
Feathered Serpent Pyramid	ACL-2870 TEO-PTQ10C	Rib	2.1	-8.2	13.6	0.7046
Feathered Serpent Pyramid	ACL-2871 TEO-PTQ10C	M2	2.2	-5.5	14.6	-
Feathered Serpent Pyramid	ACL-2872 TEO-PTQ5D	M2	1.9	-5.4	14.7	0.7059
Feathered Serpent Pyramid	ACL-2873 TEO-PTQ5D	Rib	2.0	-8.2	13.5	0.7047
Feathered Serpent Pyramid	ACL-2874 TEO-PTQ6D	Rib	1.9	-9.9	11.8	0.7048
Feathered Serpent Pyramid	ACL-2875 TEO-PTQ6D	M2	2.1	-6.8	13.2	-
Feathered Serpent Pyramid	ACL-2876 TEO-PTQ11B	M2	2.2	-6.7	13.4	-
Feathered Serpent Pyramid	ACL-2877 TEO-PTQ11B	Rib	2.0	-9.4	12.3	0.7046
Feathered Serpent Pyramid	ACL-2878 TEO-PTQ5I	Rib	2.0	-7.3	14.5	0.7047
Feathered Serpent Pyramid	ACL-2879 TEO-PTQ11A	Rib	2.0	-12.9	8.8	0.7046
Feathered Serpent Pyramid	ACL-2880 TEO-PTQ10D	Rib	2.0	-6.8	15.0	0.7046
Feathered Serpent Pyramid	ACL-2881 TEO-PTQ5F	Rib	2.0	-6.4	15.4	0.7048
Feathered Serpent Pyramid	ACL-2882 TEO-PTQ10A	Rib	2.0	-8.8	12.9	0.7047
Feathered Serpent Pyramid	ACL-2883 TEO-PTQ6A	Rib	2.1	-8.2	13.6	0.7046

[1]Reported values are raw oxygen isotope values, unadjusted for differences based on tissue type.

[2]Reported values were calculated from the raw data as described in Chapter 6 and incorporate an adjustment to make tooth enamel values directly comparable to the values in somatic bone.

APPENDIX C

STABLE CARBON, NITROGEN, AND STRONTIUM ISOTOPE DATA

Context	Laboratory Number	Sample Type	C/N	$\delta^{13}C_{carbonate}$[1] (VPDB)	$\delta^{13}C_{collagen}$ (VPDB)	$\delta^{15}N_{collagen}$ (AIR)	$\delta^{88}Sr/^{86}Sr$
Conjunto Noroeste	ACL-5378 TEO-CN7	Rib	2.9	-3.0	-7.6	10.1	0.22
Conjunto Noroeste	ACL-5379 TEO-CN13	Rib	2.9	-5.0	-7.6	7.5	-0.03
Conjunto Noroeste	ACL-5380 TEO-CN14	Rib	2.9	-3.0	-7.6	10.3	0.02
Conjunto Noroeste	ACL-5381 TEO-CN26	Rib	3.0	-4.4	-7.4	9.1	0.05
Conjunto Noroeste	ACL-5382 TEO-CN35	M3	-	-3.3	-	-	-0.03
Conjunto Noroeste	ACL-5383 TEO-CN35	Rib	2.9	-3.5	-8.1	10.2	0.19
Conjunto Noroeste	ACL-5384 TEO-CN38	M3	-	-4.2	-	-	-0.28
Conjunto Noroeste	ACL-5385 TEO-CN38	Rib	2.9	-	-9.6	8.3	-
Conjunto Noroeste	ACL-5386 TEO-CN42	Rib	2.9	-3.2	-8.5	9.7	0.16
Conjunto Noroeste	ACL-5387 TEO-CN54	Rib	2.9	-	-9.0	10.1	-
Conjunto Noroeste	ACL-5388 TEO-CN58	M3	-	-3.6	-	-	-0.07
Conjunto Noroeste	ACL-5389 TEO-CN58	Rib	2.9	-3.2	-8.7	8.9	0.13
Conjunto Noroeste	ACL-5390 TEO-CN65	M3	-	-3.6	-	-	-0.20
Conjunto Noroeste	ACL-5391 TEO-CN65	Rib	2.9	-3.5	-7.9	9.5	-
Conjunto Noroeste	ACL-5392 TEO-CN67	Rib	2.9	-3.0	-7.1	9.4	0.10
Tetitla	ACL-5180 TEO-TET8	Rib	2.9	-	-7.6	9.3	-
Tetitla	ACL-5181 TEO-TET11	Rib	2.9	-3.3	-8.1	9.7	0.15
Tetitla	ACL-5182 TEO-TET11	M3	-	-2.8	-	-	-0.11
Tetitla	ACL-5183 TEO-TET12	Rib	2.9	-3.2	-7.4	10.7	0.16
Tetitla	ACL-5184 TEO-TET16	Rib	2.9	-3.2	-7.9	9.9	0.15
Tetitla	ACL-5185 TEO-TET16	M3	-	-5.3	-	-	-0.23
Zacuala	ACL-5194 TEO-ZAC3	Rib	2.9	-3.8	-8.1	9.6	0.28
Zacuala	ACL-5195 TEO-ZAC3	M3	-	-3.2	-	-	-0.31
Zacuala	ACL-5196 TEO-ZAC4	Rib	2.9	-5.5	-10.2	9.2	0.25
Zacuala	ACL-5197 TEO-ZAC4	M3	-	-3.4	-	-	-0.17
Zacuala	ACL-5198 TEO-ZAC11	Rib	2.9	-3.7	-8.4	8.8	0.07
Zacuala	ACL-5199 TEO-ZAC11	M3	-	-3.5	-	-	-0.14
Zacuala	ACL-5200 TEO-ZAC13	Rib	2.9	-4.5	-8.0	10.4	0.09
Zacuala	ACL-5201 TEO-ZAC23	Rib	3.0	-3.3	-8.6	8.5	0.10

