

THE CULTURAL ECOLOGY OF THE
TEOTIHUACAN VALLEY

MUSEUM OF ANTHROPOLOGY

by
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A Preliminary Report of the Results
of the Teotihuacan Valley Project
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Errata

Page 5 - line 15
Page 42 - line 48
Page 98 - line 16-17
Page 111 - line 10

Page 112 - line 26

Page 121 - line 48
Page 127 - line 7
line 24

Page 137 - line 14

Page 179 - line 11

Page 185 - line 37

Page 186 - line 23

Page 196 - line 2

Figure 1 -

"usable" should be "usable"
"growth deterioration" should be
"growth or deterioration"
"dissucced" should be "discussed"
delete "with faint geometric design
was uncovered" and end the sentence
after the word "painting"
"altar of more" should be "altar, but
of more"
"high" should be "highly"
"is" should be "in"
"hamlet" should be "hamlets"
"higher in" should be "higher than in"
"oax caca" should be "oaxaca"
"Xochimalco" should be "Xochicalco"
"Xochimilco" should be "Xochicalco"
"monolistic" should be "monopolistic"
"Coyotetelco" should be "Coyotlatelco"
"Huapacalco" should be Huapalcalco"

On Page 186 the following paragraphs should be inserted after line 4.

7. We stated previously that we accepted Vaillant's hypothesis that the Anales de Cuauhtitlan and Ixtlilxochitl lists refer to separate dynasties. We also noted the presence of a ceremonial precinct, probably built during the Coyotlatelco Phase of the history of Tula, emphasized the striking differences between Coyotlatelco and Mazapan ceramics, and noted the shift of the location of the civic center of Tula from one end of the site to the other. Furthermore one could derive the Coyotlatelco complex from the earlier Teotihuacan styles whereas Mazapan seems to have affiliations to the north - particularly with the Bajío. The archaeological data plus the documentary references to conflicts between rival religious sects during the reign of Topiltzin all suggest a sociopolitical upheaval that temporarily interrupted the evolution of the Toltec state.

Ixtlilxochitl's list may therefore refer to the early part of Toltec history and perhaps equates with the Coyotlatelco Phase. In the 9th Century we suspect that there was an invasion from the north by a group that was able to create a political and religious crisis. The documentary references to a conflict between Quetzalcoatl (Topiltzin) and Tezcatlipoca could be interpreted as a mythological reference or version of this crisis with Quetzalcoatl representing the older tradition and Tezcatlipoca the new. The result was the expulsion of one faction (that of Quetzalcoatl) and, the establishment of a new dynasty, religious system and artistic style. The Anales de Cuauhtitlan may therefore refer to this new dynasty and equate archaeologically with the Mazapan style. The fact that Quetzalcoatl (although with altered attributes and functions) remained the patron god at Tula suggests that some compromise was reached.

Acknowledgements

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Maps and drawings were prepared by Joseph Marino.

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PART I

INTRODUCTION AND BACKGROUND

The Ecological Approach.

Perhaps the central concept of twentieth century anthropology has been that which views each of man's cultures as an integrated, organized system. Anthropologists have argued that a given culture should be analyzed in terms of its own organized principles, and not be evaluated on the basis of values derived from other cultures. (Carried to extreme this position means we cannot use the principles of Western science to evaluate other cultures, since these principles derive from Western traditions!). This approach has, of course, been an extraordinarily productive one but we feel that it has certain weaknesses and limitations.

In my own case my research interests concern the origin and development of a basic pattern of type of cultural behavior archaeologists call civilization. It is a type that evolved within a number of diverse, distinct, cultural systems. A detailed analysis of the values, ethos, and postulates (in other words the organizing principles of each of the various cultural systems) leads us nowhere in understanding the developmental processes that are involved in the origin of a cultural system. Such studies tell us how each system works; they do not answer the fundamental question as to why and how such systems evolved.

I believe that the relatively new and rapidly developing ecological approach in anthropology is a way out of this impasse. Briefly, the cultural ecologist sees the culture of a given people as a subsystem in interaction with other subsystems. He argues that the key to understanding the developmental process of the cultural subsystem lies in this interactive relationship. I will call the larger total system the ecological system. It includes the cultural, biological and physical environments as its components.

By way of warning I wish to emphasize that I hold no brief for nineteenth and twentieth century concepts of environmental determinism. Neither however, shall I reject the powerful influence of the biological and physical environments on the development of man's diverse cultural systems. As I have stated above, the cultural, biological, and physical are all components in an overall system. This means that all three subsystems interact mutually in a three-way process. Cultural systems modify the biological and physical environment and vice versa. Perhaps Toynbee in his Challenge and Response theory (1947) comes closest to a formal presentation of this ecological approach. I will state the ecologist's position as I see it in the following postulates:

1. Each biological and physical environment offers certain problems to human utilization.

2. Diverse environments offer different problems; therefore the response by man (i.e., the development of a cultural subsystem) will be different.

3. To a given environment there are a variety of responses possible, but not an unlimited number (e.g., the cultural systems of Bronze Age Egypt and Mesopotamia evolved in similar environments but they were quite distinct).

4. Responses to environmental challenges may be technological, social, or ideational.

5. In a broad sense men living in similar environments solve the problems of adjustment in similar ways; in different environments, in different ways. This is essentially what Julian Steward (1949) demonstrates in his concept of multilineal evolution. Furthermore, although a number of alternative solutions are possible, certain kinds of responses are more likely to occur than others and are repeated throughout the culture history of a given area.

6. There is some overlapping of responses and solutions even in cases of strikingly dissimilar environments; i.e., the Mesoamerican cultural system occurred in arid mountain valleys and lush tropical lowlands.

7. Cultures, as are all of the components of an ecological system, are dynamic and the degree of integration of a cultural subsystem to the total ecological system will vary. This may be a function of time or external disturbances that temporarily disrupt the integrative process (the Mongol invasion of Mesopotamia is an extreme example of the latter), or because the initial trend of development itself was an alternative one to that leading to the most efficient adjustment. We have previously indicated that cultural responses to a given environment may be different. As a simple measure of "efficiency of adjustment" I would utilize population density.

As an example of this latter point of view we might draw a comparison between two quite dissimilar cultural responses in two similar environments: the Amazon and Ganges River basins. In the former case the solution was slash and burn cultivation with starchy root crops combined with fishing and hunting for protein foods. The result was a very low population density, with residence in small, widely-spaced, autonomous hamlets and small villages. In the case of the Ganges Valley, the solution was the development of intensive rice cultivation and the result was a very dense population, which was the base of a very elaborate civilization.

The Mesoamerican Ecological System.

We will now apply this preliminary statement of principles to one of the major cultural historical problems in American archaeology, the origin and development of Mesoamerican civilization. Archaeologists visualize a civilization as a special type of cultural growth that occurred only in a few regions of the world. Restricted distribution of such growths is especially marked with respect to that general stage in man's history before the development or introduction of iron technology. In pre-Iron Age times there were only four areas of the world where cultures of the type called civilizations by the archaeologist occurred. One is the greater Near Eastern center with its four foci in Crete, Mesopotamia, Egypt, and Pakistan. North China was another in the Old World and in the New World there were two, the Andean and the Mesoamerican areas.

Archaeologists define civilizations in terms of excellence of technology, and especially by the presence of monumental architecture. These

traits are used as criteria for obvious reasons. More significant, however, are the social and economic implications of these technological achievements. They are always the product of a large organized human society with marked occupational specialization and social stratification. Furthermore, in pre-Iron Age technologies, with relatively primitive basic tools and transportation techniques, at the base of the system is intensive agriculture and a high population density.

In the case of each of the four major pre-Iron Age civilizations and the four foci of the Near Eastern center, the specific cultural systems were different; but all share those traits we are calling civilization. We may then classify all of them into a general cultural type. Civilization is one kind of solution for the adjustment to a physical and biological environment.

The major question to consider then is why civilizations evolved so rarely and what factors were involved in their development. We will confine our application of ecological theory to one of these centers, Mesoamerica.

In the previous discussion I defined an ecological system as possessing three basic components, the cultural, biological, and physical. Before discussing the interactive processes between these three components, we will first briefly describe the three components of the system in Mesoamerica at the time of the Spanish Conquest.

The Cultural System. In 1519, all over the region that includes Central and Southern Mexico, Guatemala, and adjacent parts of Central America, the Spaniards found a complex civilization and a relatively dense population. The basis was a highly developed agriculture characterized by a great number of crops but with maize as the staple. Animal domestication was feebly developed and land transportation therefore unelaborated. Metallurgy (gold, silver, copper) was a highly skilled craft but used primarily for ornaments for the ruling class and religious cult. Most of the basic cutting tools were of stone: chipped obsidian for scrapers, knives, projectile points and drills; ground stone for tools for wood working and grinding of grain. In other words, the technological stage was what archaeologists call the Neolithic.

Many crafts were extraordinarily, highly developed, such as weaving (cotton and maguey), ceramics (pottery and figurines), monumental stone sculpture, feather mosaic, stone jewelry using jade, turquoise and other semi-precious stones, and finally architecture. The latter involved huge platforms with ascending stairways and summit temples or elite residences built of earth and stone with lime concrete and plaster surfacing.

Economically there was a great deal of specialization, some community and part-time, other professional and full-time, and goods were distributed by an elaborate market system and organized caravans of human pack animals.

All over Mesoamerica people were organized in little states with populations of tens of thousands of people ruled by petty kings or, in some cases, by orders of priests. Such states were in constant military competition, and super-states enjoyed brief periods of prosperity based on conquest and tribute collecting. Society was highly stratified with at least two basic levels: a landed nobility with control of production and distribution of goods via markets and the taxation system; a peasant class that provided labor for war, construction, cultivation of land and agricultural produce, and craft products to support the nobility. In many areas this

system of social stratification was more elaborate with professional warriors, elite craftsmen, serfs, and slaves as clearly defined social classes.

The constant, recurrent, and dominating theme of Mesoamerican civilization, however, was clearly religion. Much of the fine craftsmanship and architectural energy was devoted to the gods. The religious system involved a pantheon of gods with specialized functions; but the universally most important deities were agricultural, especially the rain gods. The gods were omnipotent and needed to be propitiated and appealed to in order to establish a stable relationship between man and his world. This idea reached its climax in human sacrifice. Temples were built as homes of the gods, a calendar invented to predict the seasons and the behaviour of the gods, and to regulate and order the extraordinarily elaborate ceremonial that was dedicated to them. A professional priesthood with formal schools for novices and an elaborate rank system was present to minister the cult. Intellectual development included a high development of astrology and writing.

Within this basic pattern of cultural uniformity, however, was an extraordinary diversification of regional subcultures and at least two fundamentally dissimilar patterns. One was in the tropical lowlands and involved slash and burn agriculture, lower population density, a feeble development of markets and craft specialization other than the elite crafts, greater focus on religion, lesser military development, and lack of evolution of large states and true cities. The settlement pattern included ceremonial precincts where priests and elite craftsmen resided. The bulk of the population, consisting of peasant farmers, resided in hamlets.

In the highlands, or at least the arid highlands, agriculture was more intensive involving irrigation and terracing and there was a much denser population per unit of agricultural land. Markets, community and occupational specialization were much more highly developed, involving even the peasant crafts. The status system had a less religious emphasis with professional warriors and a secular nobility; warfare generally was more elaborated and of greater economic significance, and there was a marked tendency toward the formation of huge tributary states. The most striking difference, however, was the presence of huge urban centers or cities.

The Biophysical System. The Mesoamerican area is extraordinarily complex geographically. Over distances of 40 to 50 miles we may encounter nearly all of the world's environments. This is a function of the latitude and topography.

Elevations vary from sea level to nearly 5500 m. above sea level, temperatures from tropical to arctic, rainfall from near-desert conditions to areas with 6000 mm. (240 inches) of average annual precipitation, soils from laterites to chernozems, topography from steep canyon valleys to flat riverine flood plains and vegetation ranges through xerophytic, steppe, mixed forest, boreal forests, tundra, tropical grasslands, jungle and tropical rainforests. Mesoamerican civilization was found wherever maize could be grown; it is perhaps the adaptability of the Mesoamerican maize farmer to the fantastically diverse landscape that is the most impressive achievement of this civilization.

Although hundreds of environmental types could be established based on combinations of the geographical characteristics noted above, six broad ecological types may be defined on the basis of human utilization of the area.

1. Tierra Caliente (Hot Country) 0 to 800 m. above sea level.
 - a. Humid, excess of 1200 mm. average annual precipitation.
 - b. Subhumid, average annual precipitation below 1200 mm.
2. Tierra Templada (Temperate Country) 800 to 1600 m.
 - a. Humid, average annual precipitation in excess of 1000 mm.
 - b. Subhumid, average annual precipitation below 1000 mm.
3. Tierra Fria (Cold Country) 1600 to 2800 m.
 - a. Humid, average annual precipitation in excess of 800 mm.
 - b. Subhumid, average annual precipitation below 800 mm.

Environment and Culture in Mesoamerica.

Excluding Mesoamerica, all of the centers of pre-Iron Age civilization occurred in areas with biophysical environments falling into two basic types:

1. Rainless deserts with extensive alluvial plains, fertile soils and major rivers usable for irrigation and transportation.
2. Areas of light seasonal rainfall (topographically, occurring in riverine or coastal plains or mountain plateaus and valleys), sparse vegetation, fertile, but friable soils.

Within Mesoamerica the Mesa Central (Central Plateau) and the Southern Highlands have identical biophysical environments to type (2), and fit into our Mesoamerican ecological types (2b) and (3b). With this in mind several researchers, Armillas (1947), Wolf and Palerm (1954-55), Wolf (1959), Millon (1954-57) and the present author (1956) have attempted to apply the concept of the "Irrigation State" to Mesoamerica. The concept, stated here very summarily, states that the successful manipulation of an arid environment by a farming population requires organization of people on a large scale to dig and maintain canal and dike systems. Furthermore some type of supra-community organization is necessary to police and regulate the distribution of water.

Although, as Millon (1962) and Adams (1960) have demonstrated, several kinds of arrangements are possible, the most effective social organization is the state with its hierarchy of formal status positions and their delegated powers and centralized authority. This is essentially what I meant in my postulate number (5) in which I said certain solutions are more efficient than others and therefore tend to be repeated in similar environments or in one area several times during the course of human adjustment to that area. The argument is that the investment of control of water in the hands of a small group of directors was one of the factors that resulted in the evolution of the highly stratified society that is characteristic of all of the pre-Iron Age civilizations.

Irrigation farming, furthermore, is extraordinarily productive and permits very dense populations and the growth of very large communities even with a partly or almost entirely rural base. Chinampa communities in the southern Basin of Mexico have populations ranging from 3000 to 6000 that are completely rural in subsistence and one partly-rural partly-urban community has a population of 30,000 (Xochimilco). Even in 1920, before Mexico City became industrialized in a modern sense, Xochimilco still had 15,000 inhabitants.

The resultant social system is precisely the type we have defined as an essential characteristic of all civilizations. I have argued in a previous paper (Sanders, 1962) that one can visualize the process of initial development of civilization in Mesoamerica as occurring in the arid

Central Plateau where the biophysical environments were propitious for such development.

We believe this argument to be a tenable one, but it does not explain the diffusion of civilization into other environmental zones in Mesoamerica, nor does it entirely explain the development of certain characteristics of Highland Mesoamerican civilizations. For this reason we feel that other interactive processes in the Mesoamerican ecological system must be considered. In our brief survey of Mesoamerican biophysical environments the one, striking, salient characteristic of the area was its extraordinary diversity. We feel that this diversity perhaps was as important a factor in the evolution of Mesoamerican civilization as irrigation agriculture.

The tight, microgeographical, zoning results in an extraordinary diversity of and highly localized distribution of raw materials, involving even basic food crops and raw materials for peasant technology. Herein lies the ecological problem: How can a small community situated in one area obtain the raw materials or finished products necessary for the maintenance of a peasant economy? One alternative is incessant warfare in which each community procures such materials by periodically raiding the territory of other communities. Another, of course, is organized trade combined with part-time or full-time community specialization. McBryde's superb analysis of patterns of trade and specialization in the Southwest Highlands of Guatemala (1945) is a good example of this type of response. Such patterns, however, are difficult to maintain except when the communities are part of some larger sociopolitical structure such as a regional state. Community specialization and supra-community sociopolitical systems are obviously a more efficient solution to the biophysical challenge than is intercommunity warfare. Wholly aside from the need of a peaceful and stable political climate for the successful establishment of such economic patterns, the traditional, repetitive, market encounters of people from different communities would tend to produce a feeling of community of interests and social identification that should act as a subtle integrative factor.

In our definition of civilization we stated that archaeologists define such cultures on the basis of a permanent architecture and the exceptionally fine quality of the technology. The former is the product of large, organized, social systems, the latter of occupational specialization. The development of patterns of community specialization is a basic step in the development of occupational specialization and, as we have indicated, can be partially visualized as the product of the interaction between the biophysical and cultural subsystems.

On the basis of diversity of needs and mutual interdependence of zones, Mesoamerica may be divided into a series of regions for which the term "Symbiotic Region" is useful. Each consists of zones of contrasting environments, and has a Highland and a Lowland component. Highland Chiapas and Lowland Tabasco, for example, would comprise a Symbiotic Region, as do the Central Plateau and Central Vera Cruz and Highland and Pacific Coastal Guatemala. None of these regions make up discrete units. Highland Guatemala for example could just as easily form a unit with the Peten (and in Classic and Late Formative times probably did), and Highland Chiapas with Pacific Coastal Chiapas. The interrelationships of the components of these regions are complex and overlapping. One of the definable Symbiotic Regions stands out in the total Mesoamerican area with respect to its historical importance and in terms of the more vigorous roles played by the

two geographical factors emphasized in the preceding discussion (irrigation and microgeographic zoning). This is the Central Mexican Symbiotic Region, which includes the Central Plateau and adjacent southern escarpment. In a total sense it includes the modern states of Michoacan, Mexico, Puebla, Tlaxala, Morelos and northern Guerrero but within it is a smaller core where the bulk of the population was concentrated in 1519. This included the Basins of Mexico and Puebla plus the Amacusac-Nejapa drainage. According to Cook and Simpson (1948) and Cook and Borah, (1963) 25 percent of all of the population of Mesoamerica resided in this area in 1519 (an area of about 20,000 km.²). It was the center of the two post-Classic pan-Mesoamerican empires, Toltec and Aztec, and in Early Classic times was the location of the most vigorous of all of the great Classic civilizations of Mesoamerica. It may have been one of the places of origin of Mesoamerican agriculture and of sedentary village life, and played a significant role in the evolution of the first civilization, the Olmec. In short, there is no area of comparable size in Mesoamerica that played such a vital role in the overall culture history of the area.

We have little patience with attempts to derive complex cultural manifestations from single sources via simple cultural processes, and are not implying that all of the regional cultures of Mesoamerica derive their specific characteristics from this center. As will be made abundantly clear, the focus of this paper and the theoretical orientation is evolutionary and ecological, each regional variant of Mesoamerica civilization is seen basically as the product of a local process. However, the nature of the concept of economic symbiosis is that when areas were in constant historic contact, such contacts were a primary force in the enrichment of local cultural traditions. It is also obvious that a number of areas were more donors than recipients, or simply that events there had greater repercussions on the area as a whole. This is where the Central Mexican Symbiotic Region is outstanding. Its uniqueness was, we believe, the product of its peculiar geographical characteristics. In no other Symbiotic Region of Mesoamerica do we find both a highland and lowland component in which intensive agriculture and dense population were characteristic. The term Nuclear Area is being used for these especially vigorous foci of cultural dynamics within major culture regions. The concept is a flexible one; one can conceive of nuclear areas within nuclear areas. Within the nuclear area defined above for example the Basin of Mexico is a nuclear area, that is, its role in the history of the overall area was more stimulative than any of the other parts. Within the Basin, specific small areas played unusually vital roles in different time periods (i.e., the Valley of Teotihuacan in the Classic, province of Xochimilco during Late Formative times, the lakeside plain west of Lake Texcoco in the final Phase of the post-Classic).

Parallel with this concept of the nuclear area one can also use the term marginal area with the same territorial levels of meaning.

In 1960 Eric Wolf, Associate Professor of Anthropology, University of Chicago, applied for and received an NSF grant to support a conference entitled, "Coordinated Anthropological Research in the Valley of Mexico." The main purpose of the Conference was to unite in a single discussion group a number of specialists on Mesoamerica with the specific interest in the Valley of Mexico. The Conference had two primary objectives: a) to assess our present state of knowledge in the development of the field, and b) to plan future research.

The meeting took place in June, 1960, at the University of Chicago. The following persons were present at the Conference: Robert Adams, Assistant Professor, University of Chicago; Pedro Armillas, Visiting Curator, Museum of Anthropology, University of Michigan; Pedro Carrasco, Associate Professor, University of California; Michael Coe, Assistant Professor, Department of Anthropology, University of Tennessee; Edward Deevey, Associate Professor and Director, Osborn Zoological Laboratory, Yale University; William Mayer-Oakes, Director, University of Oklahoma Museum; Rene Millon, Assistant Professor, University of California; Angel Palerm, Executive Secretary, Pan American Union; Roman Piña Chan, Archaeologist, Instituto Nacional de Antropología e Historia, Mexico; William Sanders, Assistant Professor, The Pennsylvania State University; and Eric Wolf, Associate Professor, University of Chicago.

The overall objective of the proposed program was to foster research leading to the definition of the role of the Valley of Mexico in the cultural development of Mesoamerica as a whole. In Wolf's original NSF Conference Grant the following specific objectives were listed:

1. Changes in the natural and man-made environment of the Valley of Mexico over time and the possible correlation of these changes with cultural factors.
2. The antiquity, development and relative importance of major and minor patterns of land use over time.
3. The characteristics of settlement in the Valley and changes in settlement patterns over time and related population problems.
4. The nature of the relationships between hamlets, villages, towns, cities and similar units at various periods including a discussion of relations between specific sites.
5. Problems of urbanization.
6. The characteristics of symbiotic regions in the Valley in various periods of time and their social consequences.
7. The relevance of environment to agriculture and settlement patterns to problems of social controls at various levels.
8. Patterns of ceremonial control at various time levels.
9. Patterns of political control at various time levels.
10. Patterns of warfare in the pre-Hispanic Period.
11. Effects of the Spanish conquests and colonization on social and cultural groups in the Valley of Mexico.
12. Cultural persistence or change in major patterns throughout all known time periods within the Valley.
13. Casual or functional relationships between various cultural patterns at different time levels.

On the basis of the discussion at this Conference it was decided at that time to set up an informal organization in which we would plan specific research and discuss the results of such research projects. Each of the constituent members would carry out specific research projects independently but coordinated with overall objectives. One of these projects was to be carried out by William T. Sanders, Associate Professor of the Pennsylvania State University and is called the Teotihuacan Valley Project.

The Teotihuacan Valley Project.

This long range program of research will involve a series of intensive studies of selected areas within what was defined as the "Nuclear

Area". For this purpose the Basin of Mexico has been divided up into six areas, each of which will be the subject of a specific project. These are as follows: the Southwest (the old Provincia and approximately the modern Delegacion of Xochimilco), the Southeast (the old Provincia and modern Distrito of Chalco), the East Central (most of the old Provincia of Acolhuacan or Distrito of Texcoco), the West Central (the area immediately north and west of Mexico City), the Teotihuacan Valley, and the North (old Provincias and Distritos of Cuauhtitlan and Zumpango). Outside the Basin of Mexico, survey projects will include test areas around Cuernavaca, Xochicalco, and Jonacatepec in Morelos; Tula in Hidalgo; and Cholula and Atlixco in Puebla, a total of 12 areas. Each of these studies will involve a diachronic analysis of the cultural ecology.

The first of these area surveys, the Teotihuacan Valley, has been completed and is the subject of this report. The Teotihuacan Valley Project was designed for five years as a model and test of methodology. Each of the other areas will be the subject of one-year projects.

The program as a whole is concerned with three basic objectives:

1. What adaptive processes and patterns have characterized each area in the past and present?
2. How have these processes and patterns affected the culture history of the areas?
3. What was the nature of the historical contacts between the various areas?

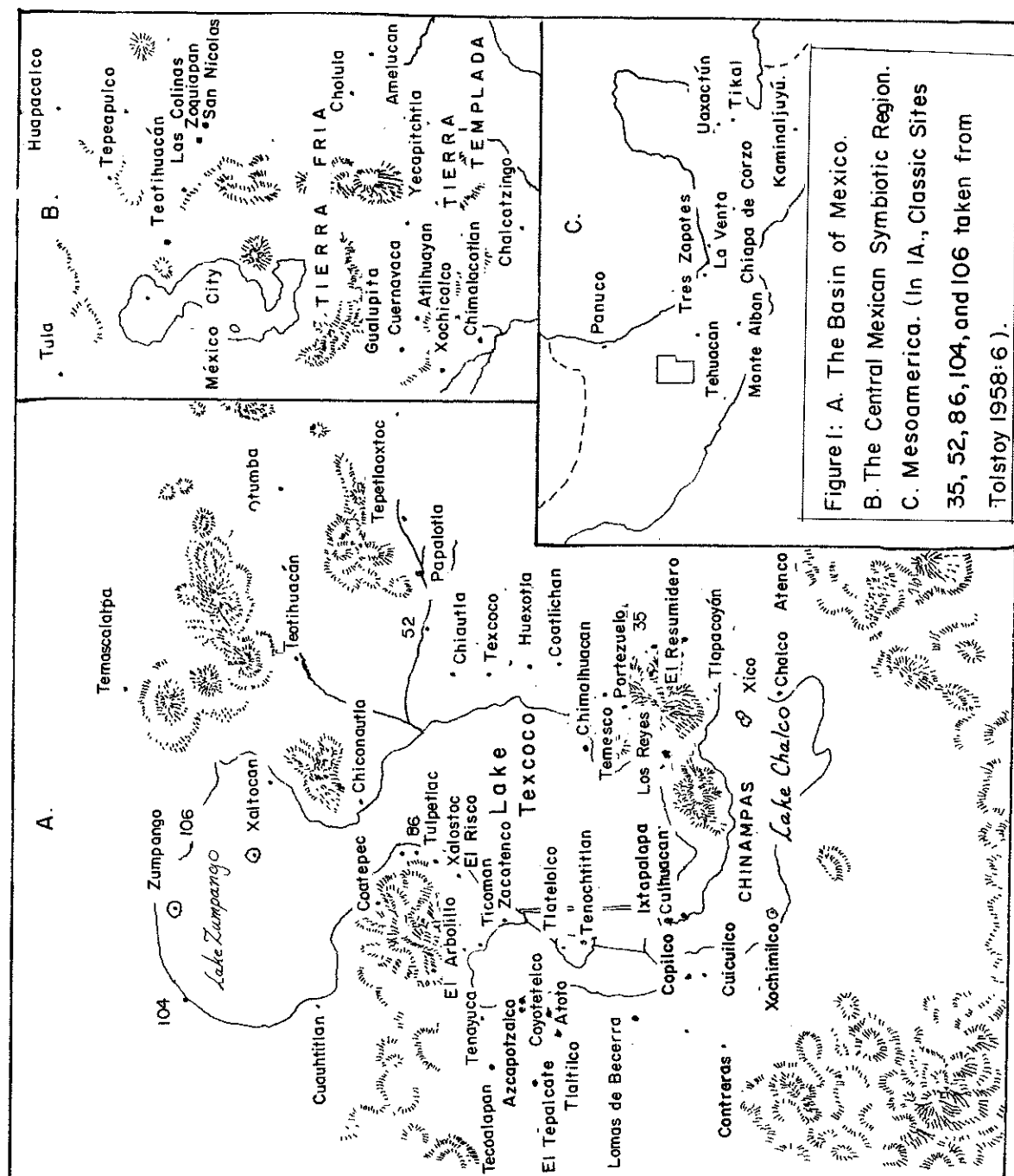
The Teotihuacan Valley was selected as a test study for several reasons. The largest urban community in the history of Mesoamerica was located there and one of our major interests is the study of the process of urbanization. A series of previous studies of the modern, colonial and pre-Hispanic occupation had been published and provided a base of data from which to work. Finally, Rene Millon planned a long-term study of the city itself, thus supplementing our own research. His project is called the Teotihuacan Mapping Project and will be referred to as such in the remainder of this paper.