Zacuala	ACL-5202 TEO-ZAC23	M3	-	-3.2	-	-	-0.21
Zacuala	ACL-5203 TEO-ZAC28	Rib	2.9	-3.0	-7.9	9.0	0.15
Zacuala	ACL-5204 TEO-ZAC28	M3	-	-2.0	-	-	-0.32
La Ventilla Frente 2	ACL-3063 TEO-LV8	Rib	3.0	-3.3	-8.7	11.5	-0.06
La Ventilla B	ACL-5156 TEO-LVB16	Rib	2.9	-3.8	-8.1	8.0	0.20
La Ventilla B	ACL-5157 TEO-LVB22	Rib	2.9	-3.8	-8.4	9.0	0.15
La Ventilla B	ACL-5158 TEO-LVB24	Rib	2.9	-2.9	-7.5	9.7	0.11
La Ventilla B	ACL-5159 TEO-LVB32	Rib	2.9	-3.2	-8.0	8.6	0.13
La Ventilla B	ACL-5160 TEO-LVB32	M3	-	-2.4	-	-	-0.42
La Ventilla B	ACL-5161 TEO-LVB47	Rib	2.9	-2.8	-7.8	9.5	0.20
La Ventilla B	ACL-5162 TEO-LVB56	Rib	2.9	-3.3	-7.1	10.5	0.10
La Ventilla B	ACL-5163 TEO-LVB56	M3	-	-3.9	-	-	-0.33
La Ventilla B	ACL-5164 TEO-LVB59	Rib	2.9	-3.0	-7.8	8.9	0.10
La Ventilla B	ACL-5165 TEO-LVB59	M3	-	-3.8	-	-	0.03
La Ventilla B	ACL-5166 TEO-LVB67	Rib	2.9	-2.7	8.9	9.0	0.12
La Ventilla B	ACL-5167 TEO-LVB75B	Rib	2.9	-	-8.5	9.1	-
La Ventilla B	ACL-5168 TEO-LVB75B	M3	-	-4.2	-	-	-0.32
La Ventilla B	ACL-5169 TEO-LVB78	Rib	2.9	-2.7	-8.6	9.2	0.15
La Ventilla B	ACL-5170 TEO-LVB101	Rib	3.0	-3.3	-9.2	8.8	0.15
La Ventilla B	ACL-5171 TEO-LVB101	M3	-	-6.4	-	-	-0.38
La Ventilla B	ACL-5172 TEO-LVB107	Rib	2.9	-2.3	-7.1	9.6	0.09
La Ventilla B	ACL-5173 TEO-LVB116	Rib	2.9	-2.6	-7.9	9.0	0.14
La Ventilla B	ACL-5174 TEO-LVB116	M3	-	-2.6	-	-	-0.04
La Ventilla B	ACL-5175 TEO-LVBXIV	Rib	2.9	-2.9	-7.5	9.3	0.12
La Ventilla B	ACL-5176 TEO-LVBXVI	Rib	2.9	-3.3	-7.7	10.2	0.08
La Ventilla B	ACL-5177 TEO-LVBXX	Rib	2.9	-3.0	-8.1	9.0	0.11
La Ventilla B	ACL-5178 TEO-LVBXXIII	Rib	2.9	-3.2	-8.4	9.7	0.05
La Ventilla B	ACL-5179 TEO-LVBXXIII	M3	-	-3.0	-	-	-0.20
La Ventilla Frente 3	ACL-3064 TEO-LV68	Rib	3.0	-3.1	-8.0	10.4	0.14
La Ventilla Frente 3	ACL-3065 TEO-LV45	Rib	3.0	-3.0	-7.3	9.0	0.09
La Ventilla Frente 3	ACL-3066 TEO-LV54A	Rib	3.0	-2.3	-7.2	9.0	0.21
La Ventilla Frente 3	ACL-3069 TEO-LV224A	Rib	-	-3.0	-	-	0.12