The specific objectives of the Teotihuacan Valley Project are listed below:

1. To trace the history of development of agriculture in the Valley with special focus on irrigation, terracing and other patterns of land use.
2. To define and trace the history of rural and urban community types.
3. To construct, on the basis of data on settlements, at least a relative profile of population history.
4. Finally, and on a higher level of abstraction, to explore the functional relationships among such phenomena as settlement patterns, agricultural techniques and demography, and by an analysis of the interaction between these patterns to throw light on the urban development of the area.

The field work phase of the project was initiated in June, 1960, and completed in September, 1964. Financially, the project has been supported by the Pennsylvania State University, the Pan American Union and especially by the National Science Foundation. The research has been combined with a Summer Field School in archaeology for undergraduate and graduate students with the most intensive activity occurring during that period. Nearly all of the excavations were conducted during the summers with a field party varying from five to 20, including faculty and students.

During the three years 1961-1962-1963, several students and/or the Field Director have remained in the field on survey for additional periods ranging from three to nine months. Four graduate students have been with the project since its inception, and two participated in four of the five seasons, thus lending continuity to the project.



PART II

METHODOLOGY

Five basic methods were used in the gathering of data: archaeological excavation, archaeological survey, ethnography, documentary research and geographical survey (the latter including palynological analysis).

Archaeological Survey.

This was the primary method; the other four may be considered as auxiliary. Survey methods were similar to those used by Ford and Willey in their Viru Valley study, involving a unit of comparable size. The Teotihuacan Valley has been photographed aerially twice at base scales of 1:10,000 and 1:25,000 by the Compañía Mexicana de Aerofotos. Unlike the Viru Valley, (at least without the use of more sophisticated techniques) aerophotos have only limited utility in finding sites. They are extremely useful in mapping them, once discovered, and are also indispensable in studies of modern land use and settlement patterns. Larger mounds, such as pyramids, and features such as dams, canals and terraces are visible on the photos but residential structures are not. The torrential summer rains reduce such structures to heaps of rock and earth debris.

The first three years of the survey were devoted to what was termed "general survey" and consisted of locating sites approximately on the aerophotos and recording the chronological mode and range of occupation. Approximately 600 sites were located.

Between June, 1963 and September, 1964, 350 of these sites were "intensively" surveyed. A detailed schedule was designed and data recorded for each site. Each schedule included: an aerophoto of the site area (amplified to 1:4000); a series of traced maps locating archaeological, natural and modern data; a description of the natural setting; modern occupation and land use of the site and surrounding area; archaeological features, including condition of the site, structures (with accompanying large scale drawings of walls, floors and profiles), estimates of sherd and other artifact distributions and densities; photographs of archaeological, natural, and ethnographic features; a sheet for recording subjective impressions and interpretations; and laboratory sheets for analysis of surface collections.

Surface samples were collected from each site varying in number from one sample in very small sites to over 100 in large ones. An attempt was made to collect from very small areas (preferably a single structure). A minimum of 50 rims was collected for each sample, but the samples frequently ran into the hundreds.

The definition of a "site" is a highly arbitrary and subjective matter and an extremely difficult methodological problem, especially for the Aztec Period. In this report a site is defined simply as any localized area that

shows signs of alteration by man as observable by archaeological method. This would include anything from an isolated house (a question here might be raised--how isolated?) or ceremonial structure, dams, canals, terrace systems, to a city of 100,000 inhabitants. The important point is that a site is a "spatially isolatable unit". A spatially isolatable unit should have had some cultural significance to the prehistoric population and not be simply an archaeological abstraction if such units are to be used conveniently in settlement pattern analysis. One example will suffice here to illustrate the point. Classified as a single site would be an area within which were a small pyramid, a series of closely-spaced residential structures and a set of terraces and floodwater canals that were all "contemporary", that is, belong to one of the units of time used in the survey. Such a cluster of features is classified as a single site because it obviously formed a meaningful socioeconomic-religious community in prehistoric times.

As a methodological procedure, sites were grouped into four major periods for recording. These periods were Formative, Teotihuacan (Micaotli to Metepec), Toltec and Aztec. In actual analysis of the pottery a much more refined chronology is being used and is presented on page 16. In cases of multiperiod sites (i.e., the four-fold divisions noted above) each occupation at the present stage of research is being considered as a site. When all samples are processed, each of the shorter phase occupations will be called sites. At the time of the writing of this report, the Formative Period samples have been examined and the occupational phases defined. The Formative site numbers used in the report therefore refer to the phase occupations.

One of the major problems of the survey has been that of site sampling. At first the intention was to intensively survey all of the easily observable, modern field units and houselots in the aerophoto for the entire Valley. By this method the expectation was to locate and describe all of the sites.

In the first field season the impossibility of the method became evident. On the basis of the ecological survey, the Valley was then divided up into geographical divisions based on variations in slope, soil depth, and water resources, the prime determinants of settlement location and land use today. Sample areas of each of these types were surveyed using (1) a more general extensive survey method and (2) intensive field-by-field test strips over areas of several square kilometers each. All pre-Toltec and a sample of 200 Toltec-Aztec sites, representing all the ecological zones and all the types of sites, were selected for intensive survey.

Archaeological Excavation.

All excavations were conducted with two primary objectives in mind, to define the functions of the several types of structures encountered on survey and to refine or check the chronological sequence. Although much chronological work has been done on the Basin of Mexico, surprisingly little of it has been adequately published and researchers have tended to be highly selective about presentation of data. For example, most of the literature dealing with Aztec and Toltec pottery has been primarily concerned with the decorated pottery, and for the Teotihuacan Period only gravelots have been reported in detail. Recently some studies of sherd material of the latter period have appeared (i.e., Tolstoy, 1958; Sejourne, 1959), but the former rested on a very inadequate sample of sites, the

latter on poorly controlled stratigraphy. Only the Formative Period is adequately reported and then only for certain phases. In the latter period, reports are especially deficient on what we are calling Terminal Formative (i.e., the period between Vaillant's Late Ticoman and Miccaotli). Furthermore, as this report will emphasize and the final report demonstrate, there is a fair amount of regional variation within the Basin of Mexico, thus adding a further complication.

Altogether, excavations were conducted in 20 sites ranging from small test pits to large, multiroomed houses.

Documentary Research.

Documentary Research on general aspects of Aztec culture was initiated by the senior author as far back as 1949 and has continued intermittently since that date. Before the final report is published, an intensive survey of documents in the Archivo General de la Nación specifically relating to the Teotihuacan Valley is planned. This preliminary report is based on published syntheses plus some published colonial documents such as the Relacion de Tecciztlan (Tequisistlan) and a number of sixteenth-century census reports.

Ethnographic Research.

In 1954, the author conducted a preliminary study of present-day settlement patterns, population distribution and agriculture. This data has been amplified in the present project and new data collected on house types, markets, village specialization, territorial organization and pottery uses and techniques of manufacture. The present population has considerable continuity with the past (both cultural and biological) and the analysis of certain aspects of modern peasant life should be highly relevant to our research objectives.

Geographical Research.

Gamio's study published in 1922 involved considerable geographical research. The present project has amplified these data especially in the area of ethnobotany and palynology. This latter research was conducted by Anton Kovar, plant ecologist and palynologist at the Pennsylvania State University.

Problems.

The Teotihuacan Valley offers certain advantages and problems to the type of research involved in the project. It is a denuded area, thus making mapping and observation using aerophotos a relatively easy task. Erosion and the use of the plow make surface sampling a useful method of dating, since in areas of thin soil the total range of occupation is readily visible. The area today is densely populated by peasant farmers with many cultural patterns linked to the past, providing the researcher with many insights into problems of archaeological interpretation and a convenient base line for studying problems of human adaptation to the area. Local peasants also serve as excellent guides in survey and excavation.

The area also offers serious problems, in some cases related to the same characteristics that aid research. Erosion presents one of the most difficult obstacles, especially with respect to one of our fundamental objectives, securing data on prehistoric irrigation and terracing. The

archaeological and historical data suggest several periods of disastrous erosion, the most severe of which occurred in the sixteenth and seventeenth centuries following the Spanish Conquest. It is probable that many of the deeply cut barrancas that occur in the area were once shallow trenches capable of being dammed for floodwater irrigation (possibly even with a permanent or semi-permanent flow of water). Erosion of such streams has been lateral as well as vertical, so that any prehistoric stone or earth dams that may have existed would have been washed downstream. There are cases of stone dams only 50 years old now almost completely destroyed by water action.

The rate of erosion is extraordinarily rapid, a function of the torrential rainfall and generally sloping terrain. Erosion of both gully and sheet type is a common sight. As examples of the rapidity of gully erosion, several cases were noted of recently dug drainage ditches which generally have depths of only 50-60 cm. At the entrances of the ditches, however, where they enter the barrancas, the water action has cut them down to the depth of the barrancas about 10-15 m. below! Such ditches are frequently only 40-50 years old! The force of water running over a dam spillway built around 1900 has, in many cases, gouged deep pits into the bed of the barranca to depths of 20 m. Sheet erosion has in some cases denuded hundreds of hectares of gently sloping hillside since the Spanish Conquest.

Sheet erosion is very destructive to habitation sites which, in certain periods, tend to be concentrated on the lower flanks of the hills bordering the Valley. It is doubtful whether any of the sites located in such terrain have escaped severe erosion.

A corollary to the problem of erosion is that of deposition. The Valley floor itself has a soil cover varying in depth from one to eight meters. Conceivably many sites, especially small ones, are completely buried by sediments derived from the erosion of nearby slopes. In the survey area literally hundreds of abandoned canal-ditch systems were noted, but sedimentation of such ditches is so rapid that it is impossible to tell whether they were abandoned 50-100-500 or 1000 years ago.

The problem of deposition in the plain is a serious one (especially in the Lower Valley and Delta where soil depth is greatest) since the survey data seems to suggest a definite preference for living sites on the piedmont and hilly flanks of the Valley. The plain is the most productive segment of the Valley for agriculture and the necessity of leaving such land for strictly agricultural use and using poorer lands for residence is probably the major factor at work. The presence of numerous sites buried by sediments in the plain would alter our ecological principle considerably or possibly invalidate it. The control offered by the modern settlement pattern and the fact that there are a few sites with good surface occupation in the plain (four are at least 2500 years old) would suggest that the apparent rarity of sites in the plain is not the product of a methodological error.

Along with these special problems, characteristic of the Teotihuacan Valley, is the general problem of dating and association. Multiphase and multiperiod sites are common and frequently situated so close together or superimposed so that single spatial association dating of old canals, dams or terraces is a dangerous and deceptive process. The Aztec occupation above all is extraordinarily heavy, and very few earlier sites do not have an Aztec component as well.

A relatively refined chronological scale is being used for working out the history of settlement patterns. It is based on previous work published on the Basin of Mexico sequence, our own excavation and survey data and, for the Teotihuacan and Terminal Formative time spans, on new data from Millon's Mapping Project.

During the period from August-November, 1963, staff from the Teotihuacan Valley Project, from Millon's Mapping Project and from the Instituto Nacional de Antropologia e Historia, participated in a seminar on chronology and established the following tentative sequence. The following chart also includes the published Basin of Mexico sequence. In this report the chronological system will not be discussed in detail.

Teotihuacan Valley Sequence			Published Basin of Mexico Sequence		
	Periods	Phases	Periods	Phases	
AD					
1500	Aztec	Teacalco	Aztec	IV-Tlatelolco	
1400		Chimalpa		III-Tenochtitlan	
1300		Zocango		II-Tenayuca	
		Hueixtla??		I-Culhuacan	
1200	Toltec	Atlatongo	Toltec		
1100		Mazapan		Mazapan	
1000					
900		Xometla		Coyotlatelco	
800		Xometla-Oxtotipac			
700	Teotihuacan	Metepec	Teotihuacan	IV	
600		Maquixco (Late Xolalpan)		III	
500		Xolalpan		III	
400		Late Tlamimilolpa		II-III	
300		Early Tlamimilolpa		II-III	
200		Miccaotli		II	
100	Terminal	Apetlac (Early Miccaotli)		II	
0	Formative	Teopan		Teotihuacan	
100	BC	Oxtotla	Tzacualli	I	
200	Late	Tezoyuca-	Ticomán	Late	
300	Formative	Patlachique			
400					
500		Cuanalan			
600				Early	
700	Middle	Chiconautla	Zacatenco	Middle (Tlatilco)	
800	Formative				
900	Early	Altica			
1000	Formative	(probably at			
1100		least 2 phases)			
1200				Early	

At the seminar the pros and cons of using a number or name system and of using the terminology of the already established Basin of Mexico sequence was discussed. We came to a general agreement that a system of place names

was a more convenient tool than one using numbers since the latter always creates problems as new, earlier, or intermediate phases are defined. We also felt that the Basin of Mexico is much too large an area to use as a unit of local chronology. We felt that it was also necessary, in terms of the research objectives of both the Teotihuacan Valley Project and the Teotihuacan Mapping Project, to have as tight a control of chronology as possible by eliminating space as a factor in stylistic variation. Further research on the Basin of Mexico, we hope, will validate this position. That the Teotihuacan Valley history diverges sufficiently from that of the rest of the Basin of Mexico to warrant separate phase names will be apparent throughout this report. Furthermore, we will also demonstrate that using a sequential system this way will reveal much more data bearing on an understanding of the dynamic aspects of culture in the larger regions.

To a considerable degree the project was concerned with the problem of the history and evolution of social systems. In evaluating the social structure of any prehistoric people, the archaeologist can at best make only rough approximations since his data is primarily technological. The problem of reconstructing ancient social systems, then, revolves around the general question of the functional interrelationships between technology and society. Restating this point: What kinds of technology are most intimately related to what kinds of social organization? All human societies are organized on the basis of a few fundamental principles; status, kinship, age, sex, territory and voluntary association are the primary ones. Two of these, status and territory, have strong technological referents and our own analysis will concentrate on the kinds of social organization that are based primarily on these two principles. The growing interest of the archaeologist in settlement pattern analysis is based on the assumption that territorially based groups can be defined on the basis of spatial arrangements of residential units and civic buildings in an archaeological site or area. Keesing makes this point succinctly in the following passage:

"Housing has a close functional relation to the habits of social aggregation of the group. An extended family household will require either a large structure, or else a cluster of related structures. More specific social arrangements may effect the layout of rooms, furnishings, sanitary facilities, and other elements in the physical setting.... The layout of housing to form a community in a physical or structural sense also ties in with habits of social aggregation and helps to condition each generation in specific ways. Every group tends to have a visibly distinctive way of distributing living houses, together with public buildings, traffic ways, fence or walls, and other community impedimenta."

(Keesing, 1959, p.207).

Variations in individual status may be reflected in housing, dress and burial, at least to the degree of demonstrating that variations in rank are characteristic or not characteristic of a society and the range of variation. Conceivably the factors responsible for producing differences in rank might be identifiable as well as the characteristics of social positions. Community status variations should be definable on the basis of ranges in size and population, and in size and ornateness of civic buildings or residences.

At the present stage of archaeological method it seems improbable that kinbased social aggregations unrelated to territory (i.e., exogamous sibs, bilateral kindreds) are identifiable. Especially in this area of non-material culture, but throughout this report, we shall be constantly dealing with the question of probability levels of conclusions derivable from archaeological data. The general attitude of the report is optimistic; we intend to carry the possible and probable interpretations of the data to the limits of controlled and disciplined imagination. To clarify this point the following example is presented.

Data. As the result of excavation, a small, five-room structure constructed of stone and earth walls and earth floors was uncovered. Pottery, including cooking, storage and serving vessels and sherds; stone tools, broken and complete, including manos and metates, were abundant on the floors of the room and in the immediate vicinity of the outer walls of the structure. Manos, metates and pottery tended to be much more abundant in two rooms of the five-room structure. Furthermore, hearths were located in these same two rooms. A final fact, three of the rooms had interconnected doorways, the remaining two had an interconnecting door but there were no doors facilitating direct communication between the two room groups. The ceramics pertained to the Zocango Phase.

Conclusions--levels of probability:

Level one - the excavated structure was a residence. This is based on the overall plan, presence of hearths and the kind of occupational debris.

Level two - it was a two family house. One of the functions of the nuclear family is food consumption. All family groups have some mode of insuring privacy. The two apartment-like complexes each with its own kitchen would suggest a two family house.

Level three - the residential group was an extended family probably involving two nuclear families of unequal size. This conclusion is based upon the extraordinary frequency of extended families in non-urban societies around the world and the rarity of mutual residences of unrelated families.

That the two families were of unequal size is suggested by the range in number of rooms of the two apartments. This might also indicate that the two heads of the nuclear families were not of equal status, i.e., older-younger sibling or parent-child relationship.

Level four - the residential unit was probably a patrilocal, extended family. This, of course, is going far out on the proverbial limb but documentary references to the Aztec emphasize the dominant role of the male in social, religious and political life. Today in Mexican villages residence is strongly patrilocal by barrio, community, and where extended families occur, by extended family.

PART III

THE NATURAL ENVIRONMENT

Basin of Mexico.

The Basin of Mexico is a great elevated plain surrounded on three sides (to the east by the Sierra Nevada, west by the Sierra Las Cruces, south by the Sierra Ajusco) by high mountain walls and to the north by a series of low, discontinuous ranges of hills. The mountain wall reaches a maximum elevation of slightly below 6000 m. in the south-east with two snow-capped volcanoes of Ixtaccihuatl and Popocatepetl. The three ranges have numerous peaks with elevations in the 3000-4000 m. band and the Basin floor in the center has an elevation of approximately 2236 m. above sea level.

Before the construction of the "Gran Canal", the Basin was a closed hydrographic unit. Melt water from snowfields, springs, and runoff from the summer rains all flowed into the center of the Basin, draining into a chain of lakes that nearly traversed it from north to south. The colonial documents refer sometimes to three, at times as many as six, lakes (based on such artificial divisions as dikes); but during part of the year they formed a single sheet of water, located at varying elevations. To the north was Lake Xaltocan (or Lakes Xaltocan-Zumpango); the center, Lake Texcoco (or Lakes Mexico-Texcoco); and to the south, Lake Xochimilco (or Lakes Chalco-Xochimilco).

Lake Chalco-Xochimilco was located three meters higher than Mexico- Texcoco and drained into it. Because of this outlet, which apparently functioned all year, and the presence of numerous springs along the southern shore, the water was fresh and covered by floating vegetation ("so thick one could walk on it"). Lake Mexico- Texcoco was the lowest lake, was extremely saline, and the ultimate destination of all drainage. Lake Xaltocan-Zumpango was also situated at a higher level than Lake Texcoco-Mexico but drained into it only seasonally and was therefore more saline than Chalco-Xochimilco, except for small areas near local springs.

In the nineteenth century the lakes covered an average area of approximately 1000 km.² or one-eighth of the surface of the Basin. The average contour of the shore of Lake Texcoco was 2240 m., although this varied from season to season and year to year. The lakes were shallow, varying from one to three meters in depth. During dry seasons they frequently shrank in surface area so that canoe traffic from lake to lake was interrupted for short periods.

The total surface area of the Basin of Mexico is approximately 8000 km.² and it extends approximately 120 km. N-S by 70 km. E-W.

Melt water from the snowfields, local springs (especially in the south) and runoff from the rains feed into hundreds of permanent and seasonal streams that ultimately enter the lake system. The seasonal

streams have cut canyon-like beds locally called barrancas, and the drainage from rainfall is extraordinarily vigorous and destructive.

Within the Basin, rainfall is sharply seasonal and is concentrated in the months from June through September. Rains usually begin in May and decrease sharply in October. Approximately five-sixths of the rainfall occurs between May 1 - October 1. Inception and closure of the rainy season vary considerably from area to area and year to year, as does the annual rainfall. Internal droughts are common in the north and central parts of the Basin during the rainy season. No recent cases are known, however, of complete failure of the rainy season as a whole. Rains also tend to occur in late afternoon and evening. Hail storms are also common during the rainy season but a snowfall would be an extraordinary event. Mean annual rainfall varies from south to north and from basin floor to adjacent slopes. Stations in the northern Basin range from 500-600 mm., in the center from 650-750 mm. and in the south averages as high as 1100 mm. are recorded, all for the Basin floor. Rainfall for adjacent slopes, particularly on the middle flanks of the major ranges, is markedly heavier than that on the nearby plain, but there is little data for these areas. Averages of around 1400 mm. have been recorded for the slopes in the southeast.

Considering only mean annual rainfall, the southern part of the Basin would seem to be the most favorable part for maize cultivation without irrigation. In the central and northern parts of the Basin, even where soils are deep and loamy in texture, maize cultivation without irrigation is possible but crop security is low and production varies considerably from year to year. Yields are generally improved considerably (in many areas doubled) by irrigation, and it is absolutely necessary for effective maize agriculture all over this area where soils are one meter deep or less. The high elevation with correspondingly higher rates of transevaporation further aggravates the problem.

The modern peasant population of the Basin resides within a contour strip ranging from 2240-2800 m. above sea level. There is no permanent population of subsistence farmers above the latter elevation. Even those communities that lie between 2600-2800 m. have an economy based partly on grazing and lumbering. The primary factor that limits the upward expansion of agriculture seems to be the temperature regime. At lower elevations frosts begin normally in October and last until the beginning of March. Maize, the staple crop, (and nearly all of the secondary pre-Hispanic cultivates) cannot be grown during this frost season. Maize is especially susceptible to frost damage, notably during the early phase of its growth. The range of inception and cessation dates of the frost season varies as much as the rains do. In occasional years frosts begin as early as September or as late as December and may last through March and even April. Below 2600 m., however, local elevations seem to offer more favorable conditions for agriculture than the plains proper, since frosts tend to settle in the lower areas. Above 2800 m. the normal frost-free season is too short for dependable maize cropping. Particularly disastrous for agriculture based only on rainfall is a combination of a late inception of the rainy season and an early frost season, since crop planting must be delayed. Under such conditions plant growth is retarded so that the early frosts cause heavy damage. Of course, too early a planting is risky as well.

Most soil maps classify soils of the central and southern parts of the Basin (within the strip of agricultural exploitation) as "Chernozems", those of the north as "Chesnut". Both are associated with subhumid to semi-arid climates, fit into a major soil grouping called "soils of calcification" and generally have great natural fertility. The overall impression is that local differences in soil types within the 2240-2800 m. contours are minor in relation to agricultural productivity. Much more important are variations in soil depth and texture, because these soil characteristics are those most closely related to the problem of water conservation.

Soil depth, because of variations in intensity of erosion or angle of slope, varies considerably and has a striking effect on agriculture production, particularly in the drier center and north. The least productive part of the Basin is undoubtedly the north where mean annual rainfall is lowest. Maize cultivation is exceedingly precarious in that area. With respect to soil texture, loamy, friable, loose-textured soils are the most common and are ideal for primitive agriculture. They are, however, extremely susceptible to erosion. Sandy and clay-textured soils do occur in localized areas; the former in eroded slopes where the finer soil particles have been washed out, the latter especially near the lake shore and along streams. Above 2600-2800 m. podzol soils predominate. They are notoriously poor soils for agriculture, a further factor limiting its upward expansion.

It is difficult to reconstruct the natural vegetation of the Basin since at least 4000 years of agricultural exploitation has completely removed it from the belt of peasant occupation. Small areas of relatively unaltered vegetation can be used as a guide. There was probably a gradual shift from broadleaf forest in the south to xerophytic or scrub forests in the north. Between 2600 and 4500 m., conifer forest is the dominant vegetation; above that are strips of alpine meadows or tundra and finally, in the southeast, snowfields. With respect to human occupation and land use, two important points may be stressed. Between 2240-2600 m. the permanent removal of the vegetation (in contrast to the tropical lowlands of Mesoamerica) presents no serious obstacle to the Mesoamerican farmer even with his primitive technology. Above 2600-2800 m. the pre-Hispanic population had an easily available source of forest products for construction, household technology, transportation and medicine.

In summary, this brief survey of the geography of the Basin of Mexico reveals a number of significant factors with respect to its utilization by a farming population equipped with a technological complex comprised of neolithic tools, simple transportation and a cereal (maize) as a staple food:

1. The soils are easily cultivated using neolithic tools, are generally fertile and capable of sustained cultivation with modest application of simple soil restoration techniques (i.e., animal and vegetable fertilizers, crop rotation, short-phase fallowing, intercropping, floodwater and permanent irrigation, terracing). There is, however, a high percentage of sloping terrain where soils are markedly susceptible to erosion, and constant effort is required to control this destructive process.

2. The plant cover is fragile and easily controlled with simple tools.

3. The rainfall-temperature regime is favorable to maize cultivation only in the south. In the central and northern parts of the Basin the combination of early frosts and retarded rains plus internal droughts make maize cropping difficult and crop loss frequent.

4. In a number of areas local, permanent, water resources are available for permanent irrigation, and the numerous barrancas are sources of water for floodwater irrigation. Such systems, however, require intensive land use, heavy expenditure of labor per man, and supra-family, often supra-community, cooperation to maintain, construct and operate.