La Ventilla Frente 3	ACL-3070 TEO-LV227	Rib	3.0	-3.6	-9.0	10.0	0.12
La Ventilla Frente 3	ACL-3071 TEO-LV231	Rib	3.0	-3.0	-7.9	9.4	-
La Ventilla Frente 3	ACL-3072 TEO-LV236	Rib	3.0	-3.0	-7.6	10.5	0.10
San Antonio de las Palmas	ACL-5393 TEO-SA125	M3	-	-2.6	-	-	-
San Antonio de las Palmas	ACL-5394 TEO-SA125	Rib	2.9	-2.7	-6.9	9.9	0.15
San Antonio de las Palmas	ACL-5395 TEO-SA126	Rib	3.1	-2.4	-7.6	10.0	0.11
San Antonio de las Palmas	ACL-5396 TEO-SA128	M3	-	-2.9	-	-	-0.03
San Antonio de las Palmas	ACL-5397 TEO-SA128	Rib	2.9	-	-7.7	9.9	-
San Antonio de las Palmas	ACL-5398 TEO-SA131	M3	-	-2.9	-	-	-0.16
San Antonio de las Palmas	ACL-5399 TEO-SA131	Rib	2.9	-2.9	-8.1	8.2	-
San Antonio de las Palmas	ACL-5400 TEO-SA136	M3	-	-3.5	-	-	-0.23
San Antonio de las Palmas	ACL-5401 TEO-SA136	Rib	2.9	-2.2	-7.5	8.6	-
San José 520	ACL-2861 TEO-SJ2.2	Rib	3.0	-3.8	-8.5	8.4	0.14
San José 520	ACL-2862 TEO-SJ2.4	Rib	2.9	-3.4	-8.0	8.5	0.10
San José 520	ACL-2863 TEO-SJ2.3	Rib	3.0	-3.5	-8.3	8.1	0.10
San José 520	ACL-2864 TEO-SJ2.1	Rib	3.0	-3.1	-8.0	8.2	0.13
San José 520	ACL-2865 TEO-SJ2.5	Rib	3.0	-3.3	-8.1	8.5	0.07
Tlailotlacan TL1	ACL-5352 TEO-BO1TL1A	M3	-	-3.4	-	-	-0.10
Tlailotlacan TL1	ACL-5353 TEO-BO1TL1A	Rib	2.9	-3.9	-8.2	9.0	0.19
Tlailotlacan TL1	ACL-5354 TEO-BO1TL1B	Rib	3.0	-2.1	-7.2	9.3	0.15
Tlailotlacan TL1	ACL-5355 TEO-BO2TL1	M3	-	-3.0	-	-	-0.24
Tlailotlacan TL1	ACL-5356 TEO-BO2TL1	Rib	-	-2.7	-	-	0.23
Tlailotlacan TL1	ACL-5357 TEO-BO5TL1	M3	-	-1.9	-	-	-0.19
Tlailotlacan TL1	ACL-5358 TEO-BO5TL1	Rib	2.9	-	-7.4	9.5	-
Tlailotlacan TL11	ACL-5359 TEO-BO2TL11	M3	-	-3.2	-	-	-0.34
Tlailotlacan TL11	ACL-5360 TEO-BO2TL11	Rib	2.9	-3.5	-7.5	9.6	0.09
Tlailotlacan TL11	ACL-5361 TEO-BO10TL11	M3	-	-3.5	-	-	-0.26
Tlailotlacan TL11	ACL-5362 TEO-BO10TL11	Rib	3.0	-3.3	-7.9	10.0	-0.10
Tlailotlacan TL11	ACL-5363 TEO-BO20TL11	M3	-	-4.0	-	-	-0.08
Tlailotlacan TL11	ACL-5364 TEO-BO20TL11	Rib	2.9	-3.3	-7.4	9.8	0.03
Tlailotlacan TL11	ACL-5365 TEO-BO21TL11	M3	-	-2.3	-	-	-0.03
Tlailotlacan TL11	ACL-5366 TEO-BO21TL11	Rib	2.9	-2.6	-8.0	9.6	0.03

Tlailotlacan TL11	ACL-5367 TEO-BO40TL11	Rib	2.9	-2.7	-7.8	9.8	0.08
Tlailotlacan TL11	ACL-5368 TEO-BO41TL11	M3	-	-2.6	-	-	-0.03
Tlailotlacan TL11	ACL-5369 TEO-BO41TL11	Rib	2.9	-3.0	-6.9	8.4	0.05
Tlailotlacan TL67	ACL-5370 TEO-BO1TL67	M3	-	-2.0	-	-	-0.31
Tlailotlacan TL67	ACL-5371 TEO-BO1TL67	Rib	3.0	-2.2	-8.7	9.8	-0.03
Tlailotlacan TL67	ACL-5372 TEO-BO3TL67	M3	-	-1.8	-	-	-0.08
Tlailotlacan TL67	ACL-5373 TEO-BO3TL67	Rib	3.0	-2.4	-6.3	9.5	0.16
Tlailotlacan TL67	ACL-5374 TEO-BO4TL67	M3	-	-1.9	-	-	-0.22
Tlailotlacan TL67	ACL-5375 TEO-BO4TL67	Rib	3.0	-3.2	-7.4	9.6	0.03
Tlailotlacan TL67	ACL-5376 TEO-BO5TL67	Rib	2.9	-3.6	-8.1	9.4	0.09
Tlailotlacan TL67	ACL-5377 TEO-BO6TL67	Rib	2.9	-2.9	-7.7	9.4	0.16
Feathered Serpent Pyramid	ACL-2866 TEO-PTQ6B	M2	-	-3.9	-	-	-
Feathered Serpent Pyramid	ACL-2867 TEO-PTQ6B	Rib	3.0	-2.3	-8.9	8.9	0.12
Feathered Serpent Pyramid	ACL-2868 TEO-PTQ11C	Rib	3.1	-5.9	-8.9	8.6	0.20
Feathered Serpent Pyramid	ACL-2869 TEO-PTQ11C	M2	-	-3.9	-	-	-
Feathered Serpent Pyramid	ACL-2870 TEO-PTQ10C	Rib	3.0	-3.8	-8.5	9.2	0.22
Feathered Serpent Pyramid	ACL-2871 TEO-PTQ10C	M2	-	-3.3	-	-	-
Feathered Serpent Pyramid	ACL-2872 TEO-PTQ5D	M2	-	-3.3	-	-	-0.14
Feathered Serpent Pyramid	ACL-2873 TEO-PTQ5D	Rib	3.0	-3.5	-8.1	8.4	0.17
Feathered Serpent Pyramid	ACL-2874 TEO-PTQ6D	Rib	3.1	-2.7	-10.4	8.5	0.11
Feathered Serpent Pyramid	ACL-2875 TEO-PTQ6D	M2	-	-3.7	-	-	-
Feathered Serpent Pyramid	ACL-2876 TEO-PTQ11B	M2	-	-3.8	-	-	-
Feathered Serpent Pyramid	ACL-2877 TEO-PTQ11B	Rib	3.0	-4.0	-10.1	8.5	0.10
Feathered Serpent Pyramid	ACL-2878 TEO-PTQ5I	Rib	3.1	-1.9	-9.0	8.7	0.19
Feathered Serpent Pyramid	ACL-2879 TEO-PTQ11A	Rib	3.0	-3.1	-8.3	10.0	0.10
Feathered Serpent Pyramid	ACL-2880 TEO-PTQ10D	Rib	3.0	-3.1	-8.4	8.6	0.14
Feathered Serpent Pyramid	ACL-2881 TEO-PTQ5F	Rib	3.0	-3.2	-8.5	8.2	0.15
Feathered Serpent Pyramid	ACL-2882 TEO-PTQ10A	Rib	3.0	-3.2	-8.4	9.1	0.14
Feathered Serpent Pyramid	ACL-2883 TEO-PTQ6A	Rib	3.0	-3.2	-8.9	8.2	0.23

[1]Reported values incorporate an adjustment of -2.3‰ to make tooth enamel values directly comparable to the values in somatic bone