5. Since the summer rains generally provide adequate moisture in areas with moderately deep to deep soils, the primary need is a pre-planting irrigation. This enables the farmer to get a head start on the rainy season and gives the plant more time for growth before the arrival of the fall frosts. Most of the humidity for plant growth, even in areas of permanent irrigation, is derived from rainfall. This means that a small amount of irrigation water goes a long way, as will be demonstrated in the case of the Teotihuacan Valley. Mexican agronomers call this system "medio riego".

6. The lakes were an enormously significant resource for the pre-Hispanic and Colonial population. They provided a natural highway system for a people lacking beasts of burden. They linked all parts of the Basin, and most of the major population centers in 1519 were located near the shore or within the lakes. The lakes were important sources of protein foods for a population with few domestic animals, and of other products, especially salt. The freshwater Lake Chalco-Xochimilco was nearly covered by artificial, island-like gardens called chinampas, which were the most intensively cultivated and productive lands in Mesoamerica and provided much of the surplus foods for the support of urban communities in 1519.

7. Internally there is considerable variability in geographical characteristics within the Basin, a characteristic that stimulated local specialization and trade. Variations in amount and distribution of rainfall, vegetation, topography, soil depth, water resources, elevation, and spatial position with respect to mountain passes and lake shores, along with the distribution of specialized resources (salt, clay, obsidian, lumber, lime, stone, etc.), all acted as factors promoting this specialization and trade.

Ranges of small hills within the Basin tend to isolate parts of it into smaller topographic and hydrographic units. One of these is the Teotihuacan Valley, the subject of this paper. A detailed analysis of the geographic characteristics of this unit follows.

Teotihuacan Valley.

Topography and Hydrography. The Teotihuacan Valley is defined in this report as the drainage basin of the Rio de San Juan and covers an area of 505 km.². From Ixtapan, on the shore of Lake Texcoco, to Xaltepec, near the northeastern watershed, the Valley has a total length of 35 km. The elevation of the Valley floor varies from 2240-2300 m. and slopes gently down from northeast to southwest.

The southern and southeastern edges of the Valley are bordered by a solid rampart of hills with tributary valleys and small intermontane plateaus called the Sierra de Patlachique with a maximum elevation of 2800 m. It is a spur of the big Sierra Nevada range. To the north, the Valley is delimited by a string of isolated volcanoes separated by wide passes; major peaks here are Cerro Chiconautla (2550 m.), Cerro Malinalco (2580 m.) and Cerro Gordo (3050 m.). To the northeast, the Valley is open to the Tepeapulco-Apan plain with a low ridge serving as a watershed.

The Valley as defined above is a hydrographic unit. Drainage is explosive and destructive, and all slopes have deep gullies or barrancas that carry runoff to the mainstream, El Rio de San Juan, which in turn empties into Lake Texcoco. The flow of water in all of the barrancas is sharply seasonal and even during the rainy season water usually flows only a few hours, or at most a few days, following the torrential showers. The Barranca de Los Muertos, Atlamajac o Ixtetes, Huixcololco, San Martin and San Lorenzo (see figure 3) are especially significant in agriculture, particularly the first two. All of the mentioned streams join the Rio de San Juan above the town of San Juan Teotihuacan.

Approximately 80 permanent springs are located in a small area within and just outside of San Juan. They provide a relatively constant (varying seasonally) flow that averages approximately 600 liters of water per second into the river system, so that below the town, the Rio de San Juan becomes a permanent stream. There is an area of about 100 hectares in the vicinity of the springs where the water table is less than one meter below the surface.

Climate. The following chart summarizes the temperature and rainfall data at the one, permanent, meteorological station in the Valley (at the archaeological zone) for the period 1938-1963. Precipitation and evaporation figures are in millimeters, temperature is in the centigrade scale. It was compiled by Kovar from Mexican government meteorological data.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Maximum Rainfall	34.9	29.0	59.0	85.7	164.7	222.5	154.0	151.5	170.5	110.3	66.2	21.5
Av. Monthly Rainfall	6.3	5.1	10.97	34.89	64.64	92.92	87.87	98.86	75.47	37.87	17.05	4.48
Minimum Rainfall	0	0	0	0	16.8	21.0	25.7	13.0	31.0	0	0	0
Times Rainfall Above Av.	11	12	10	1						2	5	10
Times Rainfall Below Av.	15	16	14	11	12	15	11	11	15	14	14	15
Number of Years	24	24	24	23	23	23	24	24	23	23	23	24
Extr. Monthly Max.	29.5	29.0	31.5	34.0	33.5	38.0	30.5	29.0	28.8	28.5	28.5	29.5
Av. Monthly Temp.	12.46	13.41	15.50	16.99	17.38	17.10	16.32	16.23	16.01	14.70	13.75	12.44
Extra. Monthly Min.	-8.3	-6.0	-2.3	-2.5	1.3	1.8	3.3	3.0	0.5	-4.5	-4.0	-5.3
Times Frost Occurred	20	20	5	3						5	14	20
No. of Years	23	23	23	22	23	22	23	24	23	21	23	23
Monthly Evap. (Av.)	157.45	180.30	233.37	235.75	220.10	185.23	165.30	164.45	144.59	159.91	151.29	142.18

Annual Averages
 Max. Ann. Prec. 791.5
 Av. Ann. Prec. 547.54 (19 yrs.)
 Min. Ann. Prec. 378.75
 Prec. below av. 10x
 Prec. above av. 9x
 Av. Ann. Evap. 2210.28 (9 yrs.)

Generally speaking, the chart indicates a pattern fairly typical of the Basin of Mexico as a whole but with certain local peculiarities.

The low ranges that define the Valley act as an obstacle to free movement of moisture-laden winds and reduce the annual rainfall to one of the lowest averages in the Basin of Mexico. At least four-fifths of the total rainfall falls in the period from June 1 - October 1. An inadequate precipitation for a May planting is more common an occurrence than in most stations in the Basin. The pattern of rainfall noted as characteristic of the Basin as a whole, with brief, torrential, highly localized showers; late inception; and internal droughts are nowhere as pronounced as in the Teotihuacan Valley. The extraordinary range of rainfall from year to year (almost 100 percent) and high frequency of years with below average rainfall both point out the difficulties for maize cultivation without supplementary irrigation.

Our impressions indicate that rainfall is somewhat higher, possibly by as much as 50 percent, on the upper slopes of the Patlachique Range and Cerro Gordo, with perhaps less of an increase on Chiconauhtla and Malinalco. This observation is based on the relative lushness of natural vegetation, since meteorological stations are absent. Camphor forests and unusually good pastures are on top of Cerro Gordo.

The greater tendency for the rains to come late and for a generally lower rainfall than in most of the Basin retards planting, slows down plant growth, and aggravates the early frost problem. As can be noted in the "times frost occurred" column, temperatures below freezing may occur during the period from October 1 to May 1. Normally, the frost season runs from November 1 to March 1. This latter fact is extremely significant in terms of patterns of land use.

In the Teotihuacan Valley perhaps more than in any other part of the Basin, the timing of rainfall and frosts is of utmost concern to the peasant farmer; some crop loss is a common occurrence and crop disasters not infrequent. During the five years of the project, 1960 and 1961 were fair years with perhaps half of the unirrigated crops producing from fair to good yields; 1962 was a disaster year with the unirrigated crops a complete loss and even irrigated crops producing only from one-half to three-quarters of normal years; 1963 was a good year in which only maize crops planted on shallow soil failed to produce; 1964 was a poor year, almost as bad as 1962.

One of the impressions of the author, based on the five-year period, is that some kind of a positive correlation exists between dry rainy seasons and early frosts and between wet rainy seasons and a late inception of frosts. If the correlation holds as a general rule, it may be of crucial importance in the study of cycles of climatic history of the Valley and land use patterns.

Soils. The subsoil of the Teotihuacan Valley consists of a material locally called "tepetate", a hard, compact, crumbly, earth-like formation that is relatively impervious to water in contrast to the soil above. According to Gamio's field study, it is composed of volcanic ash and redeposited by fluvial action.

The organic or "A" soil layer above the tepetate varies considerably in thickness over the Valley and is generally loamy in texture. Near the barrancas and lake shore, clay textured soils are common and in badly eroded areas sandy textured soils predominate. In general, soils in the

plains are deeper and more finely textured than those on slopes; soils in the Lower Valley are deeper and finer textured than those in the Upper Valley. Most of the soil in the Valley is easily worked with simple tools and has extraordinary capacity for storing water. In areas where soil depths exceed one meter, water may be stored for several months using special techniques of working the soil. The less permeable layer of tepetate below acts as an artificial tank floor.

Soils are generally classified as "Chesnut" in most of the Valley and Chernozem in the alluvial plain of the Lower Valley and Delta. Such soils, before degraded by intensive cultivation, are characterized by fair to rich concentrations of organic matter, nitrogen and lime, and have a high concentration of potassium and phosphorous. Furthermore, in arid climates like that of the Teotihuacan Valley, there is a general tendency for water to percolate upward in the soil bringing fresh supplies of plant nutrients to the surface. Today, with varying degrees of intensity of cultivation and application of soil restoration techniques, the soil varies considerably in the presence of these nutrients and greatly degraded soils are common. In general, soils of the Teotihuacan Valley are fertile, capable of sustained cultivation, and rarely fallowed. The major soil factor that inhibits or limits productivity is depth. In the alluvial plain, soil depth varies from three-tenths to three meters in the Upper and Middle Valleys and increases to seven to eight meters near the lake shore. Most of the slopes, however, have a soil depth of less than 50 cm. and large areas of exposed tepetate are common.

Specialized Resources. The Teotihuacan Valley, as in the case of the larger unit (the Basin of Mexico), is characterized by definite ecological zoning and localized distribution of key resources. Lake Texcoco at the lower end of the Valley was an important source of salt, and several villages, Ixtapan, Nexquipaya and Tequisistlan specialized in salt-making in the sixteenth century and still do so today. Although not as rich in aquatic life as the freshwater lakes, Lake Texcoco also provided some resources such as fish, reeds for mats and baskets, insect larvae and eggs. Even today, although the lake has almost disappeared, the lake shore villages purchase excess water from the irrigation system, divert it into big earth banked tanks in the lake bed and raise fish! Clay deposits for pottery and clayey textured soils for adobe are found all over the Valley but are especially extensive in the lake shore plain and along the margins of barrancas. Several villages specialize in pottery and adobe manufacture. Obsidian resources are concentrated in the Upper Valley in the hilly borders and barranca profiles above Otumba. In the pre-Hispanic, Colonial and Republican Periods deposits of volcanic material varying in size from fine gravel to rock outcrops have provided material for building construction and are especially abundant in the Middle Valley.

Ecological Divisions of the Valley. On the basis of the discussed geographical variations, the Teotihuacan Valley may be divided into the following ecological zones. As shall be demonstrated at a later point, these divisions played highly distinctive and varied roles in the history of occupation in the Valley.

1. Upper Valley - from San Pedro Ixquitlan to Xaltepec. The town of Otumba is located in the center of this division of the Valley within a small oval depression of deep soil. The soil ranges from 50-200 cm. in depth and the depression has a diameter of two to three kilometers.

Surrounding this core of deeper soil to the north, east and south is a band of gently sloping piedmont with thin soil, approximately 10 km. in width. To the north and northeast this piedmont is delineated by a few low hills, to the south and southeast by foothills of the northern terminus of the Sierra Nevada or by the Patlachique Ranges. The Upper Valley is the most unfavorable area for agricultural exploitation today. Barranca runoff is abundant only to the south and even there the hills are so far from the deep soil core and so deeply eroded that very little floodwater irrigation is possible. Nearly all cultivation is "temporal" (i.e., based on rains) and it is primarily a zone of maguey cultivation. There are small, deep soil flood plains along the barrancas to the south that alleviate the problem somewhat, but the total acreage is small. A special local resource other than agriculture in this area for the pre-Hispanic Period would be obsidian.

2. Middle Valley - the section of the Valley between San Juan Teotihuacan and San Pablo Izquitlan. The topographic and hydrographic characteristics of this section of the Valley are exceedingly complex with numerous barrancas, each with small flood plains separated by low ridges and hills. The largest of these flood plains extends from San Juan Teotihuacan to San Pablo Izquitlan in the center of the Valley where soils vary from one to three meters in depth. Soil depth on the piedmont of Cerros Gordo and Malinalco and the Patlachique Range or on low ridges and hills is much less.

The key factor affecting agriculture in this area is the combination of extensive, deep soil plains within a short distance of adjacent hills, and numerous barrancas with shallow enough beds to serve as sources of water for floodwater irrigation. Special resources located in the area are good pottery clay and abundant volcanic debris for building materials.

3. Lower Valley - the section from San Juan Teotihuacan to Cuanalan-- including the prize agricultural land of the Valley. In the center is a great continuous alluvial plain varying from four to five kilometers in width, with a soil cover varying from three to seven meters in depth, a total area of approximately 3000 hectares. The San Juan springs are located just above the plain, providing a permanent source of water for irrigation.

Between Cuanalan and Tepexpan the alluvial plain constricts to a width of only 1500 m. and then fans out into the lake shore plain or Delta which in turn merges into the large Texcoco plain to the south.

Adjacent and parallel to the alluvial plain on each side is a narrow, gently sloping piedmont varying in width from 500-1000 m. on the east side to a band twice as wide on the west. In these two strips soil depth is extremely variable but generally has a modal depth of 20-60 cm. with much exposed tepetate. Soils are deeper where barrancas and their small flood plains traverse the piedmont. The steep, nearly denuded slopes of the Patlachique Range border the piedmont on the east side of the Valley, whereas the gentler slopes of Cerro Chiconauhtla and the Maravillas cluster of small hills to the west and north are terraced nearly to their summits.

4. Delta - a fan-shaped plain along the lake shore. Ecologically the area differs from the Lower Valley in that it is further from the springs and the supply of water (especially in drier years) for irrigation is more limited. It is also further from the hilly flanks thus reducing available runoff for floodwater irrigation. Finally, the presence of the lake offered

to a peasant population a variety of resources not found elsewhere in the Valley (salt, fish, more extensive clay deposits).

5. Patlachique Range - defined as a distinct ecological division for a number of reasons. Rainfall is undoubtedly higher than in the adjacent valley floor, slopes are steeper, and soil cover much less than most of the Valley. It is also the largest continuous mass of high ground and therefore relatively frost-free. Along with steep slopes, however, small intermontane plateaus, valleys and gently sloping surfaces have greater agricultural potential in terms of present-day erosion patterns.

Before intensive cultivation, there was undoubtedly a fairly deep soil cover, even on the steeper slopes. At one time we suspect that the area had considerable vegetation and that many of the deep barrancas were probably small permanent streams. These characteristics plus the higher rainfall and relative freedom from frosts would have given the area unique advantages for primitive agriculture within the Teotihuacan Valley. Today, because of extensive erosion, it is primarily used for pasture.

6. North Tributary Valleys - as has been noted, the hills that border the Teotihuacan Valley to the north are separated by wide passes. A network of barrancas draining into the San Juan River, in the Middle and Lower Valley, originates north of the hills and enters the Valley by way of these passes. The area is characterized by small flood plains bordering the barrancas and badly eroded, gentle slopes. In part its northern edge is defined by a cluster of small hills where erosion is less severe.

7. Cerro Gordo-North Slope - the north slope of Cerro Gordo, strictly speaking, is not part of the Teotihuacan Valley since the drainage flows northwest directly to Lake Texcoco. It was included in the survey because of the presence of an extraordinarily heavy Teotihuacan occupation (Tzacualli through Xolalpan). It is an area of long descending ridges separated by barrancas with abundant runoff. Today it is elaborately terraced into one of the most complex terrace systems in the survey area. The addition of this area plus that part of the North Tributary Valleys that does not drain into the Teotihuacan Valley increases the size of the project survey area to an approximate total of 600 km.² (505 included in the Teotihuacan hydrographic basin).

Geographical History. The descriptions of the natural environment of the Basin of Mexico provided by the relaciones of the sixteenth century demonstrate that there were no major differences between the environment then and the twentieth century, other than those created by man himself. The lakes have all but disappeared as the result of artificial drainage projects and erosion has destroyed much of the soil on slopes. In the previous discussion we pointed out briefly the evidence for a severe cycle of erosion following the Spanish Conquest and in the section on Aztec settlement patterns this evidence will be elaborated. Erosion has resulted in a widening and deepening of barrancas but the basic hydrographic system has changed very little since the sixteenth century. Streams that are seasonal now are described as seasonal in the relaciones. The relaciones also emphasize the scarcity of water and many villages relied on jagueys for most of their water supply. Aztec history is replete with references to droughts and frosts so that the two major problems faced by modern cultivators were problems then. In summary the Aztecs of the fifteenth and sixteenth centuries faced the same problems of adaptation to environment as do modern mestizo peasants and as shall be demonstrated in a later section the responses were similar.

Since a major objective of the project was to collect data on the history of agriculture and to correlate the development of agriculture with the growth of cities and states, a knowledge of the pre-Aztec geographical history of the Teotihuacan Valley is crucial. Many of our conclusions about pre-Aztec agriculture are based on indirect archaeological evidence and inferential reasoning derived from a comparison with Aztec and post-Conquest patterns. The use of such evidence assumes that the geographic characteristics of the Valley have not changed in any major way over the past 4000 years.

The most important single factor affecting settlement in the area is water. In the Teotihuacan Valley water is obtained from two sources, precipitation and subterranean; the latter ultimately derives from the former. Changes in rainfall and variations in flow of water from the springs would be critical factors effecting land use and agricultural techniques.

In a recent publication Lorenzo (1956) has summarized the evidence for climatic change in the Basin of Mexico. In this report he cites two lines of evidence, fluctuations in lake levels and pollen profiles. He concludes that there were some changes in lake levels between the beginning of the Formative Period and 1519. We have adapted his graph of lake levels in figure 16. The graph is based on the following data:

1. Evidence of periodic flooding at Zacatenco, El Arbolillo and Ticoman from Vaillant's excavations indicating higher (than Aztec) lake levels during the Early and Middle Formative.

2. Evidence at Tlapacoyan of a drop in lake level between Middle and Late Formative times.

3. The terminal Formative site at Chimalhuacan is located on the 2237 m. contour, five meters below the Aztec shoreline. The site in question is definitely a village site, not a set of chinampas. It consists of scores of rock mounds arranged in a linear strip. The linear pattern is typical of Aztec settlement and in all known cases relates to topographical features, in this case undoubtedly a lake shore.

4. Aveleyra excavated a tlatal near the Tepexpan man site in the Teotihuacan Valley (our TC 3 site). His excavation revealed a predominantly Teotihuacan Period occupation. Since the tlatal is at the 2242 m. contour, Lorenzo argues that the Early Classic lake was as large as the Aztec. We agree, but in his report he does not demonstrate that the site had any necessary relationship with a lake shore. Our examination of the site plus a new excavation by Litvak King (1964) suggests the strong probability that it is a salt-making site. (See discussion under Teotihuacan settlement patterns to follow). Such sites always occur in the immediate vicinity of the lake shore.

5. Evidence for the postulated lowering of lake level in the Toltec Period is not presented.

The Teotihuacan Valley Project data, insofar as it can be related to the problem supports Lorenzo's reconstruction. Several Aztec salt-making sites were located, all on the same contour and in the vicinity of the Aztec beach. Two of these sites (not including TC 3) had traces of Teotihuacan and Mazapan occupation. The most convincing support of Lorenzo's reconstruction, however, comes from a site near Venta de Carpio on the old Aztec shoreline (TF 73). Two trenches were excavated and the site was surface sampled. Three major phases of occupation are represented, Chiconautla, Tlamimilolpa and Aztec. There is a light Cuanalan occupation, no Terminal Formative and scanty Mazapan.

The phase of heaviest use of the site includes occupational debris in situ, in other words it was a living site during those phases. No evidence of salt-making was found which means that one cannot definitely assume that the occupation phases relate to lake levels. The close correlation of phases of maximum occupation with Lorenzo's phases of high lake level, and the lack of substantial occupation during lower and higher levels, however, is very suggestive of such a relationship.

In conclusion, it seems probable that minor fluctuations in lake level have occurred between the beginning of the Formative and 1519. The major problem is whether the changes in lake level were the products of fluctuations in precipitation or some other process. One factor that might affect lake levels is erosion of hillsides followed by sedimentation in the lake bed. Lorenzo seems to suggest this as the factor. He argues that slash and burn agriculture was characteristic of both the Formative and Classic Periods and that intensive agriculture began in post-Classic times. This he feels resulted in severe erosion.

It is difficult, however, to fit this explanation with the cycling of lake levels indicated in his chart. Furthermore, as we shall attempt to demonstrate in the section on pre-Hispanic agriculture, there is evidence of intensive agriculture for the Classic Period. We feel that the fluctuations are in fact the product of minor changes in precipitation.

The second line of evidence for climatic history is from palynology or fossil pollen analysis. Sears in 1951 published the results of his pollen studies from cores taken from the old lake bed. In this report he suggested that there were changes in rainfall during the period in question and attempted to correlate them with archaeological periods. He argues that the Formative Period was characterized by higher lake levels and higher precipitation than in 1519, that the Classic was a period of lower lake levels and drier climate, and that in post-Classic times there was a return to a higher lake level and precipitation (but not high as in the Formative Period). This reconstruction was based on a percentile comparison of tree versus herbaceous plant pollen. This reconstruction does not agree with the evidence previously presented and was severely criticized by Lorenzo. Lorenzo argued that the decline of tree pollen was simply the product of human activities in the Basin and related to population growth. We agree that much of the decline of forest pollen was indeed the product of agricultural activity but again how does this explain the cycling of lake levels in the graph?

As part of the Teotihuacan Valley Project activities, Kovar took several pollen cores from localities in the Teotihuacan Valley. The samples are still being processed. One of the most significant cores was taken from El Tular, a small spring near Atlátongo. The results are presented in the graph in figure 16.

Summarizing briefly, the principal characteristics of the graph are:

1. One of the dominant vegetation types was apparently cyperaceae, water loving plants commonly called sedges. They make up approximately 30 percent of the sample in the lower levels, and were probably the dominant plants all over the spring area before it was drained for irrigation. We relate its sharp decline in frequency in the upper levels to artificial drainage in connection with irrigation. This point will be elaborated on in the section on pre-Hispanic agriculture.

2. Between the 1.5 m. level and the uppermost sample there was a very rapid decline of tree pollen coincident with an increase of compositae and

chenopodium, plants that thrive as weeds on agricultural land. This pollen is undoubtedly the product of deforestation by man as Lorenzo suggests.

3. The behavior of pinus (Pine) and quercus (Oak), however, is strongly suggestive of minor climatic changes. Even eliminating local vegetation like the cyperaceae from the graph, there are still two definite peaks in the frequency of these types.

4. A major problem is the correlation of the Tular graph with the archaeological sequence. A core taken from near the excavation site at Cuanalan provides the key to this correlation. The pattern of events at Cuanalan is in very close agreement with that from Tular excepting, of course, a much lower percentage of cyperaceae since there were no springs around Cuanalan. The pollen levels at Cuanalan can be related to the Cuanalan Phase (Late Ticoman) occupation there and demonstrate that the drainage at El Tular took place at the close of the Late Formative Phase. This indicates that the two peaks at Tular of tree pollen coincide with the Early Formative and Early Classic archaeological periods.

5. The decline of pine following the first peak seems to occur somewhat earlier than the decline of oak. In terms of the reconstruction of agricultural history of the Valley presented later, this makes sense. We have evidence of a focus of occupation in the hilly flanks during the Formative. Pine tends to replace oak upslope in the Basin of Mexico as a whole. The earlier decline of pine therefore is probably the product of this selective deforestation of slopes for agriculture.

McQuown (1961) reports a parallel situation that occurred in highland Chiapas in pre-Hispanic times. Slash and burn agriculture in that area also selected against pine and for oak so that the former suffered most from agricultural activities. In our graph the evolution of intensive agriculture in the final phases resulted ultimately in a complete destruction of both the pine and oak forests.

In summary the pollen graph seems to correlate well with Lorenzo's lake level fluctuations and the variations are probably the product of minor climatic cycling and human activities. Compared to climatic cycling during the Pleistocene, the variations seem very minor indeed, but we must remember that the Valley of Teotihuacan today has a precipitation pattern that is on the borderline between subhumid and semi-arid. An increase of a hundred millimeters of annual rainfall makes the difference between crop failure or success.

In summary we are going to suggest a correlation of climatic, hydrographic and cultural events for the Valley between 1500 BC and 1519 AD as follows:

1. During the Early and Middle Formative Periods, conditions were favorable for extensive agriculture. Precipitation and lake level were both maximal in quantity and height respectively.

2. In Late Formative, and especially Terminal Formative times, there was a reduction of rainfall and lowering of lake level. This was a crucial period for the farming population and in Terminal Formative times the stimulus for new ecological adaptation was considerable.

3. The Teotihuacan Period generally was as favorable for agriculture as the Aztec especially if intensive agricultural practices were in vogue.

4. The climate and lake level returned to Terminal Formative conditions in Early Toltec times. The Late Toltec Phase probably witnessed a gradual return to more favorable conditions.

5. The Aztec Period was one of return to favorable conditions.*

*It should be noted here that the previous reconstruction is primarily based on Sanders' interpretation of the pollen graph. Kovar is still not convinced that climatic changes are necessarily the explanation and plans to return to Mexico in 1965 to collect more samples.

PART IV

MODERN OCCUPATION OF THE VALLEY

Modern Agriculture Practices and Land Use.

Domestic Animals and Plants. The basic subsistence crop in the Valley today is maize, consumed primarily as tortillas. Maguey and beans are significant secondary food plants, the former as the source of a fermented beverage called pulque. Minor food plants whose products are consumed locally are squash, nopal (the fruit is eaten fresh and young leaves are cooked as a green vegetable) and capulin (a native cherry). Along with locally consumed foods, wheat and barley are planted primarily for export. In the area near the springs a variety of vegetables are produced for the Mexico City and San Juan markets. Several important aboriginal food plants consumed in the diet, such as tomatoes, avocados and chile peppers, are not grown locally.

Most families have chickens and/or turkeys and consume and sell their products; a few have pigs, mostly for sale; and many have sheep and/or goats. In the Lower Valley, where the springs provide water for all year pasture, or in the Middle Valley, where larger landowners have artesian wells, dairy cattle are raised. My impression is that most animal produce is sold rather than consumed locally and that beans are the primary source of proteins.

Maize, being the staple food, is generally grown everywhere, even in areas where soil depth and moisture are inadequate. There is a tendency to extend maize cultivation to the limits of the capacity of the area in years when the rains begin early. Several varieties of maize are known, including a fast-maturing, low-producing "tres meseño", adapted for drier areas. Most maize, however, requires abundant moisture and relatively deep soil. Consequently, the heaviest production is in the alluvial plains of the Delta, Lower and Middle Valleys. Production is also high on gently sloping terrain with good terracing. Wheat requires basically the same conditions as maize and is therefore grown primarily in the same areas but the amount of sown land is considerably less. In the Lower Valley it is planted as an irrigated winter crop following the summer crops. In the rest of the area it is planted during the summer rainy season. Beans and barley require less moisture and soil and are grown primarily in the Upper Valley or on hilly terrain. In a general sense barley tends to replace maize up-valley and upslope. Beans, barley, squash, and even wheat may be interplanted with maize in exceptionally fertile soils.

Maguey is planted in a variety of situations, e.g., houselot orchards or large fields where soils are thin. It is primarily planted, however, as a border around fields and terraces in the alluvial plain of the Upper and Middle Valley, on gently sloping hillside or in closely spaced rows parallel to the slope in areas of medium to steep slope.

Nopal is almost always grown on houselot orchards, predominantly in the villages of the Middle and Upper Valleys and in the North Tributary Valleys.

Problems and Basic Techniques. The major problems faced by the cultivators in the Valley today may be summarized as follows:

1. The precipitation pattern is characterized by rainfall that is very variable in quantity and duration from year to year, with frequent droughts during the rainy season, and a tendency to be torrential and highly localized.

2. Winter frosts occur normally during four months of the year. They also occur sporadically during an additional three months, thus reducing the growing season in some years to five months for pre-Hispanic cultivates. Within the Valley, frosts are more severe at lower elevations.

3. The combination of early and/or late frosts and retarded rains is a frequent occurrence.

4. The combination of scanty vegetation, loamy soils, torrential rains and generally sloping terrain make gully and sheet erosion a serious problem.

5. As a result of the above factors, a high percentage of the Valley today must be classified as marginal land. Deep soil plains probably do not account for more than 100 km.² of the 505 km.² of the drainage basin.

The Valley today is intensively exploited. Only in the Delta and Lower Valley, where communities are closest to Mexico City, are agricultural lands frequently left unused (a high percentage of the population in the former area work in factories in the city). Slopes too steep or too denuded of soil to be cultivated are used as pasture, and most fields are planted annually.

Today, the plow is generally used, even on terraces, and hoe tillage is rare. Basic techniques applied everywhere are use of animal fertilizers, weeding by cultivation with the plow, crop rotation (although infrequently applied in small holdings), and interplanting.

There are, however, considerable variations in techniques of land use and cultivation dependent on crops to be grown, depth of soil, availability of water and angle of slope. On the basis of these criteria the following agricultural systems may be defined.

Floodwater Irrigation. This system is most highly developed in the Middle Valley alluvial plain but is practiced all over the Valley, where the combination of shallow barrancas and deep soil plains or gently sloping terrain occurs. In the Lower Valley it is a desirable auxiliary method to permanent irrigation. For effective application of this system a minimal soil depth of 50-60 cm. is required and at least one meter is desirable. The most careful preparation of the land in the entire Valley is applied with this system, because of the combination of fertile soils and irregular water resources.

Dams of loose stone, earth, or masonry are built across barrancas at selected spots where the latter are relatively shallow. Following a torrential shower, a considerable flow of water runs in the barranca. This is blocked by the dam and a temporary pond forms behind it. In some dams the water is diverted immediately into one or two primary canals. Secondary canals feed the water to the individual fields. Small temporary earth dams are built across the primary canals to divert water into the secondary canals in succession, and across the secondary canal to divert water into the individual fields.

The individual dams and primary canals are generally small and do not provide water for more than 50-100 hectares of land each. A major barranca may have a chain of five or six such dam-canal complexes. Each dam has

portable wooden floodgates which are closed and opened in succession as the water moves downstream. A single dam and its canal may serve lands belonging to residents of one or two villages and/or a hacienda and is constructed and maintained by cooperative labor. Such cooperative groups, therefore, crosscut village membership. The variability and uncertainty of water flow made formal regulation of water distribution impractical. It is probably unnecessary anyway since there is normally either no water in a barranca or more than is needed. Lands further upstream, of course, have an advantage in that water from even brief showers may be utilized. Units located well downstream are those most affected by droughts. Most haciendas in the nineteenth century were located near the headwaters to insure first rights, either for irrigation or to supply jagueys for live-stock. Quarrels and even fights over water rights, although infrequent, have occurred.

The success of the system is based on the localized nature of rainfall in the Valley and the fact that slope areas receive more rain than the plains. Therefore, by an efficient use of the system the effectivity of the scanty rainfall is considerably improved. The system collects water from areas of marginal agricultural use and diverts it to areas of high productive capacity.

Dams and primary canal construction and maintenance are cooperative tasks frequently involving people from different social communities. One of the major problems is the removal of silt. Secondary canals are maintained by small groups of farmers who use them.

Since water resources are uncertain, special techniques of working the soil have been developed to conserve the humidity. The most intensive preparation of the soil is for maize. Fields may be irrigated several times during the rainy season, but irrigation during May and the autumn months is especially valuable for the success of the system; the May irrigation to give the present year's crop a start, the autumn irrigation to store water for the following year. During the growing season, the soil is cultivated several times to keep the texture loose, facilitating downward drainage. In November, after the rainy season has ended and autumn irrigations completed, a thorough plowing called "barbecho" is given. The purpose is to turn weeds over and facilitate the final drainage. After plowing, a "rastrillo" (heavy board) is pulled over the field to smooth down the plowed surface and seal off capillary spaces in the upper levels of the soil thus reducing evaporation of the stored water. In January, a second, shallower, more closely spaced plowing at right angles to the barbecho is applied, called the "cruzada". This is also followed by a "rastreo" or application of the rastrillo. Very conscientious farmers may even plow a third time diagonally.

The depth of the soil, presence of the relatively impervious tepetate below, use of earth banks, careful plowing and rastreo, floodwater irrigation, and loose crumbly soil texture all facilitate the storage of water in the lower soil levels. The upper soil level acts as a dry mulch protecting the humidity below and by spring has the appearance of talcum powder.

Prior to 1950, these techniques were combined with a special planting method called "a cajete" or "a todo costo". In March or April, possibly as late as May, depending on soil depth and frequency of irrigations the previous year, the land was given a "zurcada" or final plowing to loosen it for planting. Following this, small pits or cajetes were excavated with shovels

in the loose soils at 50-100 cm. intervals down to the level of the humid layer of soil. Seeds were then planted in the humid soil and the pit partially filled with dry surface soil to seal off capillary action. The shallow depressions that remained served as catch basins for rain or irrigation water. The technique is extremely effective but laborious. Even with metal tools it requires 80-160 man hours per hectare. Under reasonably good conditions crops may be planted as early as March or April and can withstand 60 days of droughts. If water is available for at least one good irrigation in May, crop loss is very rare, even with a retarded rainy season.

Since 1950, the cajete technique has been rapidly replaced by a new, faster method called "al tubo". After the zurcada, a special steel plow with a deeper excavating share is used in combination with a "tubo" as a planting drill. The tubo or tube is a cylinder manufactured from two maguey pencas lashed together and tied to the plow. The farmer drops the seed into the cylinder as he manipulates the plow. The plow theoretically slices down to the humid subsoil, the seed rolls down the tube to this level and the soil falls back over the seed. Most farmers feel that the cajete system is more dependable (since the humidity level varies and in dry years the plow probably does not reach it) but the al tubo method is more economical. Only 30 man hours of work are needed to plant one hectare.

Along with these humidity conservation practices, soil conservation is practiced as well. Much of the area where the system is applied is gently sloping so that some erosion control is necessary. Maguey is planted around most of the fields as a defense against erosion. Fields are rarely rested and most of them are in continuous cultivation. The technique of floodwater irrigation not only brings water to the field but fresh soil in solution as well. Animal fertilizers are sparingly used, applied every three to six years. Maize is the dominant crop with wheat or barley as secondary crops frequently rotated with it. Beans are commonly interplanted with maize and, in exceptionally fertile soils, barley and wheat are sown broadcast between the rows of maize.

The result is a highly productive, intensive system of agriculture. At San Pablo Izquitlan, one of the informants stated that in a 10 year period, in seven years a field yielded fair to good maize crops with production ranging from 900-1500 kg. (kilograms) per hectare, three years were considered poor with yields ranging from 600-750 kg. (during these years unirrigated lands were a total loss). The average yield over a 10 year period is probably around 1000 kg. per hectare. The same informant also stated that the mentioned 10 year period (1945-54) was the poorest in the 30 years he had cultivated the land.

Specific data from other fields at San Pablo and San Martin tend to confirm these figures. The Secretario Ejidal of San Martin in 1953 estimated that if the floodwater system was managed with maximal efficiency, the alluvial plain of the Middle Valley (called locally "La Vega") should yield an average of 1200-1500 kg. per hectare. This figure then, would represent a theoretical maximal productivity in terms of present-day technology and climate.

Permanent Irrigation. As was previously stated, approximately 80 springs with a permanent water flow are located at San Juan Teotihuacan, in the two barrios of Puxtla and Maquixco. Gamio's field group (op. cit.) estimated an annual flow of 31,000,000 cubic meters of water. The measured

flow of water in December at that time (1922) was 1500 liters per second (at the end of the rainy season). They estimated a probably average flow of 1000. Today the output has dropped to an average of 588.6 liters per second. The decline is apparently due to perforation of artesian wells up-valley by large landowners.

As Gamio stresses, the system is primarily one of drainage and is technologically simple. Water is collected from the springs by means of small earth ditches and diverted into a single canal immediately above Maquixco. Below Maquixco, at a place called "La Taza", the canal divides into two main branches, the canal of San Antonio with an average flow of 200.26 liters per second, and San José Canal with 287.32. There are also two smaller canals that derive their water from local springs at Maquixco, the canal of Texcalac (50.36 liters per second), and Cadena (12.66 liters per second). Near Atlatongo are some very small springs at a place called "El Tular" that provide an additional two liters.

Before the agrarian reforms, the water was controlled by the four big haciendas of Cadena, San José, San Antonio and Santa Catarina. After the reform, it fell under the jurisdiction of the Mexican government and a set of water regulations was designed to administer the system. Fifteen villages or barrios and five haciendas or ranchos cultivate lands supplied by the system with a total area under irrigation of 3652 hectares of which 3373 are assigned to the villages and barrios. Two barrios of San Juan Teotihuacán also use the water directly from the springs before it reaches the taza. The 15 villages and the haciendas and ranchos are organized into a Junta called the "Junta de Los Pueblos de los Aguas de los Manantiales de San Juan" with its center at Calvario Acolman. The primary function of the Junta is to implement the water regulation laws established by the federal government. It does not have the power to change them.

The holdings of each village are divided into two divisions, "pequeña propiedad" and "ejido". These broad divisions may also be broken up into water distribution units depending on from which canal the water is supplied. The Junta meets monthly and consists of one elected representative from each hacienda or rancho and two from each village and barrio (one for the ejido, the other for pequeña propiedad) who in turn elect a president. Water is assigned on a day, hour, minute schedule from each canal for each of the large units, such as the ejido or pequeña propiedad of a particular village. The large units in turn have an internal regulation system by land holdings. It requires approximately four to six hours to irrigate one hectare of land from the San Antonio Canal.

As we have emphasized previously, most irrigation in the Teotihuacán Valley involves a single pre-planting flooding of the field to give the crop a headstart on the growing season. Most of the humidity for plant growth is derived from the summer rains. The importance of this pre-planting irrigation is clearly demonstrated by the concern of the individual farmer over his share, especially the timing and the almost continuous disputes between villages over water theft. Since most of the moisture used by the crop is based on rainfall, however, the relatively small amount of water flowing from the springs goes a long way and involves a far greater number of people and communities than would be the case in a desert valley.

Each farmer in the Valley receives water normally once or twice a year. Using the figure of four to six hours of water needed per hectare from one of the main canals, theoretically the system could be used to irrigate 4350

to 6600 hectares of land. Actually the situation is not quite as favorable as far as maize or other pre-Hispanic crops are concerned. Maize must be planted no earlier than March 1 or later than June 15 for maximum production or over a period of three and one-half months. If pre-planting irrigations for maize were confined to that period this would mean only 1080-1620 hectares of land could be irrigated for maize per year. Actually lands can be irrigated as early as December 1 or as late as June 30 and still be planted in maize. In the case of the former, the lands are flooded in December, January, or February but planting is delayed until March. The soil is thoroughly worked and prepared to store the water in the manner noted for the Middle Valley. Each farmer receives his share at a different time each year to avoid unfair assignments since the ideal time for planting is May and for irrigation is March. The total amount of irrigable land for maize then ascends to 2544-2716 hectares. The amount of land classified by the Junta as "tierra de riego" is close to these figures. The situation is further alleviated by the fact that some pre-Hispanic crops, such as beans, mature faster than maize and can be irrigated as late as June or July. It is very probable that in pre-Hispanic times lands that were irrigated as early as December or January or as late as June were planted with crops that were less demanding than maize. If Gamio's data is to be trusted, all of these figures would need revising upward 50 percent with the former greater flow of water (1000 liters per second).

Today a number of farmers raise small herds of dairy cattle and plant their fields in alfalfa or clover. Some European crops, such as wheat, are frost resistant and are therefore grown during the winter season so that there is a high percentage of land that is double-cropped. The usual pattern is to plant maize in the spring, followed by wheat in the fall if the farmer has two or three water allotments in a given year, followed by a single summer barley crop the second year without irrigation. Another cycle would be to plant barley without irrigation in the summer of a year followed by an irrigated wheat crop in the winter and then an irrigated maize crop in the summer of the second year. The exact order is a highly flexible one based on the number and timing of irrigations in a given year. If maize and wheat are to be grown in a single year, at least three rations of water are required since wheat grown during the dry season would require two irrigations (pre-planting and again during the growing season).

One of the villages, Atlatongo (figure 2) has special rights to a continuous flow of water (38.0 liters per second) from the San Jose Canal. This claim was apparently based on a resurrected colonial document and is a constant source of dispute.

The alluvial plain below the springs is traversed by a vast network of secondary and tertiary canals, each of which must be cleaned annually. The main canals and springs are cleaned by all of the villages under the direction of the Junta in September and October. Each village sends its own allotment of men and the total number of workers may reach as high as 800. Secondary and tertiary canals are cleaned by smaller work gangs involving farmers who use the particular canal. On this level the work is as informally organized as in the Middle Valley.

Characteristic then of the system is a pyramid of cooperative work gangs that acts as a powerful integrative factor on the infra-community, community, and supra-community levels. The system also, however, has disruptive qualities that produce community rivalry and conflict. Water theft

is the primary source of conflict and verbal disputes are frequent, at times evolving into physical conflict, as Millon and his co-workers have demonstrated (Millon, Hall, & Diaz, 1962). This combination of integrative and disruptive effects of the administration of the system has theoretical significance as we shall demonstrate at a later point.

Techniques of preparation of the soil are similar to those used with floodwater irrigation, including multiple plowing, use of earth banks, crop rotation, fertilizers, cajete or al tubo planting, and interplanting. An additional technique for fertilizing the land was once used by the haciendas. This involved annual flooding of the land with water from the barranca system to introduce fresh soil since the spring water was relatively free of sediments. It was called "enlame". (See Gamio, op. cit.).

Yields of maize vary considerably depending on the date of planting and the quality of the rainy season. At Atlatongo, the most favorably located community, production ranged from 900-2700 kg. per hectare with a probable mode of 1500-2250 over a 10 year span. Over a two-year period, a one hectare field in the irrigated plain near Atlatongo averages 1875 kg. of maize, 1400 kg. of wheat, and 1400 kg. of barley plus small quantities of interplanted beans and squash. At Acolman, at the mouth of the Lower Valley, average maize yields drop to 1350 kg. and wheat to 1200. These figures are undoubtedly more applicable to the irrigated plain as a whole.

If these figures are dependable and the 3600 hectares of land served by the system were all planted in maize every year, it could supply maize for a population of at least 18,000 people. Assuming Gamio's figures of water flow for the springs to be correct and applying them to the Conquest Period means that the spring system may well have supplied maize for some 30,000 people. All such figures are hypothetical and undoubtedly too high since not all land would be planted in maize in any single year.

Temporal Cultivation. Generally speaking, in the Mesoamerican Highlands the term "temporal" refers to agriculture in which the humidity for plant growth is derived primarily from rainfall. In the Teotihuacan Valley we are using the term to refer to a rather casual-extensive system of farming which is practiced over much of the piedmont areas and the alluvial plain of the Upper Valley. The system is common in areas of relatively thin soil (below 50 cm.) and gently sloping terrain and involves a minimal amount of labor and low productivity. All archaeological evidence suggests that it is a system of marginal agriculture developed in post-Hispanic times as the product of erosion of terrace systems.

A similar kind of extensive cultivation may have been practiced in the past during phases of relatively low population density, without the plow. It is also practiced today in the alluvial plain of the Middle Valley where floodwater systems have not been built recently or have fallen into disuse. It may be combined with incipient maguey terracing, but fields lack the relatively close spacing of the lines of maguey that are required for effective erosion control.

The majority of land cultivated with this technique is planted in barley and maize with beans as an important secondary crop. Maize cultivation is extremely precarious and its practice is a reflection on the significance of maize as a food plant and the deficiency of better lands. Complete crop loss is a frequent occurrence, especially with maize. Barley and beans are much more secure crops. It is difficult to establish the average productivity of such lands since this depends on the vagaries of rainfall, variations of soil depth, and the crop planted.

The following data is from San Francisco Mazapan and refers to flat terrain with a depth of 50-100 cm., lands which would normally be cultivated using the floodwater system, and would be considered relatively productive within the category of temporal. Between 1945-53, a poor period, a test field yielded the following crops: five barley crops with yields ranging from 300-1200 kg. or an average of 600 kg., one-year maize yielded 900 kg. per hectare. Over a 25 year period a yield in excess of 600 kg. for barley or of 900 kg. for maize occurred only eight times.

At Santa Maria Coatlan, a village with lands similar to Mazapan, the Secretario Ejidal in 1955 stated that 1937, 1938, and 1939 were all exceptionally good years in which yields of maize over the ejido ranged from 1500-1800 kg. Between 1940-1953, a generally poor period, the range on fields in which a crop did mature was from 450-900 kg.; but in many years numerous crops were a total loss. Over that period the average yield was probably not over 500 kg. The year 1954 was good with yields ranging from 1000-1500 kg. The data indicates a fertile soil but variable productivity because of the uncertainties of rainfall. In areas with less than 50 cm. of soil the picture would be much more dismal.

Techniques of cultivation in this system include the fall barbecho, spring zurcada, some crop rotation and very infrequent fertilization. Many fields do not have earthbank retaining walls and are not adequately protected from erosion. Since many of the lands cultivated using this system are of low productivity, most farmers do not use soil or humidity conservation practices, the result of which is further deterioration. Planting is done by a system called "tapa pie" in which one man plows while the other walks behind dropping the seed and covering it with his feet. One special technique, used in years when the rains are delayed, is to plant the special, rapidly maturing, black maize called "Tresmesño". It has low productivity but is well-adapted to withstanding drought and matures rapidly, thus escaping the autumn frosts even when plantings are delayed until July 1.

Terrace Cultivation. The primary difference between terrace agriculture and temporal cultivation lies in the degree of application of certain soil conservation practices known to the present-day peasant population. The degree of application of such techniques is linked with a variety of factors, mostly demographic in nature. The sixteenth and seventeenth century decline and consequent abandonment of fields, recent population growth and urban migration, and loss and recovery of lands to the haciendas are important factors. The borderline between terrace cultivation on one hand, and temporal cultivation on the other is a vague one. The term "terrace agriculture" is applied here to situations when the terrain is sloping; where erosion is being checked by stone, earth or maguey structures to the degree that soil depth in slopes exceeds 20-30 cm.; and where downslope drainage is controlled. As the archaeological data will demonstrate there is reason to believe that most of the gentle-medium sloping terrain in the Teotihuacan Valley that is today cultivated using the temporal system was covered by complex and carefully constructed terrace systems in 1519.

Following the Conquest, several processes occurred that resulted in a deterioration of many terrace systems and their conversion to marginal land. Slope areas (at least since the Tzaqualli Period) in the Teotihuacan Valley should generally be considered as marginal lands that may be

converted to productive lands by a heavy investment of labor, but nevertheless remain peripheral in value to the alluvial plain in village economy.

Between 1519-1720 there was a disastrous demographic decline all over Mesoamerica, the product of the introduction of European diseases. In the Teotihuacan Valley the population declined at least to one-third of its former number by 1580, to one-fourth by 1600.

Accompanying this population decline, a second process called "Congregacion" occurred in which the Spaniards, to facilitate conversion and taxation, moved small communities or dispersed populations into former towns, large villages, or new population centers. In the Teotihuacan Valley this occurred in the early decades of the seventeenth century.

The displacement of the population of numerous small communities from marginal areas, the fact that terrace agriculture generally was an economically marginal system, and the general decline of population all permitted a general reduction of agricultural land in production and resulted in the abandonment of many terrace systems, thus exposing them to erosion. Furthermore, the rapidly expanding use of such domestic animals as sheep and goats and conversion of distant agricultural land to pasture stepped up the erosional process. Terrace systems in this area require constant maintenance and care. Once abandoned, the process of erosion is rapid and there are no large areas of sloping terrain in the Valley that have completely escaped the process. It is probable that 40-60 percent of the gentle- to medium-sloping terrain in the Upper and Middle Valley has a soil cover of less than 20 cm. of soil today.

During the nineteenth and twentieth centuries, most of the land of the Valley was gradually incorporated into large haciendas--practicing basically an extensive rather than intensive system of farming. However, the hacenderos did partially canalize the barrancas and develop elaborate maguey terrace systems that have partially restored the area.

As the seventeenth and eighteenth century erosion progressed, only terrace systems located near villages managed to survive. Well-maintained systems occur today at Belen, Tolman, Santiago Tepetitlan, and Oxtotipac, within the Valley, and also on the northern slope of Cerro Gordo. Generally terrace systems in relatively isolated parts of the Valley tend to be better preserved and more thoroughly utilized than those in the Lower Valley. Such communities are more dependent on agriculture than those lower down where the urban labor market absorbs a growing proportion of the peasant population into non-agricultural activities. Ambitious attempts at land reclamation on slopes are most commonly found in the more isolated areas. Apparently when recent population growth produces pressures, the more isolated communities respond by building terrace systems; where facilities for commuting to the city are available, the population responds by working part or full-time in the city.

The most impressive system of terracing in the survey area is located near the modern villages of Maquixco Alto and Colhuacan on the north slope of Cerro Gordo. Topographically, the area appears as a series of long, gently sloping ridges extending outward radially from the main mass of the hill, each separated from the next by barrancas.

Because of the height of Cerro Gordo and the closeness of the agricultural area to the upper flank of the hill, considerable runoff is available for floodwater irrigation. The ridges are covered with terraces and the lower and middle segments of the barrancas are frequently partially absorbed

by check dams. The total area today presents a very complex picture of deep gullies; sedimented barrancas; large patches of bare tepetate; sections of new lands reclaimed from tepetate; old, disintegrating, terrace systems; and well-maintained, productive terraces.

Partly because of the wealth of archaeological remains in this area, and partly because of the highly developed terrace system, it was decided to survey intensively a test area of eight square kilometers near Maquixco Alto. Data were collected on both modern land use and ancient settlement patterns. On the basis of this survey the present-day land use and land characteristics may be summarized in the following chart.

	Percentage of survey strip
1. Steep unclutivated slope (isolated hills) - pasture, scattered maguey cultivation	10%
2. Tepetatal - gentle to medium slope - unused - some pasture	20
3. Marginal agricultural land - gentle to medium slope, much erosion, thin soil; new terraces, old disintegrating terraces or untterraced, some in agricultural use, much of it used for pasture	35
4. Good agricultural land - well-kept terraces - medium soil depth (30-100 cm.) deep soil (over 100 cm.)	25
	10
	<hr/> 100%

Terraces in all stages of growth, construction, and deterioration may be seen. There is considerable variation in soil depth, slope angle, crop use, effectivity of erosion control and water conservation. Where terraces are carefully maintained, there is practically no free-flowing drainage. The terraces are arranged in vertical strips of parallel lines running down-slope with very shallow, main canals running between the strips. The upper corner of each terrace is equipped with a low bank of earth that projects into the main canal that automatically diverts part of the flow into the terrace, a self-flooding system. All water derives from flash floods that follow showers.

The most effective terracing occurs just east, north, and south of the village of Maquixco Alto. In these areas soil frequently exceeds one meter in depth; the lower edge of the terrace has a high earth bank, frequently planted in fruit trees or maguey; the surface of each terrace is completely level; and the sides have earth banks to prevent lateral erosion or loss of water. In the most developed terraces the water is not directly diverted into the field but into a ditch located along the upper edge of the field and situated just below and parallel to the lower bank of the terrace just above it. The ditch breaks the force of the water as it enters the fields, holds it and prevents gullying of the field. Terraces generally vary from five to 20 m. in width, but this is a highly variable feature depending primarily on slope angle.

Most of the deep soil terraces are planted in maize, frequently interplanted with wheat, habas (a Spanish bean) or squash. Such lands are as productive as the floodwater irrigated plain of the Middle Valley. This part of the survey area had a lush, almost jungle-like appearance in 1963 (with the maize crop two to four meters high, fruit trees and maguey along the terrace banks, closely-packed, interplanted secondary crops, and natural

vegetation) in startling contrast to the vegetation-bare tepetate waste-lands only a few hundred meters distant. There is little doubt that careful terracing is an extraordinarily effective solution to the problem of hillside agriculture in the Valley. The controlled drainage, use of earth banks, and deep soil with high water storage capacity all act to reduce crop loss to a minimum.

Much of the land in the survey test zone today has a soil cover of 0-50 cm. with large areas of exposed tepetate (approximately 55 percent). Traces of old terraces are found all over this area. Scattered throughout this part of the zone are numerous, recent reclamation projects, all small in size and constructed by groups of only familial size, many occurring even in areas of bare tepetate. Techniques of recovery involve the following steps:

1. Excavation of a trench 30-100 cm. deep into the tepetate, parallel to the slope, the length of the future terrace.
2. Tepetate extracted from the ditch is then pulverized to manufacture soil.
3. A series of shallow pits is excavated at one to two meter intervals, about 30-50 cm. deep in a row just above the trench and paralleling it.
4. Young maguey plants are planted in each pit, which is then partially filled in with crushed tepetate.
5. Blocks of tepetate, adobe, chunks of rock combined with earth are used to build a low wall between the maguey plants to form a terrace facing. Crushed tepetate may also be heaped over this to form a continuous bank.
6. A lateral bank is constructed on each side of the terrace using the same method.
7. In some cases the surface of the tepetate for a width of five to 10 m. behind the bank is worked over with a pick to manufacture a layer of soil.

Once completed, the banks trap free-flowing drainage as it moves down the slope. Such water contains fragments of tepetate and coarse soil particles which are gradually heaped up behind the banks to form a delta of new soil. After a few years, a layer of soil 10-20 cm. deep forms behind the bank for a width of two to five meters, depending on the quantity of soil particles available on the slope above and the steepness of the slope. At this time beans or barley are frequently planted. The texture of the soil in this early phase is usually quite loose, sandy, and very light in color. The maguey has meanwhile grown to the height of a meter or a meter-and-a-half and new terraces are being constructed above. After five to 10 years, the planting of barley and beans and growth of weeds adds organic matter to the soil, the soil depth has increased to 30-50 cm. and the "tresmeseño" maize may be planted. After 10-20 years, highly productive terraces with deep, loamy, dark-colored soils have formed.

The technique described above is extraordinarily effective; it is doubtful that any land is completely unreclaimable using the system in the test zone.

The majority of the terraces today have soil depths varying from 20-100 cm. One can see such terraces in all stages of growth deterioration. Some are obviously new, others are abandoned and still disintegrating. Such disintegration takes place both laterally and vertically. In cases where the lateral banks have not been carefully maintained, the terrace gradually washes away from either side into an adjacent barranca, gully,

canal or down into a lower terrace. Breaches in the lower banks form easily. If a breach occurs in the lower bank of one terrace the flow of water erodes gullies in the terrace immediately below, first washing out the soil, then cutting deeply into the underlying tepetate, forming a miniature barranca. Once this process has advanced, the surface of the terrace presents an undulating appearance; water flow becomes uneven, much of it lost laterally; and the water flowing through the tiny barrancas begins to tear down the next bank below and the process is repeated down through the terrace system. A deteriorating terrace is therefore a menace to the entire system. Terraces in a relatively advanced state of decline are usually planted in barley, if used at all, and are frequently less productive than new terraces, even with their more fertile soils, because of the loss of water. Well-kept but still relatively new terraces (five to 10 years old) are usually planted in barley but may have several rows of maize at the front end, where soils are deeper, and barley at the upper strip.

Another, similar technique of land reclamation which, according to local informants, was initiated approximately 50 years ago, is that of constructing check dams in the barrancas. The idea is similar to terrace-building on tepetate slopes, except that accumulation of soil in a barranca bed is much faster than that on slopes. A low stone and earth wall is constructed across a barranca bed. In a single year enough soil accumulates behind the wall to permit barley planting. Each year the height of the wall is increased; the soil layer behind this wall increases in depth and fans back to form an increasingly more extensive delta. Finally a wall 30-40 feet high may result and the entire barranca may be filled in with soil for distances of 30-50 m. upstream behind the wall. The completed walls are impressive works, yet are the product of the labor of one farmer and a few assistants. Such check dams, if isolated, are very unstable. The erosive force of water flowing through a barranca is great and even well-built "presas", as they are called, can be torn apart and washed downstream in a few seasons. Stability can be maintained only if a series is built, one directly below the other, so that each terrace acts as a buttress for the one just below. Once this process is completed, erosion is no more serious a problem than in ordinary terracing.

There are several barrancas near Maquixco Alto and Colhuacan that have become completely silted in by this method and converted into lands as productive as any in the Lower Valley. Not only do the check dams permit the accumulation of deep soils, but such soils have higher humidity because of their location in depressed areas.

Terrace maintenance is an arduous and never-ending task. Erosion is a constant threat. Although no detailed study was made, there seems to be a very close relationship between the condition of terraces and the distance from house to land, population pressures and degree of dependence of the landowner on agriculture for subsistence.

The settlement pattern today includes a Low-Density Compact village, (see the community classification presented at a later point) roughly rectangular in shape, covering an area of 15 hectares with a population of approximately 400 people. Houselots are relatively large and usually planted in maguey or nopal, or used to keep domestic animals. A few families live isolated at distances up to one kilometer from the village. The best terraces are located near the village or near the houses of isolated families.

Apparently, it is difficult to maintain terrace systems when they are located more than 300-400 m. from the farmer's house.

Chinampa Cultivation. A system of cultivation very similar to that practiced in the southern part of the Basin of Mexico occurs in the area around the springs of San Juan Teotihuacan. This system, called chinampa cultivation, is probably the most intensive and productive kind of agriculture practiced in the New World in pre-Hispanic times. The main characteristic of the system as practiced in the south includes the construction of artificial islands within freshwater lakes. These islands are built of alternate layers of mud scooped from the lake bottom and vegetation collected from the surface. After the island has reached a height of a few inches above the lake surface, huejote trees are planted along the edge to retain the soil. The islands are usually in the form of long narrow rectangles which facilitate bucket irrigation and natural inward seepage of water from the lake. The soil is very rich in organic matter, porous, very dark in color, and land use is extraordinarily intensive; no chinampas are rested for more than three to four months a year. By the use of seedbeds a continuous succession of crops in all stages of growth (mostly vegetables for the Mexico City market) may be seen on a single chinampa. To maintain such a demanding cycle of cropping, fertilizers in the form of fresh mud and floating vegetation are periodically added to the chinampa. Crops are irrigated by scooping or splashing water onto the chinampa from canoes or by poles and buckets from the chinampa itself. All preparation of the soil is done by hand tools.

As the system was expanded, most of the surfaces of Lake Chalco-Xochimilco and Lake Mexico (a part of Lake Texcoco diked off from the main lake) were reduced from open lake into a network of chinampas and canals. An added advantage of this system is that produce could be loaded from chinampas into canoes and poled directly to the urban markets along the lake shores or to towns within the lakes, such as Aztec Tenochtitlan and colonial Mexico City. The growth of urban centers in and on the lakes in the Aztec Period was in part correlated with the evolution of this system of agriculture.

In the area around the springs at San Juan a system of agriculture very similar to the chinampas is practiced today. The total area involved is small, not over 100 hectares, but with more humid ground-water conditions in the past, it may have been several times as large.

In this area the water table is high, frequently no more than 30-100 cm. below the surface. Farmers simply excavate trenches down to water level around long rectangular plots of land which are similar in shape and size to true chinampas. The ditches have a constant supply of water due to seepage. Huejote trees are planted along the edge as in the Southern Basin.

Other parallels to chinampa agriculture are: a focus on truck gardening, intensive land use with seedbeds, scoop irrigation and hand techniques of working the soil. Here, however, animal fertilizers are used, presumably because the soil does not have as high an organic content. Today, with the gradual dropping of the water table, much of the land has been converted to maize cultivation. Apparently, there is still enough subsoil moisture to permit early planting of maize without irrigation (such lands are called "Tierra de Humedad" in Mexican agronomy), but not enough for maintaining standing water in the canals for irrigation. Farmers who still plant vegetables tap water from the spring system and apparently have rights to use

the water when they need it. Probably the highest maize yields in the Teotihuacan Valley are achieved here. Because of the humidity of the soil, crops may be planted early and grow faster so that the first harvest of the year occurs in these lands. Much of it is sold as "elotes" or boiled fresh corn at relatively high prices.

Nongrain Cultivation. Most of the previous discussion has primarily involved grain crops, especially maize. Vegetables, mostly European in origin, are grown in the chinampas, but the produce is primarily consumed by town and city dwellers. There is, however, a variety of minor, locally consumed crops that are planted in houselots, interplanted with grains, or planted along terraces or canals. These include apples, pears, peaches, apricots, habas, figs, and pomegranates, (all European); avocados, chayote, beans, squash, and capulin (all native plants). None of these have any great dietary or commercial significance.

However, two indigenous, xerophytic cultivates, nopal and maguey, are of considerable dietary and commercial value and are well-adapted to the natural environment.

Nopal is a fleshy, succulent cactus that produces a fruit called tuna which has a very high sugar content. The young leaves are also cooked as a green vegetable. There are a number of varieties, one producing fruit all year round, others during late summer and early fall. The commercial varieties are of the latter type and most of the produce is sold in the urban markets. Generally, nopal is a houselot orchard crop, but occasionally outlying fields are planted entirely in this crop. At times it is planted along terraces instead of maguey. Young plants are imbedded in excavated pits, frequently in areas of exposed tepetate, to provide extra moisture even though the nopal has great drought resistance qualities.

More important for subsistence is the maguey or agave. From it is made a significant staple food, a beverage called pulque. As a food pulque contains a variety of minerals and vitamins otherwise lacking in the diet and has the added advantage that it can be produced throughout the year. Maguey has an enormous advantage over all other crops in that it requires a minimum of moisture and soil. Even the most severely eroded slopes can be planted with maguey.

The average maguey plant in the Teotihuacan Valley takes from 8-10 years to mature, then produces four to six liters of pulque daily for a period of three to six months. After that the plant must be replaced. This means that between 16-40 plants must be kept in various stages of growth for each one in productivity to insure a daily supply of four to six liters. The plant also had a variety of other uses in pre-Hispanic times (cordage, cloth, awls, roofing, sugar, vinegar, honey, food--the roots were cooked--and fuel). Post-Hispanic uses would include fodder for domestic animals, planting drills, and wrappings for barbecued and steamed meat dishes. The pencas or leaves have a variety of casual uses, e.g., drinking and eating utensils, rollers and ramps. Its use as fuel is extremely important since, by Teotihuacan times, all other sources of fuel must have been very scarce in the Valley.

The importance of maguey in the history of the Valley was undoubtedly great in the pre-Hispanic periods, but its importance has undoubtedly grown with the colonial and recent progress of erosion. This is especially true in the Upper Valley with the growth of the haciendas in the nineteenth century.

As we have noted previously, maguey is planted in a variety of situations. Typically, agricultural terraces on gentle to medium slopes have a

aguey border to help retain the soil. On steep slopes it is planted in closely spaced rows parallel to the slope with very narrow, uncultivated terraces between the rows. In some cases each plant may have a small, individual, half-moon stone terrace. In the Upper Valley, on areas of relatively level ground but thin soil, large fields may be completely planted in rows of aguey.

Summary. In summary, then, agriculture in the Teotihuacan Valley today has the following characteristics:

1. Humidity regulating techniques. Chinampa cultivation, spring-fed irrigation, terracing, and floodwater irrigation combined with specialized planting techniques.
2. Soil conservation techniques. Use of aguey, earth, and stone terraces, irrigation (bringing in soil and minerals in solution), canalization of drainage to control erosion, check dams to reclaim barrancas, use of tepetate to manufacture soil, crop rotation, fallowing, fertilization and interplanting.
3. Miscellaneous patterns. Use of plows, orchard crops, use of marginal lands for grazing, extensive agriculture, aguey cultivation.
4. Crop assemblage. Maize as a staple; aguey and beans as important secondary foods; a great variety of minor crops for sale and consumption, nopal, barley and wheat for a cash crop.

Demography and Settlement Patterns.

This part of the paper will be devoted to a detailed analysis of recent population distribution in the survey area and will attempt to answer the following questions:

1. What changes have occurred in the number of people utilizing the resources of the Valley over the past 50-60 years?
2. What are the variations in population density within the Valley?
3. What factors, ecological and non-ecological, are responsible for the recent population distribution?
4. In what kinds of physical communities is the population distributed and what are their characteristics?
5. What factors have produced the specific characteristics of the various types of communities?
6. What factors determine community locations?
7. To what degree is there a coincidence between physical and social population units?
8. What are the social, economic and religious interrelationships between communities?

Below the level of the state, Mexico today is divided up into political districts called "municipios". These vary considerably in areal extent, population, and the patterns of population distribution within them. In the survey area they range in size from 25.93 to 256.51 km.² and population from 2531 to 15,226. In the country as a whole these ranges are considerably greater.

Except where large cities affect the situation, municipios tend to have populations in the thousands and tens of thousands. They are political divisions, units of self-government with an officialdom headed by a Presidente Municipal, an elective office. One community or locality in each municipio is the seat of government and is called the cabecera. All or parts of the following municipios lie within the survey area: Calvario

Acolman, Atenco, San Martín de los Piramides, San Juan Teotihuacán, Tezoyuca, Axapusco, Nopaltepec, Otumba, Temascalapa and Ecatepec. The following chart presents a rough estimate of the fraction of each municipio that lies within the survey area and recent population history by municipio. Seven municipal cabeceras lie within the survey area (Acolman, San Martín, San Juan, Tezoyuca, Axapusco, Nopaltepec, and Otumba).

Population History by Municipio

	Surface Area km. ²	Population					Fraction of municip- io in survey area
		1900	1910	1930	1940	1950	
Acolman	86.29	5822	5522	5827	7234	9422	all
Atenco	72.24	3848	3275	4463	5023	5425	1/3
San Martín	57.79	non existent		3717	4171	4718	all
Teotihuacán	75.41	5175	5570	5418	6667	8348	all
Tezoyuca	25.93	1837	1709	1960	2161	2531	all
Axapusco	256.51		7944	7049	7662	7598	1/3
Nopaltepec	76.20		2580	2333	2709	2931	2/3
Otumba	172.59		11264	7167	7584	8407	all
Temascalapa	147.85		7074	7304	8136	8191	1/4
Ecatepec Morelos	143.30		7320	8762	10501	15226	1/6
	1114.11		52308	54000	59848	72796	

all data taken from official government censuses

There is some difficulty in estimating the population actually residing in or utilizing the resources of the Valley since all data are by municipal district.

The chart suggests a decline of population between 1900-1910, presumably the end of a long trend of nineteenth century decline produced by the growth of haciendas; but after 1910, the data indicates a continuous accelerative growth. In 1910 the population for all municipios was 52,308. It climbed slowly to 54,000 in 1930. Since the latter date, the pace has increased with 59,041 in 1940 and 72,790 in 1950. This accelerated growth is undoubtedly the product of several processes: increase of tourism, effects of the Agrarian Reform, and development of the industrial labor market in Mexico City. Utilizing the estimates of the percentage of municipios lying within the survey area as a base, the figures for the survey area would probably be close to 35,000 in 1910 and 45,000 in 1950. Recent censuses, therefore, show a range of population varying from 35,000 to 45,000 or a density of 47-55 persons per km.² (117-137 per square mile).

Although the phenomenal growth of the city over the past 30 years has undoubtedly had some demographic effects on the Valley, most of the population is either rural in mode of life or participates in urban activities that serve the local rural population. Perhaps the 1930 census would be a reasonable base line for estimating the present-day demographic capacity of the Valley (since this would predate the growth of the city). All such estimates, however, must be qualified since they would assume that substantial conversion of extensively cultivated slopes to intensively cultivated terraces is not possible. Furthermore, it must be stressed that in 1930 the Agrarian Reform was only a decade old and still could not have had much effect on population growth.

Each municipio crosscuts our ecological divisions. In addition the population density varies considerably over the survey area and only rough

estimates, based on municipal variations can be made. Acolman, a municipio with the majority of the Lower Valley alluvial plain lying within it, had a density in 1950 of 110 per km.². Axapusco, located in the thin-soil, sloping piedmont on the Upper Valley, recorded only 29. These two figures, in a general way, show the range of productivity of the various segments of the Valley today.

The ecological significance of the spring-fed irrigation system is shown in sharp relief when we realize that the 3600 hectares of land served by it are a significant factor in the economy of 21 rural communities (approximately one-third of the total number of communities) with a total population of 1940 of approximately 15,000 people. Approximately one-third of the population has an agricultural economy at least partly based on an area comprising only 6 percent of the land surface.

Within the municipio the population is distributed and organized in a series of population or administrative units variously called villas, cabeceras, pueblos, barrios, colonias agricolas, ejidos, rancherias, ranchos, estaciones, or haciendas. The term villa or cabecera is applied to the administrative center of the municipio, with villa usually being reserved for larger, more urban cabeceras. The title villa frequently dates back to the Colonial Period. All of the others are dependent communities. The term pueblo or barrio is used for old, physically and socially semi-autonomous settlements of subsistence farmers. The term barrio, as applied to these communities, is a survival of the sixteenth century pattern in which all dependent communities were called barrios (or estancias) and the term barrio was a direct translation of the Aztec word calpulli. Colonias agricolas and ejidos have similar economic or social functions but are new, government-sponsored communities. Rancherias are dispersed communities of subsistence farmers. Ranchos and haciendas are large, commercial-agricultural or livestock-raising, landholding units and estaciones are small clusters of railroad employees living near the station. Each of the barrios, pueblos, ejidos and colonias agricolas has a locally elected official called a delegado who represents the unit in the municipal center.

Excluding Ecatepec, where modern factory construction has converted much of the municipio into an economic suburb of the capital, approximately 25 percent of the population resides in the villas or cabeceras of the nine municipios and at least 70 percent resides in the various types of dependent communities occupied by subsistence farmers (i.e., rancherias, barrios, pueblos, ejidos, and colonias).

In the above discussion the population has been analyzed entirely in terms of political divisions. Socioeconomically, the settlement pattern may be analyzed as follows (the entire discussion below refers only to settlements in the survey area).

There are approximately 50 relatively discrete clusters or concentrations of population that we will call physical communities. Most ethnologists do not make a distinction between physical and social communities. Since archaeologists must deal with physical remains, the distinction between and the degree of correspondence of physical and social communities is of great importance. To clarify further, one could have an organized social group comprised of 30-40 families, but in which the population might actually be distributed in any one of the following patterns:

1. Each family residing equidistant from each other and living hundreds of meters apart.

2. The population distributed in small nucleated clusters of several families, each sufficiently isolated to appear as a physical community.
3. The entire population residing in a single nucleated community.
4. The social community might occupy a ward or subdivision of a larger physical community.

The problems of the archaeologist in reconstructing the social community from the distribution of residences would be considerable in the cases of patterns 1, 2, or 4, relatively easy in the case of number 3.

Excluding commercial establishments like ranchos, estaciones and haciendas, there are 70 social communities in the Valley. These correspond to the mentioned political units. Each has a patron saint and a church, most have communal lands for pasture (agricultural land is individually owned or worked), each has a strong sense of social identity and a general feeling of suspicion and hostility toward outsiders.

In the majority of cases these social units are also physical communities but approximately 20 are attached to other communities. In all but one case, the attached communities are equal in status, at least in recent times. The exception is San Juan Teotihuacan, one of the two communities we are classifying as urban. In cases of such compound communities all but one of the communities concerned are called barrios rather than pueblos; but as we noted previously, physically isolated social communities may be called either pueblos or barrios.

Of the 50 physical communities two may be classified as urban, five as having some incipient urban traits corollary to their political rank as cabeceras (two of the cabeceras are located outside the survey area) and 41 as rural. In 1940, 10 percent of the population of the survey area resided in the two urban communities of San Juan Teotihuacan and Otumba, 18 percent in the six incipiently urban (Tepexpan, which, although not a cabecera, has some urban traits), and 70 percent in the rural subsistence communities.

There is considerable variation in the characteristics of rural communities. All have some kind of socioreligious center, usually a plaza with a church, a small shop or two, and a school. Some may have a municipal building for meetings. Many of them have very irregular street plans, especially hillside communities; others have a grid of streets 100 m. square. All but a few are nucleated settlements, that is, the houses are located in a restricted, easily definable residential area with most of the agricultural land located outside of it. Basically, our definition of rural refers to mode of subsistence, communities in which at least two-thirds of the population derives most of its income from agriculture. There is considerable variation in population size, plan and compactness. The following chart illustrates variations in population size by physical and social community (1940 census).

Population Group	Number of social communities	Number of physical communities
0 - 100	3	3
101 - 200	9	7
201 - 300	7	4
301 - 400	7	5
401 - 500	10	7
501 - 600	3	3
601 - 700	7	7
701 - 800	3	3
801 - 900	3	3
901 - 1000	3	3
1001 - 1500	2	2
	<u>57</u>	<u>47</u>

Variations in rural community population density are so striking that this criterion has been utilized to establish the following community typology. Community population density refers to the density within the area defined as the residential segment of the community territory. There is almost complete continuum of density variations so that the following types are rather arbitrarily delimited:

1. Rancheria. Pattern in which all or nearly all of the agricultural land used by a householder lies close to his residence. This type is absent in the Teotihuacan Valley but does occur on the Gulf Coast. In this case the physical community and the community territory are the same.

2. Compact Rancheria. A feebly defined residential zone, exists in this type, but the houses are very widely spaced with much intervening agricultural land. The densities of several test cases averaged around 200-300 per km.²--much too high for a true rancheria (if located on the eroded piedmont of the Valley), but so dispersed that one hesitates to call such communities nucleated. This is a rare settlement type in the Valley.

3. Scattered Village. A very common type of community in the area. It differs from the Compact Rancheria in that most of the agricultural land is located outside the village. Houselots, however, are large, usually planted in maguey or nopal but not infrequently in grain crops. Also, empty cultivated fields frequently occur dispersed through the settlement area. Such settlements very rarely have regular street grids. The density varies from 500-1000 per km.².

4. Compact Low-Density Village. Numerous villages in the Valley have densities ranging from 1000-2500 per km.². Many houselots have maguey or nopal orchards or stalls for domestic animals but the houselots are smaller than in scattered villages and grain cultivation is rare. Regular street grids are more common in these communities than in scattered villages.

5. High-Density Compact Village. Densely nucleated communities with small houselots occupied primarily by residences and courts and with very little agricultural activity in the residential zone. Regular street grids are common. Densities range from 2500-5000 per km.².

There seems to be a rough correlation in the Valley between rural community density, ecological location, formality of plans and amount of agriculture practiced within houselots. The more nucleated the community, the greater the tendency to a formal plan of streets and lots, although the correlation is not exact. Perhaps the most regularly laid out community

is San Martin de los Piramides with a density of 2500 per km.². (This may be due to the fact that it is located on the ruins of the ancient city and the modern grid may be in part conditioned by the ancient street pattern).

All of the High-Density Compact village communities are located on the edges of fertile alluvial plains; the Low-Density Compact and Scattered Villages are situated in areas of less productive hillsides, and Rancherias are located in very marginal agricultural areas. The probable primary factors are:

1. Historical Tradition. As shall be demonstrated in the discussion of Aztec settlement patterns, the piedmont settlement tended to have a more dispersed plan than those on the edge of the Lower Valley plain. In Aztec times such settlements were linear in form. In the seventeenth century the Spanish Congregation policy resulted in a regrouping of the linear bands into radial or rectangular plans, but apparently the new communities in the piedmont continued the pattern of widely separated rooms and large houselots.

2. The development of commercial nopal cultivation, a plant which thrives in marginal land and is usually planted as a small orchard located near the house so the fruit may be more easily protected against thieves.

For the purpose of archaeological evaluation the term hamlet is used various times in this report. The term refers to villages with less than 100 inhabitants. No modern communities fit into this category.

One of the primary objectives of the Teotihuacan Valley Project has been the study of the history of urbanism in the area. A major problem is the definition of an urban community both in the archaeological past and the ethnographic present. The terms urban, urbanism, city and town have been used very loosely in the history of archaeology. In the Near East the term urbanism has been used almost synonymously with civilization. There, the rise of cities occurs synchronously with a series of technological developments such as plow agriculture, sailing ships, wheeled carts, use of the wheel for pottery manufacturing, brick architecture, metallurgy, writing and standardized weights and measures. None of these traits, however, are usually included specifically in the definition of urban or urban community. The term urban, as used by Childe, actually refers to a new economic system in which full-time occupational specialization is the characteristic trait. In the Near East these specialists lived in large, compact, tightly-nucleated communities focused around temple-palace precincts. The size of such communities, it is argued, required state-like political systems, or formally organized priesthoods to regulate human behavior and integrate the big society that lived within them. The variations in economic roles and control of power produced wide ranges in social status which resulted ultimately in the existence of well-defined social classes. Specialization, plus the demands of a wealthy upper class and the pantheon of gods, resulted in the development of a highly skilled technology which we call fine art and a monumental architecture. There has been a strong tendency to see all of these processes and traits as being functionally interrelated.

The major problem as to the definition of urban and urbanism has arisen as the product of research in the New World, especially Mesoamerica. First, many of the technological developments did not occur, such as plow agriculture, wheeled vehicles, and sailing ships, or were so late in appearance--such as metallurgy--that they long post-dated the appearance

of cities. Second, in some areas such traits as writing, standardized measures, highly-developed art, monumental architecture, some specialization, state-like political or religious systems, and social stratification were all present, but the large, nucleated, compact communities of the Near East were lacking.

As a result, many authors have expanded the terms urban, urbanism, and city to include societies or cultures possessing these latter traits.

More recently, Rowe has defined an urban community as:

"....an urban settlement is an area of human habitation in which many dwellings are grouped closely together. The dwellings must be close enough together to leave insufficient space between them for subsistence farming, although space for gardens may be present...the intent of this definition is to exclude clusters of dwellings so small that they could be interpreted as belonging to the members of a single extended family. Twenty dwellings is perhaps the minimum number which would provide this exclusion...I am proposing to use the word pueblo to designate an urban settlement in which all the residents are engaged in hunting, fishing, farming or herding at least part of the time...."

(1963, p.3)

In a previous paper I have tried to resolve the dilemma by using a sociological definition and by differentiating terminologically between urbanism and civilization. My arguments may be summarized as follows: (Sanders, 1962)

1. Civilization. Archaeologists, because of the nature of their data, have tended to classify cultures as civilizations when permanent monumental architecture is present and when (at least in some areas) the technology is so skillfully executed that it is easily classifiable as Fine Art. Socio-economically, the presence of these two traits implies some professional specialization and the organization of men into large social systems. Such organization would furthermore correlate with the evolution of complex systems of social stratification.

2. Urbanization. I then considered urbanization as a special type of civilization characterized by the presence of cities and towns. A city is defined as a social community characterized by (a) a large population, numbering at least in the tens of thousands, (b) which is concentrated in a small area, making up a single, compact physical community (c) in which most of the population were nonfood-producing specialists in economics, government or religion, (d) and where there is consequently considerable social differentiation within the community based on occupation, wealth, control of power, and ethnic origins, and with a strong tendency toward ranking of such subgroups. Towns were defined as smaller communities with transitional characteristics.

The main distinctions drawn here were the absence or presence of large, nucleated, population centers and the degree of economic specialization.

Although my attempts at standardization of terminology are certain not to satisfy everyone and perhaps no one, I feel the entire subject needs re-opening and the terms re-defining. Rowe's use of the term is too loose to be useful. One would have to call the pueblo villages of the Southwest or even the settlements of the hunting and gathering Indians of the Northwest Coast urban since they are relatively large, tightly-nucleated settlements,

yet both of these cultures lack all of the attributes considered by both sociologists and Old World archaeologists as urban. On the other hand, cultures like the Maya, which had most of the characteristics, would be excluded. It seems to this author that a typology that would group such cultures as the Northwest Coast, Southwest, Central Mexican, and Sumerian is not particularly useful.

The city or large urban community defined by sociologists as a community type does have unique socioeconomic characteristics and it is my feeling that this distinction should be carefully maintained by a more precise usage of such terms as urban, urbanism, urbanization, city or town.

Essentially, an urban community may be defined as a physical and a social community that is the product of a complex of historical processes. These processes are: demographic growth; nucleation; and social differentiation, including economic specialization and social stratification. Any one of these processes in a given area may occur independently and as an isolated phenomenon. Nucleation, for example, may occur as a response to warfare (need for common defense), environment (conditioned by distribution of water resources), agriculture (if cooperation of large numbers is needed), or variety of other factors, without any of the other processes being involved.

When these processes do occur dependently and as a functionally related, evolutionary system, then the total process may be called urbanization. The analysis, therefore, of the history of urbanism in a given area should involve the study of each of these processes, the nature of their interaction and the factors involved in the development of each process.

Since urbanization is a historic process, one should expect to find communities in all stages of urbanization in any one point in time in any area where urbanism is part of the cultural pattern. In the Teotihuacan Valley the modern communities occupy an almost complete continuum or urbanism from rancherías to towns. In two communities, San Juan Teotihuacan and Otumba, the process has evolved enough to call them towns, here defined as a transitional community between village and city.

In terms of the above discussion the most urban community in the Valley is San Juan Teotihuacan. Administratively and socially, the community is a compound settlement consisting of the Villa, and three attached barrios, Puxtla, Purificación and San Juan Evangelista. A complete census was taken of the Villa, barrios of Puxtla and San Juan Evangelista; Purificación was sampled. In the census, such data as the age, sex and kin relationship of the residents of each house or apartment, occupation, land ownership, and house plan and construction materials was collected. The data is partly summarized in the following chart with three rural settlements added for comparison. (Cuanalan was partially sampled, in the other two a complete census was taken).

	<u>farmers</u>	<u>nonfarmers</u>	<u>nonfarmers possessing land</u>
1. Compound Community of			
San Juan Teotihuacan			
La Villa	8	199	11
Purificacion	20	53	6
San Juan Evangelista	30	47	11
Puxtla	11	15	10
2. Rural Settlements			
Cuanalan (Compact Village)	66	24	0
Tepetitlan (Scattered Village)	32	11	7
Palapa (Compact Rancheria)	69	4	0

In the case of Purificacion, local resistance to the census forced us to stop about halfway through the census. Most of the resistance involved higher status groups so that the percentage of nonfarmers in this barrio is probably close to that of the Villa itself. There are numerous workshops and stores in the barrio, indicating a high index of urbanism. The suggestion of a decline in population of the Villa (compared to earlier government censuses) that appears in the chart is not correct. It is based on the fact that there is a large army barracks in the town that is included in the official census, but excluded in ours. The contrast between the Villa and its barrios and the three rural communities in economic specialization is striking, especially between the Villa, or most urban section of the community, and the villages. Purificacion and Puxtla are clearly more rural, but are still more urban than any of the rural communities, and the rancheria is the most rural of all.

Since it is a municipal center, there are numerous specialists in government, local, state and federal; specialists in communications (i.e., telephone, telegraph operators); resident religious specialists; along with merchants, barbers, carpenters, mechanics, blacksmiths, washerwomen, bakers, jewelers, masons, milkmen, shoemakers, tailors, laborers, household servants, and shop employees or clerks. Only 38 families who practice specialized occupations own land in a sample of 352 nonfarming families in the total community.

Other indications of a higher index of urbanism are the presence of a large paved plaza, large municipal buildings of stone, earth and plaster, over 100 commercial establishments (including restaurants and bars), a large permanent market (held daily but with Monday a major market), several schools including a regional high school, a parish church, and many large substantial residences. Each of the barrios has its own church but is without a resident priest, a situation also typical of rural communities. Otumba, the other true town in the survey area shows many of the above traits, but is a smaller community. It is the only other community with a market, in this case meeting on Tuesdays. In recent years, a small Sunday market has been held at Tepexpan.

With the exception of the attached barrios, the physical and the social communities in the Teotihuacan Valley coincide in most cases. All communities have churches and plazas as architectural referents to the community as an organized group. Cabecera churches are usually larger than those of dependent communities. In the case of San Juan Teotihuacan, one of the compound communities, one social community enjoys higher status and prestige

than the others and its church is considerably larger, but the other barrios do have their own church as an indication of social differentiation. One could probably define the social communities of the Teotihuacan Valley today and their status positions on the basis of a "surface survey" alone.

Below the level of the community there are no intermediate social groupings, at least of the territorial type, between it and the family. The following is a discussion of the demography and settlement pattern of this latter social group beginning with a brief summary of house types and construction.

The three materials commonly used are adobe, stone and brick. In most cases, one type of material makes up the majority of the construction in a single house, but at times all three may be found in a single house-lot. Although it is most popular in the Lower Valley and Delta, adobe is generally the most common material. The adobes are rectangular, mold-made and laid in mud mortar. Nearly all adobe walls have at least a few courses of stones laid in mud at the base. Walls are frequently plastered over with lime, so at first one does not get the impression that the house is built of adobe. In the Middle and Upper Valley adobe is used, but many of the buildings are of split or roughly cut stone laid in earth mortar or, less frequently, laid dry. Doorways are usually faced with more regular cut stone. In some villages almost all of the buildings are of stone. Constructions of baked bricks are found throughout the Valley but do not make up the majority of buildings in any community. At times they too are plastered with lime, but the common practice is to leave the bricks exposed.

Floors in poorer houses, and rural houses in general, are of pounded earth; in wealthier houses usually a subfloor of bricks, stone, or concrete is built with or without a tile surface. Roofs are of very variable construction. The most expensive roof is flat, constructed of bricks laid in concrete over wooden beams, topped by a layer of cement or earth and lime plaster and equipped with a system of drains. Most rural houses have a roof sloping in one direction constructed of wood covered by a layer of tezontle gravel and earth or by curved overlapping tile.

In rural communities and in the periphery of cabeceras, the house-lot is defined by a high adobe wall or fence built of tightly-spaced organ cactus, nopal or maguey. Inside there are usually several buildings of the types described which serve such specialized functions as sleeping, cooking and storage. They are small, frequently separated, and usually placed against the wall or fence, leaving a sizable, open courtyard area as a work space. Parts of the courtyard, especially in the more dispersed communities, are planted in nopal or maguey. In the more densely clustered communities the courtyard may have no cultivates except a few fruit trees. This type of house-lot is usually associated with the poorer types of houses, i.e., dirt floor and earth or tile sloping roof.

In a few cases of wealthier families in the villages and of most of the structures in the more urbanized central portions of towns, a more compact house-lot is the rule. The houses are predominantly of the flat, brick-concrete type with constructed floors. In this case structures are conjoined, sharing walls and a continuous roof, and strung along the periphery of the house-lot forming a solid outer wall on the street interrupted only by doors, and, more rarely, windows. One or several courtyards of varying size may be in the interior.

We are calling these two types of houselots "dispersed" and "compact" and feel that the distinction is a crucial one with reference to the problem of defining differences between urban and rural. There is almost a perfect continuum in their respective distributions within towns like San Juan from the center to the peripheral barrios and between true towns, incipiently urban cabeceras, and rural communities.

Furthermore, within the densely nucleated Villa of San Juan itself one can trace, urban block by urban block, the process of urbanization in the compact houselots. In some blocks the roofed areas involve nearly two-thirds of the total surface area of the block and population densities run from 10,000-12,000 per km.²; in others perhaps only one-third of the surface area is covered by roofed structures and the population density drops to 4,000-5,000 per km.².

The distinction between the dispersed and compact houselots also reflects differences in socioeconomic alignment and relationships. Dispersed houselots are normally the residences of either a single nuclear family or a nuclear family with additional relatives.

In Cuanalan approximately 30 percent of the sampled households had a resident population exceeding the size of a nuclear family. In such cases the social group tends to be three generational but is not a normal extended family--i.e., it may include either one of the four surviving grandparents, a married couple and their children. Furthermore, all eat together and share kitchens and living facilities so that the plans of such houselots are similar to the normal, isolated, nuclear family households.

In the case of the compact houselots the following variations were noted:

1. An entire urban block may be owned by one family who resides in a unit composed of a single, large, open courtyard and a large number of rooms; the rest of the block is divided up into small apartments of a single or a few rooms and rented to socially unaffiliated families. Some of these rented rooms or apartments may be used as workshops, shops, or as a combination of either with a residence. In some cases a large apartment may have its own small courtyard or else a group of small apartments may share a courtyard.

2. An urban block may be divided into several separately owned divisions. In some cases the owner of one will use all of the space (a large apartment complex with a courtyard) for his family or the owner may reside elsewhere and rent all of the property.

With the exception of the few cases where several small apartments are grouped around a small courtyard and therefore share a street entrance, each living unit has its own egress directly from the street; the blocks do not have communal main entrances, nor does the population of a single property share a common central courtyard. There are no common ritualistic structures and in no way do the occupants make up any kind of organized social groups.

Thus far, the discussion has been focused on community settlement patterns and typology. It now remains to define the zonal patterns, i.e., the distribution of communities over the survey area.

We have previously noted the demographic significance of the Lower Valley-Delta area. Three of the cabeceras of the municipios are located in the Lower Valley Delta (Acolman, Atenco, Tezoyuca); one on the west shore of Lake Texcoco outside the survey area near the old lake shore

(Ecatepec); one at the head of the irrigation system where the Lower Valley begins--the most urban and largest community (San Juan); one in the Middle Valley on the edge of the alluvial plain (San Martin); and three in the Upper Valley, one in the deep soil plain (Otumba), another on the piedmont (Axapusco), and the other on the periphery of the piedmont-hill juncture (Nopaltepec).

In the Delta, villages tend to occur either on the old lake shore (Tequisistlan, Iztapan, Nexquipaya), on the flank of Cerro Chiconautla at the edge of the plain (Totolcingo, Chiconautla, Tepexpan-Chimalpa) or on the flank of an isolated hill (Tezoyuca).

Three strings of settlements are in the Lower Valley, one along the west piedmont, another along the east piedmont (in both cases on the edge of the alluvial plain) and a third consisting of a string running down the center of the plain.

Santa Catarina Acolman-Tenango, Tecalco, Maquixco and the barrio of San Juan Evangelista are located along the west piedmont. Cuanalan-Zocango, Chipiltepec, San Pedro Tepetitlan, Xometla and San Lorenzo are located on the east piedmont. The central strip includes Calvario Acolman, San Bartolo-San Juanico, Santa Maria Acolman and Atlatongo. The first is situated on a low, natural elevation in the plain; Atlatongo is just within the plain, but near its edge.

The major factors operating in the determination of site location seem to be a combination of ecological and historic. Premium agricultural lands such as the irrigated plain are rarely used for residence and the tendency would be to locate villages in the poorer areas.

The position on the plain's edge places the farmer as close to the good agricultural land as possible, locates him conveniently close to his fields on the piedmont and pasture land in the hilly flanks. Village holdings tend to crosscut each of these ecological components except those located in the center which possess mostly irrigated plain.

The narrowness of the alluvial plain (three to four square kilometers) means that lands are readily available to a population residing in either a continuous linear strip on each side (which would seem to be the most convenient arrangement) or a series of small, regularly spaced, compact villages (the present pattern).

The cluster of villages on the lake shore is the product of historical tradition. The pattern relates to an earlier period when they specialized in the manufacture of salt and extraction of other lake products. Villages on the north piedmont are aligned along the modern highway which closely approximates the position of the colonial Camino Real and probably the old Aztec route through the Valley. Whether Aztec villages were built along older trade routes or the trade routes followed village distribution may be argued, but such routes once established would certainly operate as a stabilizing factor in community location. The fact that the villages in the plain lack or have very little piedmont-hillside land is probably the primary factor in their location within it. Atlatongo does possess a sizable holding on the piedmont. Here I suspect that the primary factor is the position of the canal with the special privilege of a constant flow of water for village use. Most of the irrigation villages do obtain much of their household water supply from the canal system.

The location of the largest and most urban town, with the biggest market, midway down the Valley, and near the springs reflects certain

ecological factors at work. As shall be demonstrated later, the control of the springs has been a constant factor in the power structure of the Valley for at least 600 years and probably 2000.

In the Middle Valley the same basic principle of distribution applies. San Lucas, Santiago Tepetitlan, Belem, Tolman, Oxtotipac and Cuautlancingo are all located outside the alluvial plain either on isolated hills or on the piedmont. In this area, however, the communities are located at the upper edge of the piedmont where it joins the steep slopes of Cerro Gordo and the Patlachique Range. Two factors are probably operating here. One, the alluvial plain is much smaller, and the piedmont more extensive with many small irrigable flood plains so that the latter is a more significant element in village economy. Two, water supply, a serious problem in this area, is resolved by the construction of "jagueys". Jagueys are large artificial pits dug down into the tepetate often to depths of three to 10 m. Water is diverted from the barrancas and stored in the jaguey throughout the year. Since they are uncovered and some water loss occurs through the tepetate, they are dug deeply and a large supply of water is needed. Best locations for jagueys would therefore seem to be at the upper edge of the piedmont to catch runoff immediately before it dissipates into the deep barranca beds.

In the Upper Valley the town of Otumba is located in the center of the deeper soil plain, an unusual setting. Actually the plain is so small here that it cannot be considered a major ecological factor. The archaeological data suggest its present location is of Spanish origin (and as Gibson points out, the Spanish administration was decidedly nonecological in orientation--1964, pp. 5-8). A major problem produced by the selection of the colonial site was that of water supply. It was met by the construction of a very impressive aqueduct bringing water from Cempoalla, located outside our survey area. Nearly all of the other communities are located in positions similar to that in the Middle Valley, a ring around the upper edge of the big piedmont strip and at the base of isolated hills in the north and the main range in the south.

Today there are no villages in the Patlachique Range, a reflection of its marginal agricultural value.

PART V

THE BASIN OF MEXICO IN THE SIXTEENTH CENTURY

Introduction.

At the beginning of this paper the assertion was made that in some aspects of culture, especially those concerning the relationship of men to the land, traditional patterns tend to persist for long periods of time. It was primarily for this reason that studies of certain aspects of the present-day peasant culture of the Valley were conducted as an integral part of the research project. Nevertheless, the Spanish Conquest did produce changes in the way of life of the population of the Valley, not only in such areas as settlement patterns, agriculture and uses of non-agricultural resources, but especially in those areas of culture least related to land use.

An urgent requirement for the success of the project therefore was as full a documentation as possible of the non-material culture of the final pre-Hispanic or Aztec Period as an aid in archaeological interpretation. There is perhaps no richer pre-scientific literature dealing with an extinct non-western culture than that for the Conquest Period Aztec. The literature includes native books, sixteenth-century histories written by mestizo and Spanish authors, "ethnographic" studies by Spanish priests and administrators, official ecclesiastic and governmental reports, and records of lawsuits.

The arrival of the Spaniards brought new and historically alien patterns of culture that caused shock waves and changes throughout the unique configuration of culture that was Aztec. Archaeological data, on the other hand, have demonstrated a striking continuity in general pattern from the earliest phase of occupation of the Valley by Folk farmers to the Aztec with a gradual evolution of a local variant of the general Mesoamerican civilization. Consequently and with proper precaution, the Aztec data are extremely useful in interpreting non-material aspects of the culture of the pre-Aztec Period, especially when correlated with selected types of archaeological data.

As part of the project, a thorough examination of published sixteenth-century sources dealing with the Basin of Mexico (partially completed) and of unpublished documents dealing directly with the Teotihuacan Valley is being conducted. Some of the data is presented for this report, but most of the following discussion is based on the author's previous research on Aztec culture and on such published syntheses as Gamio (1922), Gibson (1964), Armillas (1947), Palerm (1954-55), Cook and Simpson (op. cit.), and Carrasco (ms., 1963), Monzon (1946, 1949), and Moreno (1931), and Barlow (1949).

Agricultural Patterns.

All of the documents indicate that agriculture was at least as intensive during the Conquest Period as it is today; most of the data indicate a more thorough application of technological knowledge and more intensive land use in 1519 than at present. Allowing even some exaggeration, the Spaniards' descriptions of the population of the Basin of Mexico give the impression that the population was much denser then than today. Aside from these general impressions, the Conquistadores have provided some population estimates for the Conquest Period, but these figures must be considered with a great deal of caution.

More reliable and detailed tax data for the period 1550-1580 demonstrate that in 1580 approximately 500,000 people (roughly the size of the 1940 rural population) resided in the Basin. The tax documents, without exception, emphasize a major decline between 1519-1580 to at least one-third, possibly one-quarter, of the 1519 population.

To the observer, even to the anthropologist, the standard of living of the present-day rural population seems low and probably below average for the country as a whole. The major question to resolve then is: By what means was the Basin exploited in 1519 so as to permit a population at least triple, probably quadruple the present?

Before discussing agricultural techniques, a number of non-technological explanations may be offered as an answer:

1. The standard of living was even lower than today, and the average farmer produced only a small surplus for sale above subsistence needs.

2. A more efficient, highly-organized, government-regulated and controlled agriculture existed. This point is so crucial to the theoretical arguments to be presented later that the following statement is quoted in full:

"En el tiempo de Moctezuma eran apremiados a muchas cosas especialmente a dos que eran muy buenas, la una que cada uno hiciese su oficio e lo usuase forçiblemente y lo otro que todos generalmente sembrasen e fuesen labradores por sus personas o por sus dineros por manera que se podian sembrar por todos los pueblos e provincias de su reino se habian de sembrar por fuerza e habia veedores a su tiempo para que las vieses si estaban sembradas y si no el cacique era puesto en prision tal, que era peor que muerto e ansi parecen agora los cerros e laderas en gran cantidad que se solian labrar e por provincias tenian cargo de proveer de maiz e de todas las coasa necesarias a Mexico asi de maiz como de aves e cacao, e de leña e ansi de todas las mas cosas que se podian pensar ser necesarias tenian por provincias cargo de las proveer abastadamente, esto demas de lo que cada uno queria vender por su voluntad de su cosecha en manera que esta cibdad era la mas abastada del mundo."

(ENE Volume 4, pp. 169-70).

3. There is a considerable area today where erosion has reduced excellent to relatively good agricultural land to denuded tepetate and miserly pasture. This situation has been stressed previously for the Teotihuacan Valley.

Even allowing for such differences between the Aztec and recent situations in the Basin, the Aztec demographic picture argues for an extremely

efficient agriculture in which the two problems of intensive agriculture in the area--regulation of humidity and maintenance of soil productivity--were resolved. The rather scanty literature relating specifically to agricultural techniques is summarized below.

Soil Restoration.

1. One of the Spanish Conquistadores, Bernal Diaz del Castillo describes a system of collecting and selling of human refuse that must have approximated the extraordinarily careful husbandry of such a resource so characteristic of modern China. (Bernal Diaz, 1927, p. 177).

2. Sahagun presents a long detailed discussion of types of land according to the current native classification (circa 1550) in which several types of fertilized lands are mentioned:

Quauhtlalli. Soil fertilized with rotten wood.

Tlazotlalli. Soil fertilized as a result of vegetation being converted to fertilizer and turned over in the soil (this technique is still used in the southern part of the Basin, not only in chinampas but also on hillside terraces).

Callalli. Land located on old house sites.

Tlalauiac. Soil fertilized with animal fertilizer. Also distinguished in the native system were soils deposited regularly by alluviation.

Apparently, the enriching aspect of this natural process was well understood by the Indian population. (See Sahagun, Volume II, pp. 476-477, 1946).

3. The technique of Chinampa cultivation in the Basin is definitely pre-Conquest, and the procedures of using vegetal fertilizers and fresh soil are so interrelated with chinampa construction that the technique of adding these elements periodically to a finished chinampa to maintain soil fertility is undoubtedly ancient. Documentary sources demonstrate that the area of chinampa cultivation was considerably larger at the time of the Conquest than in the nineteenth and twentieth centuries. Approximately 10,000-15,000 hectares of lake bed were covered by canals and chinampas at that time. (Sanders, ms., 1956).

4. No document definitely referring to terracing is known to the present author. Of course, the Aztec Period, Texcotzingo irrigation system near Texcoco was built to irrigate hillsides (see Wolf and Palerm, 1954-1955). Archaeological remains, plus surviving remnants of the system which are still in use, indicate that terracing was highly developed. In the discussion of the Aztec occupation of the Valley of Teotihuacan, direct archaeological evidence of terracing will be presented.

Humidity Conservation.

1. The significance of Chinampa cultivation has been previously stressed. The techniques of cultivation include not only soil restorative elements but also the regulation of humidity. Crops are irrigated during all stages of growth using a scoop or bucket technique. However, its significance in the Teotihuacan Valley particularly was minimal, as not more than 100-200 hectares of land were involved.

2. Spring and stream irrigation. Because of the meteorological patterns in the area defined as the Central Mexican Symbiotic Region, irrigation is either necessary or significantly advantageous, reducing crop loss and/or resulting in greatly increased production. Palerm's detailed analysis (Palerm, 1954) of sixteenth-century sources indicates that permanent irrigation was found all over the area and in many cases the references

conclusively demonstrate the pre-Hispanic origin of the systems. In most cases the water sources were small, as was the amount of land irrigated. The picture is one of scores of small independent systems serving single communities or small clusters of communities.

In the Basin of Mexico important centers of irrigation, following Palerm, were: Coyoacan (a system of major size since it is stated to have serviced 20,000 "vasallos"), the Teotihuacan Valley, Texcoco and Cuauhtitlan.

The 1580 Relacion of the Corregimiento de Tecciztlan (Tequisistlan) (Papeles de Nueva Espana Tomo VI-VIII) includes a map of the Teotihuacan Valley irrigation system. Although the map pertains to a period 60 years after the Conquest, we doubt that any major change in the system had occurred over so short a period, especially since the bulk of the land was still in the hands of the Indians at that time. On the map the main artery collecting the water from the springs divides into two main canals (after an initial partial diversion for use in a flour mill), approximately at the place where today the canals of San Jose and San Antonio diverge. Shortly after this and before passing by Atlatongo, the eastern canal splits into two, making a total of three major canals. The three continue down-valley until all join just below the Acolman convent; the water apparently entered the lake as a single stream. At Tepexpan two smaller canals diverted water for local use.

The system differed from the modern in that the San Antonio canal apparently did not exist (i.e., the canal that runs along the southeast edge of the plain). Instead, the southeasternmost canal ran almost down the center of the plain where the present canal, called the Rio Calvario-Santa Maria, is located; the other two canals followed closely the courses of the present Rio de San Juan and the San Jose Canals.

The document also provides data on the size of the area irrigated; the following quotes from the source refer to these data. The first is a statement about the system as a whole; the second and third refer to specific administrative districts using it.

"4. La cabecera de *San Juan* y todos sus sujetos estan asentados en vn llano, y el subgeto mas desbiado esta dos leguas de la cabecera: tiene por la parte del norte, a vna legua del pueblo, vn cerro grande que los naturales llaman *Tenan*, que en lengua castellana quiere dezir madre por que del salen otros muchos cerros pequenos; pos la parte del sueste tiene otro cerro mediano que lo abriga; es tierra la de los sujetos falta de agua, beben los naturales de jagueyes, ecepto la cabecera ques abundosa de agua, tiene muchas fuentes en poco trecho de que procede un rio grande en la qual tienen los naturales vn molino, rieganse con el agua del dicho rrio dos leguas de tierra, ques toda su corriente hasta entrar en la laguna, pasando por los pueblos de *Aculma*, *Tepexpa* y *Tequisistlan* y termino de *Tescuco*: es tierra abundos de pastos y mantenimientos."

P.N.E. Tomo VI-VII, pp. 219-220.

"4. Esta asentada la cauesera de *Aculman* en vn llano, al pie de vna loma llana, es raso no tiene nenguna fuente, pasa por el dicho pueblo el *rio* que dizen de *San Juan*,

dividido en tres aseQUIAS de agua con que riegan gran pedazo de tierra casi de vna legua en largo e media en ancho; es fertil de pastos y de mantenimyentos."

P.N.E. Tomo VI-VII, p. 211.

"19. No thiene rrio ny fuente, solo pasa por el pueblo el rrio que llaman *de San Juan*, deuidido en dos aseQUIAS de agua, con que se rriega distancia de media legua de tierra del dicho pueblo de *Tepexpa*."

P.N.E. Tomo VI-VII, p. 235.

Although most of the irrigated land in 1580 fell under the jurisdiction of Acolman, the springs themselves were located in the territory of another political unit, Teotihuacan. The spring water apparently was owned as patrimony by the royal family of Teotihuacan during the sixteenth century. Gamio (op. cit., Tomo I, Vol. II, p. 526) records in detail a dispute over a water tax customarily paid by the ruler of Acolman for its use for irrigation. At that time the tribute was paid annually and consisted of 100 pesos worth of cotton mantles and feathers. Around 1580, Acolman refused to pay the tax and the case came before the Spanish courts.

In the section on modern agricultural techniques, a complex of planting and soil preparation methods was described in conjunction with floodwater irrigation. No definite documentary statement about floodwater irrigation is known, nor is there a direct reference to cajete planting. One of the techniques essential to cajete or al tubo planting is the thorough working of the soil, today using the plow. However, the plow is not essential to the technique; the requirement is that the soil be thoroughly pulverized, which can be done with a hoe.

The following quote from Sahagun would infer that the system was in use in the sixteenth century.

"El labrador es dispuesto, recio, diligente y apto para la labranza. El buen labrador es fuerte, diligente, y cuidadoso, madruga mucho por no perder su hacienda, y por aumentarla deja de comer y de dormir, trabaja mucho en su oficio, conviene a saber, en romper la tierra, cavar, desverbar, cavar en tiempo de seca, desmontar, allanar lo cavado, hacer camellones, mollir bien la tierra, arreglarla en su tiempo, hacen linderos y valados, y romper tambien la tierra en tiempo de aguas, saber escoger la buena tierra para labrarla, hacer hoyos para echar la semilla y regarla en tiempo de seca; sembrar derramando semillas, agujerar la tierra para sembrar los frijoles, cegar los hoyos donde esta el maiz sembrado, o acohombrar o allegar la tierra, a lo nacido: quitar el vallico, entresacar las canas quebrandolas, y apartar las mozorquillas, y quitar los hijos de estas y los tallos, porque crezca bien lo nacido, entresacar a su tiempo las mazorcas verdes; al tiempo de la cosecha, quebrar las cañas cogiendolas, recoger el maiz cuando esta ya bien sazonado; desollar o desnudar las mazorcas, y atar las unas con otras, anudando las camisillas una con otra, y hacer sartales de mazorcas atando unas con otras, y acarrear a casa

lo cogido y ensilarlo; quebrar las cañas que nada tienen aporreandolas, trillar, limpiar, aventar, levantar al viento lo trillado. El mal labrador es muy negligente, haragan, y a el se le hace grave y molesto todo trabajo; en su oficio es tosco, bruto grosero, villanazo, comilon, escaso, enemigo de dar, y amigo de tomar."

Sahagun, 1946, pp. 201-202.

Although the data are somewhat deficient, it seems that the techniques of intensive agriculture described for the modern period were in use at the time of the Spanish Conquest.

Crops reported in the *Relacion* of Tecciztlan for 1580 include such native plants as maguey, maize, beans, chian, huauhtli (amaranth), capulin, nopal, squash, chile peppers and such Spanish crops as wheat and "hortaliza". This source also emphasizes that the Spanish crops were planted very rarely.

Socioeconomic Organization.

The following analysis represents one interpretation of an exceedingly rich body of documentary data describing the basic socioeconomic groups which were characteristic of the Basin of Mexico at the time of the Spanish Conquest.

The smallest social group in Aztec society was the nuclear family. We know very little about its structure and function, but apparently it rarely existed as an isolated residential unit. All sources state that multifamily residence was the characteristic residential pattern. The multifamily residential unit was probably a patrilocal extended family. This is supported by the following considerations: agriculture was the subsistence base, it was primarily a male activity, lands were held by men, and there was a strong emphasis on male authority. Demographic data referring to Cortez's estates in Morelos and the Toluca Valley suggest an average for a large population sample of 2.5 family heads per family. (E.N.E., Tomo II, p. 124, 1939). Since polygamy was a privilege of rank, wealthier households might have fairly large populations, especially considering the further addition of servants and slaves.

Documentary sources describe a supra-familial territorial group variously called calpulli and tlaxicalli. Zurita (1941) offers the most detailed description of the calpulli. According to the various documentary sources, but based primarily on Zurita, the calpulli had the following territorial characteristics:

1. It was a communal land-holding unit.
2. Membership was by birth.
3. In most cases it was the local community.
4. In the larger communities, such as towns, it comprised a ward division.

One of the male members acted as custodian of the calpulli lands and performed chiefly functions. The title of this official, according to Zurita and other sources, was calpul. The office was elective, but restricted to a specific lineage (probably a patrilineage). The calpul was custodian of a set of maps that showed land boundaries. Apparently, in the actual use and cultivation, land was parceled out to the constituent families (presumably on the basis of extended rather than nuclear family). Although such lands were passed down through generation after generation of

male heirs, this did not constitute true private ownership, since use was subject to a number of rules imposed by the calpulli council of heads of households. The lands could not be rented or sold; land rights were reduced or increased by the council on the basis of family size and were lost if the family emigrated or neglected to cultivate their lands for a period of three consecutive years. In cases of illness or disability, the lands were cultivated for the holder by communal labor. Surplus calpulli lands, however, could be rented to other calpullec (the plural of calpulli) by the group as a whole. The calpulli, then, was a powerful social security group as well as a land-holding one. The chief was a full-time specialist since his holdings were cultivated for him by communal labor and his house was maintained by a labor tax (see Zurita, op. cit.).

None of the sources specifically state it, but the calpulli probably functioned as a communal work gang in constructing and maintaining small-scale irrigation works and in terrace construction. Other economic functions included:

1. Payment of taxes to the city state ruler in labor and agricultural produce. In the case of the labor tax, calpulli labor could be used for big building projects such as pyramid or palace construction. For the payment of produce taxes, each calpulli set aside a tract of land which was cultivated communally for the city state lord.

2. Unit of part-time specialization in the sense that each calpulli carried on traditional crafts. The actual cooperative work group was probably the extended family.

The calpulli also had basic political and military functions since its chief was the intermediary between the members and the city state ruler, and apparently fought for him as a military regiment. In many sources a military regiment of 200-400 warriors is mentioned. The *Relacion de Tepeaca* equates it clearly with the calpulli (P.N.E., Vol. V, 1905). Each calpulli also possessed a young men's school called a *telpochcalli*. Its curriculum emphasized military and religious training.

Apparently the calpulli also functioned as a religious unit, since each calpulli had a tutelary patron deity, a small pyramid temple for his worship, and probably a resident priest. The pyramid temple, plus the house of the calpul, and the *telpochcalli* school made up the social center of the community.

Zurita, and other sources, call the calpulli a lineage or kin group, and this feature has aroused more controversy than perhaps any other theme in the study of ancient Mesoamerican sociopolitical organization. Bandelier (1880) equated it with the North American exogamous sib and assigned it much the same social structure and function, even postulating totemism. In actual fact it was a localized group, and therefore would more closely correspond with Murdock's (1949) parti-clan than it would the sib if it were a unilinear descent group. However, none of the sources ascribe exogamic restrictions or totemism to the calpulli and Carrasco's recent studies (op. cit.) would indicate that it was, on the contrary, an endogamous group. The calpulli conforms very closely to what Murdock calls a *deme* and to the Inca *ayllu*.

In summary, the calpulli was an extremely important social group and its nature is crucial to any interpretation of rural community form, structure, function and interrelationships. It was a fundamental structural unit which provided the basic pattern for all larger social groupings.

Supra-calpulli organization, such as city states, kingdoms and empires, in their institutional aspects, can be considered simply as growths from this pattern.

Many sources mention a smaller division of the calpulli called a "barrio pequeño" headed by an official called a tequitano or tequitlato, but provide little data on its structure or function. In the *Relacion of Yecapichtla* (see discussion to follow) the term tequitano is also applied to the territorial group as well as its administrative official. It apparently was a residential and possibly a kin group. Perhaps one of the best parallels to the possible nature of this grouping and the larger calpulli is with the social organization described by Carleton Coon in his study of the Riffians (Coon, 1931). The Riffian "bone" has nearly all of the features described for the Aztec calpulli and is divided into "veins" which apparently are localized patrilineages that function primarily in marriage regulation (they are exogamous) and in government. (The constituent veins elect a number of young men to represent them in the bone council). The only definite function of the barrio pequeño ascribed by the documentary source was tax paying. The members of the group worked together and assembled tax goods or worked in small labor projects under the tequitano.

Sixteenth-century sources for the immediate post-Conquest Period provide extensive data on a supra-calpulli or supra-community territorial group called a "pueblo". It included a large central town or "cabecera" plus a large number of smaller, dependent, rural communities or "sujetos", variously called estancias, aldeas, barrios. The latter can with certainty be equated with the calpullec. Most of the estancias were within 10 km. of the cabecera, and the whole formed a compact administrative district. Theoretically, one could map these territorial groups in the Basin with great precision and estimate the location of all of the dependent estancias. One cannot be sure that the specific territorial boundaries of each pueblo correspond precisely with the Conquest Period territorial division here called a "city state", but this seems to be at least approximately true, since the same communities listed as cabeceras in the sixteenth-century relaciones and tax lists are also mentioned by the Conquistadores and later historians as centers of Aztec city states. A recent publication by Gibson (op. cit.) indicates that in most cases the Spaniards used pre-Hispanic city states as a basis for their cabecera-sujeto district.

The Conquest Period city state was the ultimate unit of stable political organization. At the top of the social pyramid was the Tlatoque or hereditary lord. He was elected from a specific lineage; had kingly functions, powers, rights and privileges; was a petty despot over a small kingdom; and was surrounded by all the trappings of royalty (i.e., stone residential palace, harem, household servants, litter, special clothing and ornaments, and court protocol). Approximately 50 territorial divisions of this type were located in the Basin of Mexico in 1519, each politically semi-autonomous. The tlatoque resided in a palace situated in the cabecera that was built and maintained by labor drafts of his dependents. His entire lineage, along with lineages of his predecessors, enjoyed superior prestige and were called collectively pipiltin (singular--pilli). Along with his other rights, the tlatoque owned private lands, worked by a class of serfs called mayeque. At his death, these estates were inherited by his kin, so most of the pipiltin held private lands (i.e., rights of transfer and exclusive utilization) and serfs. The mayeque class was apparently attached to these estates in much the same way as the medieval European serf.

The structure of the ruling class or pipiltin of a city state was caste-like since marriage was prohibited with the lower class or macehualli. We cannot call the local class endogamous, however, since there was a strong tendency to procure wives from ruling lineages of other city states. Because of this pattern the pipiltin of a group of neighboring states did apparently form a true endogamous caste. Many of the administrative or other high status positions in the city state organization were held by pilli: the priesthood, the calpixque of tax collector and the tecutlatoque or judge. The pilli class was also exempt from all taxation except military service.

The position of craftsmen in the social pyramid is not clear. All people not born in the royal lineages were terminologically called macehualtin (singluar--macehualli). The full-time craftsmen residing in the central town enjoyed higher status than rural farmers-part-time specialists. Goldsmiths, lapidaries, featherworkers and merchants seem to have had higher status than other urban craft specialists and were definitely organized into guilds (see Sahagun, 1959). All urban craftsmen were exempt from the labor tax and could not be required to work agricultural lands (Zurita, op. cit.). They paid tribute in military service and the products of their trade. A market was located in each town, theoretically administered by the tlatoque, but it was actually placed under the direction of the pochteca or merchant class. All urban craftsmen may have had a guild-like organization but the sources, except for those listed above, are not conclusive.

Most of the central towns apparently were divided into sections called barrios by the Spaniards and these into smaller barrios. That the larger barrios, usually numbering from two to six, corresponded to the rural calpullec in their origin, history or social structure is not clear. The smaller barrios almost certainly were similar in structure and membership to the calpulli subdivisions or barrio pequeños in the rural communities. According to most sources, craft specialization tended to be hereditary by barrio; it seems therefore probable that the unit of craft specialization in a small town was the barrio pequeño rather than the calpulli. In the small towns there were not enough of the larger divisions for specialization to be based on them. In large cities like Tenochtitlan the unit of craft specialization was certainly the calpulli. Two levels of craft specialization existed in the average city state, urban full-time and rural part-time, but the entire population was integrated into a single trading system focused on the town market, which in turn was one link in a chain of urban markets that made Central Mexico a symbiotic region.

One other element in the social system needs to be defined in order to complete the socioeconomic background of the settlement pattern analysis which follows. The above picture gives an impression of a rigid two-caste society. In actual fact, vertical mobility was possible through the mechanism of war. Macehualtin who had captured four enemies in battle for human sacrifice were promoted by the tlatoque in a public ceremony to the rank of tecuhtli. According to Zurita, these tectecuhtin (plural of tecuhtli) received a small landed estate from the tlatoque for lifetime tenure. This estate reverted back to the state upon his death. Zurita states that most administrative officials also received similar estates and that these estates were all part of a patrimony linked to the office of tlatoque and could only be used in this manner. The tecuhtli resided at

the tlatoque's palace as an honor guard most of the year, was a member of the war council, and his class as a whole fought as an elite squadron in battle. Many of the top administrative posts were filled by men from this class, so that an able macehual could achieve higher status than many pipiltin. They were exempt from all taxes except military service and could send their sons to the calmecac or priest school.

In summary, the important aspects of Conquest Period Aztec socioeconomic organization in terms of interpretation of settlement patterns are as follows:

1. Community differentiation into small rural settlements and central towns. The latter were probably compact, nucleated communities and larger in size, the settlement pattern of the rural settlement is not ascertainable from the documentary data.

2. The small rural community structurally and functionally equates with the calpulli, probably a deme in Murdock's terminology. The calpulli had economic, religious, educational and political functions. In some cases the rural community would be made up of several, socially distinct calpullec.

3. Division of the calpulli into smaller territorial units called barrios pequeños, probably patriclans.

4. The city state as the ultimate, stable, political grouping made up of a central urban community and dependent rural calpullec. These states were small with most of the rural units situated within a 10 km. radius, and the state as a whole had a modal population ranging between 15,000-30,000.

5. Integration of the rural calpullec into the city state in all spheres of cultural activity: economic (market system), political (war, taxes), and religious.

6. Presence of a highly stratified society with great differences in wealth and manipulation of power, and considerable socioeconomic differentiation.

This society consisted of a landed aristocracy who tended to control the political and religious institutions; a professional warrior class who shared in this control; full-time craftsmen divided into ranked levels and enjoyed generally superior status to the farmers-part-time specialists, serfs and slaves.

7. Hacienda-like communities, in some cases held for life and reverting back to the state for redistribution; in other cases, true private holdings, each with a resident serf class.

8. Considerable symbiosis in all kinds of cultural activity between all segments of the population, giving the city state a high level of integration and stability.

9. An authoritarian state with absolute control of the labor force for great building projects.

10. A social structure on all levels that lends to cooperative labor.

Settlement Patterns.

In the previous section the sociopolitical groupings characteristic of Aztec culture were delineated. In the analysis no reference was made to the manner of distribution of these units on the landscape, in other words, to the settlement pattern. One of the primary objectives of the Teotihuacan Valley Project was to define physical community types and to

reconstruct in so far as possible social groupings. The documentary references to settlement patterns for the sixteenth century are summarized in this section.

Direct references to rural settlement patterns by the Spanish sources are rare. The Spaniards were more interested in the large urban communities. The following quote from Cervantes de Salazar gives a broad impression of settlement patterns for Mesoamerica as a whole.

CAPITULO QUINTO DESCIMO. De la manera que los yndios tienen en el poblar.
Pueblan los yndios de la *nueva Spana* muy diferentemente de las otras nasciones; porque, por las ydolatrias que tenían y por hablar con el demonio mas secretamente, ni buscaban riberas, ni costa de mar, ni lugares llanos donde hiziesen sus poblaciones, y las que hazian eran en lugares altos, asperos y montuosos: sin hordem ni continuar casa con casa; por manera que vn pueblo de mill vezinos venia a ocupar quatro leguas de tierra: dezian qu'el hazer su asiento en tales partes era por fortalecerse contra los enemigos comarcanos, y el estar tan apartados los vnos de los otros por tener cada vno la sementera o milpa a par de su casa; y porque si vbiese pestilencia no se ymficionasen estando juntos: y ciertamente era consejo del Demonio, porque, ya que poblauan en lugares altos, por la fortaleza para acometer y para defenderse, mas fuertes estuvieran juntos que deramados. Aora, por yndustria de los religiosos avnque con muy gran trabajo, los hazen bibir juntos y por hordem y concierto; y si esto estuuiese hecho, asi para la policia humana como para la christiandad, haria mucho al caso, porque podrian ser visitados con mas facilidad, (fol. 29 vto.) y evitarse ian las ydolatrias, sodomias, borracheras, estrupos (sic), adulterios y homiscidios que cada dia se cometen por estar tan partados (sic). Sienten mucho el congregarse, porque, como dize el moro, desean mucho bibir y morir en la ley, casa y tierra de sus padres y abuelos: y naturalmente son enemigos de los *Spanoles*, o porque les reprehenden sus vicios, o porque tienen poca semejança con ellos; ca, como dizen los philosophos, la semejança es causa de amor. Las casas de sus moradas son de adobes y madra, y tan perqueñas que en vn dia se puede hazer vna: las puertas y ventanas d'ellas, muy pequeñas: ningun aderesco tienen sino sola vna estera, que llaman petate, por cama.

Cervantes de Salazar, 1914, pp. 33-34.

Torquemada, however, modifies this statement by restricting this dispersed settlement pattern to certain areas of Mesoamerica as the following quote makes clear.

"Y a se ha dicho, en vno de los Capítulos pasados, como estas Gentes Indianas estaban pobladas en estas Tierras, en Pueblos, y Ciudades (como luego veremos) y declaramos tambien el modo de la Ciudad, y la intencion, que al principio tuvieron, los que las fundaron; pero no todos los Moradores de estos larguissimos, e innumerables Reinos, guardaron, inviolablemente, este orden, y modo; porque como las Tierras no son iguales, asi no

todos pudieron seguir vn parecer. Por lo qual vemos, que si los de la Tierra Llana guardaron el orden de Ciudad, y Congregacion concertada, no lo pudieron guardar, ni seguir por este modo, los que poblaron Sierras, y Montañas, y orros Lugares cenagosos, y humedos; y asi vemos (y vieron los Pasados) que en algunas Provincias, y Regiones, tenian estos dichos Naturales a trechos, como a manera de Barrios, de la misma manera, que en Nuestra España estan esparcidos, y derramados, en las Provincias de Galicia, y en las Montañas.

Este modo de poblar, se ha hallado en los Reinos de Guatemala, y Provincias Totonacas, y Meztitecas, que caen en las Serranias de la Mar de el Norte, y en otras partes semejantes a las dichas; pero hase de advertir, que los pueblos, que hacian Cabeza, y Metropolis de la Nacion, o Provincia, tenia algun mas concierto, que las otras Poblaciones, o Congregaciones, sujetas, y pertenecientes a esta dicha Senoria, o Reino. En esta Principal Congregacion, y Cabeza, acostumbraban a tener sus Templos, y Culto (que por ser atribuido a sus Falsos Dioses) lo tenian sus Casas mui sumptuosamente labradas: Acompañabanlas otras Casas de Gente Principal, y Noble; y aunque no en Calles formadas, al menos, en orden concertada, conforme el Lugar les daba mano, y larga a su deseo. Y esta Congregacion (en alguna manera confusa, y derramado) era en Numero de ciento y ducientas Casas, y en partes mas, y en partes menos: El otro Pueblo (digo los demas de esta Nacion, o Senoria) que era como Miembros de esta Cabeza, estaba derramado, por los Cerros, y Serranias, por Valles, y Quebradas, que hacian Numero quantioso, y de grande exceso; y estos, se acomodaban, como cada vno, mejor, y mas podia.

Torquemada, 1943 ed., pp. 248-249.

Much more detailed sources are the relaciones, ecclesiastic documents, and tax lists for the period 1540-1580. The data are extremely useful but must be used with considerable caution, at least in some areas. The Spanish policy of congregacion has been previously noted. In those areas of Mesoamerica where the characteristic pre-Hispanic settlement pattern was very dispersed, the Spaniards collected isolated homesteads or small hamlets into large, planned, nucleated centers. In some cases the old ceremonial center was selected as the site, in others new sites were founded. In some areas, as in Yucatan, this process occurred as early as the mid-sixteenth century. In other areas, where relatively large nucleated settlements occurred, these were frequently combined into even larger communities or joined to previously existing urban communities. The demographic disasters of the sixteenth century reduced the population of many communities far below the 1519 level. In some cases even the regrouping policies did not compensate for population loss so that the Congregacion-sponsored town was not much larger than the pre-Hispanic cabecera.

The most difficult problem, however, in using the data is the flexible meaning of the Spanish word "pueblo". In most of Spain the pueblo was not only a social community but a physical one also, a large, compact, nucleated settlement.

When the Spaniards established their administrative system in Mesoamerica, they used the old Aztec city state as the primary administrative unit and called it a pueblo. As a result, many of the sources state that in New Spain the Indians did not live in "pueblos formados" but dispersed. However, this does not necessarily mean that the population of a pueblo was scattered in small groups over the landscape (although in some areas this was the case), but simply that the population of an administrative pueblo did not all live in one physical community.

In a previous section the Aztec city state was defined as a sovereign territory under a "natural lord" or hereditary ruler. It averaged approximately 150 km.² in size and the modal population of 20,000-30,000. This was the largest political group recognized by the people themselves as a legal unit. The ruling class (with its secular, religious, and military components), merchants, and full-time craftsmen resided in a cabecera or central community. This central community in the average state had a population of 3,000-6,000 people, was compact and divided up into barrios which varied from four to six in number. Apparently the residential areas of this cabecera were not customarily planned, at least in the smaller states, but there was a central plaza that served as a market and civic center. The civic center included a religious precinct that was composed of temples, convents and priestly schools, and a secular precinct where the palace of the ruler was located. The community itself had a great deal of internal social differentiation, with various religious, economic, and political specialists. The range of house types must have been considerable, according to the social status of the residents. In the Basin of Mexico these cabeceras became the center of Spanish administrative districts; the temple was replaced by a church, the palace of the ruler by municipal buildings.

A great number of the small rural settlements variously called aldeas, sujetos, barrios, and estancias in the post-Hispanic Period and that correspond to the Aztec calpulli were dependent on this central community. In each of these dependent communities the Spaniards built a church and assigned a patron saint. In the central cabecera, a patron saint was also assigned to each barrio and the community as a whole. In other words, they simply replaced the patron gods of the old social groupings with patron saints, and the hierarchial series of temples was replaced by a similarly graded series of churches. The town church had a resident priest who made "visitas" to the sujeto churches in a regular, formalized itinerary. Each rural settlement of calpulli in Aztec times had other architectural referents besides the pyramid temple, i.e., the chief's house, and telpochcalli school. The major problem, however, remains: What specifically was the physical distribution of the houses of the post-Hispanic estancias and Aztec calpullec? The sources are not clear. The ecclesiastic documents give only the population and patron saint of the cabecera; the patron saint, population, distance and compass direction of each estancia from the cabecera. When I first used the documents, I assumed automatically that the estancias, like the cabeceras, were compact nucleated settlements. However, the distances really refer to those between church and church, so that almost any physical distribution of houses was possible. In several cases the sources say that the rural dependent population was dispersed, in others it is not made clear.

The sources are equally vague about the physical distribution of the population of the subdivisions of the calpullec. Since they were called barrios pequeños, they were undoubtedly some kind of territorial units; however, the population may actually have been distributed evenly over the land holdings. The diagrams in figure 17 illustrate the possible alternative patterns that could have existed with the same basic social structure.

One of the most complete censuses of a sixteenth-century pueblo is that of Yecapichtla in the state of Morelos. The document dates from 1564 and was published under the title Los Bienes de Cortez (1946). The demographic data is summarized in detail in the following chart since it will be pertinent to the discussion of Aztec site patterns in a later section.

Date: 1564. Census taken by Zurita.

<u>Villa-Cabecera</u>	<u>Tequitanos</u>	<u>Tax Payers</u>	<u>Ave. No. of Tax Payers per Tequitano</u>
Mixtla-Barrio	11	394	36
Abatengo-Barrio	16	434	27
Ayapango-Barrio	2	65	33
Tecpa-Barrio	5	98	20
Tescala-Barrio	3	192	64
	<u>37</u>	<u>1183</u>	<u>32</u>

<u>Estancias</u>	<u>"Barrios"</u>	<u>Tax Payers</u>	<u>Ave. No. of Tax Payers per "Barrio"</u>
Suchitlan	8	96	12
Tecaxix	3	89	30
Tlachochoalco	7	140	20
Oyacatlan	3	124	41
Calapam	6	122	20
Ecatepeque	3	91	30
Texopa	3	64	21
Patzulco	8	79	10
Tlayacac	14	277	20
Xalostoque	8	223	28
Atotonilco	3	125	42
Tecpaltzyngo	4	319	80
Tetehuamaco y Tezayuca	3	71	24
Usuchapa	5	116	23
Atlacabaloya	3	72	24
Telistaca	4	145	36
Tecpa de Tetla	6	163	27
Xonacatepeque	9	647	72
Macuitcatlapilco	2	103	52
Chalcatzingo	7	201	29
Xaltetelco	18	432	24
Amayuco	6	235	39
	<u>133</u>	<u>3934</u>	<u>30</u>

Grand Totals			
Taxpayers	170	5117	30 ave.
Non-taxpayers			
Pipiltin (principales)	50	.8%	
Mayeques	738	12.5%	

Total taxpayers and nontaxpayers	5905
Average population of "barrio" in the villa	237 families
Average population of "estancia"	179 families
Average for both	189 families

The Teotihuacan Valley.

The discussion of sixteenth-century socioeconomic and settlement patterns up to this point has referred to general patterns characteristic of the Basin of Mexico as a whole. In this section the specific situation in the Teotihuacan Valley is summarized. The references to the socioeconomic organization of Texcoco are based on Ixtlilxochitl (1952).

In the fifteenth century the city state of Texcoco, located south of the survey area, conquered and exacted tribute from a number of neighboring states including those of the Teotihuacan Valley. The internal political and social organization of the conquered city states was not altered, the system being primarily one in which one state exacted tribute from other states. As the tributary empire expanded, the town of Texcoco grew into a city of perhaps 20,000-30,000 inhabitants. The temple precinct and palace of the tlatoque were considerably larger than those of the smaller states, and the city was divided into 30 craft-specializing calpullec. To this must be added the residential wards of the upper class. In order to facilitate administrative procedures, the calpullec were grouped into six major wards. This level of territorial organization was absent in the smaller urban centers.

The rulers of 14 of the conquered city states formed a council which assisted the Texcocan tlatoque in affairs of state. Their status seems to have been higher than that of the rulers of other conquered states. Most of them were relatives of the royal lineage of Texcoco; 11 of them ruled city states that lay within the Basin of Mexico. The capitals of six of the states were located within the survey area: Chiconautla, Tepexpan, Tezoyuca, Acolman, Teotihuacan and Otumba. Three former states, Axapusco, Cuautlancingo and Oxtotipac, were demoted by Nezahualcoyotl to a status directly tributary to Texcoco.

The sources that refer specifically to the Aztec Period do not give either boundaries or lists of dependent rural villages for these states. In the Teotihuacan Valley, however, the Spaniards seem to have maintained the status quo throughout the sixteenth century; each of the Aztec states was converted to a colonial pueblo. The only change was the conversion of Cuautlancingo, Oxtotipac, and Axapusco to the status of sujetos of Otumba. Therefore, the data that refer to the period 1521-1580 may be applied to the Aztec Period with some confidence.

The "Relacion de Tecciztlan" (Tequisistlan) contains lists of the sujetos or tributary villages of Tepexpan, Acolman, and Teotihuacan and a map showing their location (PNE Tomo VI-VII, pp. 209-236, 1905). In the case of the Teotihuacan Valley, the congregacion policy was not applied until after 1600 so that the settlement pattern still reflected Aztec patterns. Since a sharp population decline occurred between 1519-1580, numerous small communities disappeared. In 1580 Tepexpan had 13 sujetos; Acolman, 27; and Teotihuacan, 17. In a 1571 document, "Descripcion del Arzobispado de Mexico" (PNE Tomo III, 1905), Otumba is assigned 20 dependent communities. The data from the Relacion de Chiconauhtla (PNE, Tomo VI-VIII, pp. 167-177) suggests that Chiconautla was one of those rare cases in which the entire

population of a city state resided in a single, large, physical community. No data are available for Tezoyuca. Regional markets are located on the 1580 map at Acolman, Tepexpan, and Teotihuacan.

Unfortunately, few of the sources that deal with the valley give population figures for the individual communities. The Relacion of Chiconauhtla states that the town once had a population as large as the entire "corregimiento" in 1580, about 2000 tributaries. This would imply a community of 8,000-10,000 people. In the Abecedario de Visitas (PNE Tomo I, 1905) the cabecera of Acolman and two estancias "junto a ella" had a population of 1,324 "casados". This figure predates two of the three major sixteenth-century epidemics (i.e., 1531-1544), and would suggest a population of the cabecera in 1519 of only 5,000-6,000. In the same document Teotihuacan is assigned 690 "tributarios", a figure probably referring only to the cabecera (the Suma de Visitas is one of the oldest, most confused and inconsistent of all the tax lists), since 40 years later the pueblo (entire unit of jurisdiction) had "1600 tributarios". This would mean a population for the cabecera in 1519 of approximately 4,000-5,000. Otumba, following the Descripcion del Arzobispado de Mexico, had 557 tributaries in the cabecera or a population of perhaps 4,500-5,500 in 1519. The above data would seem to indicate that the central towns of cabeceras had population ranging from 4,000-10,000 in 1519.

Population data for tributary settlements is limited to two groups of sujetos, one tributary to Tepexpan, located in the area north of Cerro Gordo, the other tributary to Otumba. The population size of this sample of 36 sujetos in 1571 ranged as follows:

Number of Tributarios	Number of Communities
0 - 49	2
50 - 100	10
101 - 200	12
201 - 300	6
301 - 400	1
401 - 500	3
501 - 600	2

The relationship of the 1560-1580 cabeceras and their tributary domains to the survey area and the population of their districts may be summarized as follows:

1. Tepexpan. The cabecera and one sujeto are located within the valley proper; six other sujetos are in the area on the north slope of Cerro Gordo included in the survey, and the rest are outside the survey area. Population 1580 - 950 tributarios; estimated population 1519 - 8,000-12,000.

2. Acolman. Of the 28 dependent villages, approximately half were located within the survey area. Population 1580 - 1990 tributarios; estimated 1519 population - 16,000-24,000.

3. Teqiciztlan (Tequisistlan). This village was elevated to cabecera status by the Spaniards and made the center of a corregimiento. It was probably a sujeto of Tezoyuca in 1519. In 1580 it had two sujetos, and all three communities were within the Teotihuacan Valley. No population figures are given.

4. Otumba. The cabecera and all but two of the 29 tributary villages were located within the survey area. The total population in 1571 was 6,482 tributarios; estimated population 1519 - 40,000-60,000.

5. Chiconautla. The cabecera was located within the survey area. The population in 1580 was 440 tributarios. The relacion states that it once had 2000, which would yield a population of 8,000-10,000 for 1519. On the other hand, employing the same formula that was used in calculating the 1519 populations of Acolman, Teotihuacan and Tepexpan, the population of Chiconautla reduces to 4,000-6,000.

6. Tezoyuca. No data.

7. Teotihuacan. The cabecera and all of its tributary villages are situated within the survey area. Population 1580 - 1,600 tributarios; estimated population 1519 - 13,000-20,000.

The total 1519 population for the five states (excluding Tezoyuca), plus the area taken from the private domain of the Texcocan kings in the Upper Valley (i.e., Axapusco, Cuautlancingo, Oxtotipac), would amount to 85,000-116,000. Tezoyuca's district could not have been larger than that of Chiconautla, which would bring the total up to 89,000-122,000. Of this total, approximately 75,000-100,000 resided within the survey area.

The zonal pattern in 1580 corresponded closely to present-day patterns. All of the cabeceras of the six Aztec states were located within the Teotihuacan Valley. The bias in favor of the Delta is evident since three cabeceras were located there (Tezoyuca, Chiconautla, Tepexpan), only one in the Lower Valley (Acolman), a fourth at the springs (Teotihuacan) and only one (Otumba) above the springs. The primary factor was undoubtedly the greater significance of the lakes in trade and transportation.

This last-named factor also may explain some of the peculiarities of the spatial arrangements of the sixteenth-century territorial units. Normally in the Basin of Mexico, each Aztec Period state was a small, compact, physical territory with all of the sujetos located within a few kilometers of the cabecera with mutually exclusive boundaries. In nearly all cases the cabecera was near the lake shore and the sujetos extended in a band inland. In the case of the Teotihuacan Valley, however, the subject communities of Tepexpan, Acolman and Teotihuacan occurred over a wide area and were intricately interdigitated. This was especially true of the sujetos that occurred north of the survey area. Some of the dependent villages of Tepexpan were located 30 km. northeast of the cabecera. (See a discussion of this subject in Gibson, op. cit.). The apparent desirability of locating a cabecera near the lake and the limited amount of land available nearby operated to produce these peculiar territorial patterns.

Approximately 65 rural communities were located within the survey area in 1580. The patterns of distribution were undoubtedly the same in 1519, since the congregacion policy had not yet been applied to the area. The map in the relacion, therefore, is an excellent guide to rural Aztec zonal settlement patterns. Undoubtedly many more communities were present in 1519, because a large number disappeared during the population decline in the sixteenth century. Ixtlilxochitl states that in Nezahualcoyotl's time, when Cuautlancingo was demoted from cabecera status, it had 27 sujetos, nearly as many as the entire new administrative districts of Otumba (of which Cuautlancingo was only a small part) in 1571.

PART VI

PRE-HISPANIC OCCUPATION OF THE VALLEY

In the three parts of this discussion of the pre-Hispanic occupation of the Valley (i.e., Settlement Patterns, Demography, Agricultural Techniques and Land Use), the order of presentation of data for the various time periods does not follow a consistent sequence, nor is it organized in terms of chronological order. This is intentional and is based on the problems of interpretation of archaeological data. In the following section (Settlement Patterns) for example, the Aztec Period is summarized first because it is the one period where documentary data can be used to relate archaeological features to social and economic institutions as described by the sixteenth-century writers. The Aztec Period then serves as a basis for inferences about pre-Aztec time periods and is treated first.

Settlement Patterns

Aztec Period.

Introduction. With the exception of the deep soil plains and steep hillsides it is difficult to survey a field in the Valley without finding some traces of Aztec occupation. Aztec pottery and structural remains are extraordinarily abundant. The areas of gentle to medium slope on both sides of the alluvial plain are covered by a nearly continuous strip of settlements making the definition of a site a serious methodological problem. In many cases designation of a site was completely arbitrary, but in most cases varying density of house remains was the primary criteria used. House structures generally are not evenly distributed and there seems to be vague clustering. Each of these clusters was called a site. Following this usage, approximately 200 Aztec sites were located, of which 120 have been intensively surveyed. (See figure 11). The 200 probably represent about two-thirds of the existing sites in the survey area. The general impression one has is that the period was one of very intensive land use and extraordinarily dense population.

On the basis of excavation and survey the Aztec Period has been divided into three, possibly four, phases. The three definite phases are called Zocango, Chimalpa and Teacalco and they correspond closely to Vaillant's old Aztec II-III-IV (1944) or Espejo and Griffin's Tenayuca, Tenochtitlan, Tlatelolco divisions (Griffin and Espejo, 1947-1950). The possible fourth phase is pre-Zocango (tentatively called Hueoztoc), but it is not the standard Aztec I or Culhuacan (i.e., it lacks black/orange and the B/W on red Polychrome is unusually abundant). Very few Zocango Phase sites lack later Aztec occupation, but numerous Chimalpa-Teacalco Phase sites lack a Zocango component, suggesting a rapid population growth and considerable community stability during the general period.

Community Patterns. Most Aztec sites are of the type noted above, continuous strips of small sites associated with terraces on the piedmont. The density of population of these strips approximates that of modern Scattered and Low-Density Compact Villages. It is not, however, the only type of Aztec settlement. In fact nearly all of the variations in settlement pattern noted for the modern period occurred during the Aztec Period. Large, compact, nucleated villages similar to modern Atlatongo, Xometla, Cuanalan and Chipiltepec are found in the Lower Valley. In the north tributary valleys and high ridges of the Patlachique Range the density of house remains in some Aztec sites is similar to that found in modern Compact Rancherias like Palapa. Finally, six sites have been classified as urban. All are much larger than rural sites, with populations in the thousands, very densely nucleated cores, more ceremonial architecture, formal planning in the civic centers and elaborate residential architecture. The identification of Aztec towns was based primarily on documentary references to the cabeceras of sixteenth-century pueblos-city states. After the locations of such sites were established from documentary sources, the archaeological patterns were defined. Aztec Period towns, therefore, will serve as a test of methodological problems in the archaeological identification of urban communities for the survey area.

Urban Settlement. In the discussion of modern settlement patterns, the problems of defining the term urban and its cognates were discussed. We stressed that urbanization is a complex of four, basic, interrelated processes (nucleation, population growth, specialization, social differentiation) and that the end product of the process was the growth of cities. Since urbanization is a process, then it also follows that, if found in a particular culture, communities in all stages of evolution toward cities should be expected. The Aztec settlement pattern data illustrate the validity of this argument to a striking degree. Methodologically, all four of the noted processes are measurable on archaeological sites. The density and distribution of residences combined with chronological control should provide the researcher with data on physical and population size, population density and population growth; range in quality of housing and settlement pattern within the site may illustrate social differentiation; and biases in artifact distribution can reflect specialization. Dormitories for religious specialists, secular palaces and imposing civic centers combined with the above criteria would establish the relative status of urban versus dependent rural sites in a gross sense.

Of course, survey alone in any particular site might fail to yield some of the data and excavation might be required. As noted above, the problem of identifying the socioeconomic centers for the Aztec Period was simplified by the documentary data. The number of centers, approximate location and general characteristics were known, the archaeological problem was primarily to define the degree or level of urbanization achieved in the Teotihuacan Valley centers. Four of the six cabeceras of the sixteenth century were completely surveyed, and one partially surveyed. The data is summarized below.

TA-9 (Chiconautla). The Aztec town is located on the piedmont immediately adjacent to the lake shore plain. The modern village has apparently moved down into the plain and expanded into the dessicated lake bed. At the lower edge of the site the piedmont edge was remodelled into a huge platform or terrace. On top of it, along opposite sides of a plaza is a

pyramid and a huge rambling mound that may have been the palace of the tlatoque. Pottery is heavy all over the mounds and terrace, so that the latter probably contains other buried structures as well.

Vaillant conducted an extensive excavation at Chiconautla but we could not determine the precise location. Local testimony was in sharp conflict over the location of his excavation. A map drawn by Vaillant in his report to the Mexican government seems to locate it within the urban core to be defined shortly. The excavation uncovered a group of three houses arranged around a court. The house on the north side of the court was the largest and consisted of seven apartments grouped around the northern, eastern, and western sides of a patio, which was open to the south. Each apartment generally consisted of two rooms, including a porch and combination kitchen-sleeping room (based on the presence of hearths). Facing the court on the western side was a small house consisting of two similar apartments. On the southern side of the court was a third house composed of three, similar, two-room apartments plus smaller auxiliary rooms, possibly for storage.

The architecture, especially when compared to the rural houses excavated at Teacalco and Cuanalan, was fairly elaborate with porches, platform substructures under the rooms, ascending stairways, and extensive use of lime plaster. Vaillant, probably for these reasons, identified the group as the palace of the tlatoque. The plan, however, does not seem to suggest a royal residence. The frequency of kitchens, small size of rooms and apartments and lack of specialized, interdependent functions of parts of the complex all suggest that each building was the residence of a kin group with apartments assigned to nuclear families. The houses are small enough to have been residences of extended families (i.e., two to seven nuclear family apartments).

More probably the complex is simply part of an urban core and the higher quality of the architecture reflects social class differences within the town itself. Residential mounds outside the core at Chiconautla very closely resemble those in rural sites.

To return to the site pattern as a whole, the total surface area of the platform is 3.3 hectares. This area presumably was the civic center of the town with a temple, a palace, probably a market, and possibly other upper class residences. Primarily upslope, but also extending along both sides of this complex, is an area of dense pottery concentration, abundant building debris, and traces of the plaster floors of residential structures. The area has been systematically looted (one informant stated that a large pyramid was once located there) and severely eroded. The evidence is conclusive, however, that this area (nine hectares) was covered by densely concentrated residences. In this paper such densely settled areas, when found in Aztec sites, are referred to as urban cores.

The core is located at the base of and within a strip of settlement perhaps 750 km. wide that extends up the piedmont and middle slope of Cerro Chiconautla for a distance of three kilometers. In places the strip extends down to the lake shore. The total surface area of the strip is 225 hectares. Outside the core, the settlement through this strip was much more dispersed, but of varying density with houses scattered over one of the most complex terrace systems in the Valley. Parts of the latter are still in use, but most if it has been abandoned. All drainage in this area and generally on the slope of Chiconautla has been canalized.

The population density of the core must have been at least as high as it is in Compact High-Density villages in the area today and was probably more similar to that of the more urbanized blocks of the Villa of San Juan. The total pattern of the site is strikingly similar to that of the modern compound community of San Juan Teotihuacan-San Juan Evangelista-Purificacion-Puxtla and probably had the same broad range of settlement density and levels of urbanization. If the densities from the modern compound community are applied, they would yield the following population estimates:

Urban Core	500 - 1000
Suburban Periphery	2000 - 4000
	<u>2500 - 5000</u>

The data seem to indicate that the lower population figure from the previously cited sixteenth-century documents is more probable.

A special problem at Chiconautla is the usage of the term *barrio* by the Spaniards. The relation of 1579-1580 does not assign any sujetos to Chiconautla but does make the following statement:

"...pueblo se fundo y esta fundado en medio de quatro cerros pequeñas y por esta se llamo Chiconauhtla; tiene este pueblo quatro barrios que se llama el uno Capulpan Yacanqui (sic), que quiere dizir en muestra lengua castellana 'caseria principal'; Y el otro se llama Aguateopan, que quiere dizir 'lugar de yerba berde'; Y el otro se llama Ticoman que quiere dezir 'postura de una mano'."

(Relacion de Chiconautla, Papeles de Nueva España, Vol. VI, VII, p. 168.)

Possibly only the *barrio* of Capulpan Yacanqui was located at TA 9 and the other three were in other sectors of the slope of Cerro Chiconautla.

TA 12 (Acolman). One of the problems of the survey was the location of the Aztec cabecera of Acolman. The politically organized district of Acolman has persisted from Aztec through colonial times to the present day, but the location of the cabecera has shifted. In the sixteenth century the Augustinians built a convent in the alluvial plain and apparently some population concentration developed in the vicinity of this convent. In the eighteenth century a huge dam or dike was built across the Valley between Tepexpan and Cuauhtlan that resulted in the formation of a pond in the area around the convent, its consequent burial under accumulated sediments, and ultimate abandonment. The population that resided there moved to a small, low rise in the middle of the plain nearby. A sister village called San Nicolas Yauhtenco previously existed there. In the nineteenth and twentieth centuries this new community's name had changed to Calvario Acolman and it became the cabecera of the municipal district.

The 1580 map shows the Augustinian convent and a few houses in the alluvial plain, but the "comunidad" or government houses, the market, and the heaviest concentration of houses are all located on the piedmont near the edge of the plain, approximately at the location of the modern compound village of Santa Catarina Acolman-Tenango. Furthermore, neither of the latter two communities is listed as a sujeto of Acolman in the relation. There seems to be little doubt that TA 12, located in and around the modern compound village of Santa Catarina-Tenango, is the Aztec cabecera. It is the only site in the area with urban characteristics and the only site large enough to fit the status of Aztec Acolman. Conceivably, the cabecera was located near the site of the Augustinian convent, but no conclusive

archaeological evidence exists. Of course, it could have been covered with silt as a result of the construction of the big dike. Several monumental sculptures of the Aztec and probably Toltec Periods were found when the silt was cleaned out of the convent by archaeologists from the Instituto Nacional. Another possibility is that the Acolman town site extended from Santa Catarina to the convent, but again no archaeological proof that such was the case has been found.

The modern villages Santa Catarina Acolman and San Antonio Tenango are located on a small hill on the edge of the irrigated plain. To the north of the hill, the terrain slopes down to a broad depression between it and Cerro Chiconautla. To the east and south the hill abuts directly on the alluvial plain. To the west the hill merges gradually into the relatively flat strip of piedmont that overlooks the plain. The modern settlement is confined to the top and sides of the hill. TA 12 is a huge site that underlies all of the modern villages and extends beyond them to the north and west. Since much of the site lies beneath the modern villages, the pattern is somewhat obscure.

A small ceremonial plaza bordered by a pyramid six meters high and three small, low mounds is on top of the hill. The urban core is adjacent to the plaza and immediately downslope. Erosion is severe on the hillside, especially where modern streets serve as drainage washes, so that the size of this core is difficult to ascertain by survey alone. A large, continuous, rambling mound that runs under modern houses and covers at least one hectare is located near the plaza. Within the houses chunks of this mound have been destroyed by modern constructions, and plaster-surfaced walls and floors have been exposed (in one case two levels of floors, in another an Aztec floor is being used as the floor of a modern house). The concentration of rock and pottery suggests a very congested plan. Modern streets surrounding this area have obliterated any further traces, but residential mounds and heavy pottery concentrations may be detected in streets and houses on the other sides of these streets over a total area that is at least seven and possibly as much as 20 hectares in size.

A band of relatively heavy, but lighter settlement dispersed through modern terraces and houses is located around this postulated core. Structural remains are not visible in surface survey (in some cases floors were reported by informants), but rock debris and pottery are abundant. This area covers some 40-50 hectares. The general impression is that the Aztec population density in this area was similar to that of modern Santa Catarina-Tenango.

Beyond this zone to the north and west is a band of lighter settlement, outside the limits of the modern community. In this area a few residential structures have escaped destruction, and they are similar in appearance to rural Aztec house remains. Although occupation is heavy on the mounds themselves, they are separated by areas with scanty occupation. On the northern edge of the village is a cluster of a dozen or so such mounds in an area of five to six hectares. The population density in this section would be very close to modern Scattered Villages or Low-Density Compact Villages. To the west the peripheral settlement has a decidedly "rural" appearance with a string of semi-isolated clusters of residences strung along the piedmont edge. This band extends all the way to the Tepexpan town site and links the two big towns.

The hill on which the main part of the site is located is made up of volcanic ash and gravel; large ancient quarries may be detected on the upper flank. One of these undoubtedly dates from pre-Aztec times since the Aztec ceremonial precinct is located within it.

Excluding the band of settlement along the piedmont, the site may be assessed as follows:

	<u>Size in Hectares</u>	<u>Population Density per km²</u>	<u>Population</u>
Definite Nucleated Core	7	10,000	700
Possible Additional Nucleated Core	13	10,000	0-1,300
High-Density Compact Settlement	50-40	5,000	2,500-2,000
Peripheral Low-Density Band	40	1,000-2,000	400- 800
			<u>3,600-4,800</u>

TA 11 (Tepexpan). Modern Tepexpan consists of two social and territorial divisions. The main segment of the community, Tepexpan proper, occupies a great square 500 m. to a side and is located on the edge of the piedmont overlooking the alluvial plain. The plaza and its associated public buildings are situated at the lower end of the village. Attached physically to Tepexpan is a dependent barrio called Chimalpa that extends along the edge of the piedmont with houses lined up along both sides of a single street for a distance of one kilometer.

The Aztec town site corresponds to an extraordinary degree to the modern village in extension and plan. The Tepexpan church is located on the base of an Aztec pyramid and the modern plaza probably functioned as the main plaza in Aztec times. Adjacent to the plaza, an area measuring approximately 12 hectares has continuously heavy Aztec occupation in the form of rock debris and sherds. Actual residential mounds are scarce, probably as a result of post-Hispanic destruction. No evidence was found of a core of very densely nucleated residences and the density of the central 12 hectares was probably closer to that of modern irrigation villages. Tepexpan then had a less urban appearance than either Chiconautla or Acolman.

Considerably lighter sherd densities indicate that extensive suburbs were to the north of this concentrated settlement and extending east through Chimalpa. Remains of a large pyramid are in Chimalpa. This suburban fringe is about 30 hectares in size. Settlement to the south and west ends abruptly at the alluvial plain as at Acolman and Chiconautla.

The population of Tepexpan might be assessed as follows:

	<u>Size in Hectares</u>	<u>Population Density</u>	<u>Population</u>
Compact Center	12	5,000	600
Periphery	30	1,000-2,000	300- 600
			<u>900-1,200</u>

The town of Tepexpan was considerably smaller than other towns in the Teotihuacan Valley. Its small size surely relates to the reduced size of its holdings in the irrigated plain. Nearly all of its sujetos were located outside the Valley. The holdings of Chiconautla were even more reduced, but the latter apparently was a major trade center for traffic from the lakes up the Valley of Teotihuacan and was located at a transportation break. Furthermore, the Teotihuacan Valley was the main route out of the

Basin of Mexico to points east, and Chiconautla apparently was a significant stop along this route. Informants today refer to an old lake port at the lower edge of the Aztec site.

The existence of a string of small settlements was previously noted that linked the two towns of Tepexpan and Acolman. A series of small settlements is immediately north of the Tepexpan town site around Cerro Colorado and the big compact Aztec village site of Cuanalan is located 500 m. to the south across the narrow neck of the alluvial plain between the Lower Valley and the Delta. The two towns, the Cuanalan village site, and noted smaller settlements together formed one of the largest population clusters in the Valley in Late Aztec times with a total population of perhaps 5,000-9,000 people.

TA 100 (Otumba). The Otumba town site has been tentatively identified as TA 100, a large Aztec site located on the southern edge of the modern town and distributed entirely outside of it. The modern town is located in the middle of the Upper Valley plain. The Aztec site is on gently sloping piedmont on the edge of the plain with its nucleated core situated between and astride two barrancas immediately above their juncture. A sizable area of the site has been carved away by the lateral expansion of the barrancas. The barrancas were considerably shallower and narrower at the time of Aztec occupation. Plaster floors of almost obliterated residential structures have been exposed by lateral erosion.

As in the case of Chiconautla and Acolman, the site has a central area of continuously heavy occupation in the form of rock rubble and pottery that presents a gently undulating appearance. Within this area is a nucleated core where traces of plaster floors are found. The core covers five hectares, the central area an additional 25.

One curious absence at TA 100 is ceremonial architecture. Two, big, low rambling mounds 40-50 m. in diameter could either be the basal remains of badly destroyed pyramids or multiroomed residential buildings. Since colonial Otumba was a center of Spanish religious and secular control, the zeal of the padres would explain their destruction. Another possibility is that the elevated substructure beneath the church in the middle of modern Otumba is a reused Aztec pyramid base and that the ceremonial precinct was located there. The present-day plaza of the town (situated in front of the church) may have functioned as a market and civic center in the Aztec Period (as it does today). The problem here is that the colonial-modern plaza and church are located 300 m. from the edge of TA 100 and nearly 1000 m. from the core of the site. In all other Aztec town sites in the Basin of Mexico, the civic precinct is located in the center of or immediately adjacent to the residential zone. An isolated location like the one suggested for Otumba would be peculiar, although it is typical of Aztec rural sites.

The densely-settled central area lies within a concentric band of more dispersed settlement where sherd concentrations are lighter (except on and near house mounds). Where preservation is good, the density and distribution of house remains are similar to those of rural sites. Erosion has played havoc in this area with ancient house remains; many Aztec houses appear today as heaps of loose rock and sherds on bare tepetate.

The total area covered by this band is perhaps 170 hectares. On the basis of this data the population may be estimated as follows:

	Area in Hectares	Population Density per km. ²	Population
Central Area	30	5,000-10,000	1,500-3,000
Periphery	170	1,000- 2,000	1,700-3,400
			<u>3,200-6,400</u>

Evidence of possible barrio craft specialization was found at TA 100. In two small areas of the site unusually heavy surface concentrations were noted of obsidian workshop debris and figurine molds respectively.

TA 22 (Teotihuacan). Aztec Teotihuacan has been the most difficult of the Aztec-Colonial cabeceras to evaluate archaeologically. Today it is the most highly urbanized community in the Valley, especially the Villa section of the compound community. The attached barrios have a more rural way of life and settlement pattern (excepting possibly Purificacion), although the population density of San Juan Evangelista is relatively high (2200 per km.²).

The modern compound community occupies a band varying in width from 500-750 m. extending along the lower edge of the piedmont for 2250 m. If the semi-isolated barrio of Maquixco were to be included, this strip of settlement would have an extension of 3500 m. One of the barrios, Puxtla, lies within the alluvial plain with its houses very thinly dispersed through the chinampas.

The survey reveals a similar band of Aztec settlement of varying intensity extending from Maquixco through San Juan Evangelista, La Villa, and Purificacion. The Aztec site, however, extends upslope beyond modern settlement in the form of barranca side pseudopods of occupation. Survey also indicates that the Aztec Period populations scrupulously avoided the deeper soil areas at the edge of the alluvial plain for settlement whereas the modern population has invaded this area to some degree. (The barrio of Puxtla lies entirely within it, and houses of the other barrios also extend into the plain).

The survey has not revealed ceremonial and urban core zones similar to those in other Aztec towns. No evidence of an urban core was found in the area of the present villa. Of course, the methodological problems of sedimentation in the plain and destruction by the recent urbanization of the La Villa-Purificacion barrios presents problems of archaeological interpretation. The survey results, however, are probably conclusive on this point.

Unfortunately, the survey was not extended into the archaeological zone of Classic Teotihuacan. That Aztec occupation in the Classic city is extensive is known, but its precise pattern and distribution will have to await the results of Millon's project. Very probably a band of substantial Aztec settlements extends as far as the Sun Pyramid and the latter and its associated plaza were reused by the Aztec Period population as the primary ceremonial precinct of the town. A strong case in favor of this argument is presented by the following statement from the *Relacion de Teccistlan* (op. cit., pp. 221-222).

"Thenian por ydolo principal a Guitzilopochtli, el qual por mayor beneracion estaua en la ciudad de *Mexico* en el *cerro de Chapultepec*; sin este abia otros ydolos menores en el pueblo de *San Juan*, que era el templo y oraculo donde acudian los pueblos comarcanos: tenian en el dicho pueblo vn cu muy alto en el qual avia tres descansos para poder subir a lo alto; en la cumbre del estaua vn ydolo de piedra que llamauan por nonbre Tonacateuctli, el qual era de vna piedra tosca y

muy dura, todo de vna pieca: tenia tres braças grandes en largo y otra en ancho y otra de gordor: estaua buelto al poniente, y en vn llano que se azia delante del dicho cu estaba otro cu mas pequeño de tres estados en alto en el qual estaua otro vdolo poco menor que el primero llamado Mictlanteuctli que quiere dezir señor del ynfierno: este estaua buelto azia el primero asentado sobre vna peña grande quadrada de vna bara en quadra por todas partes; poco mas adelante, a la parte del norte, estaua otro cu poco menor que el primero que llamauan el *cerro de la luna*, en lo alto del qual estaua otro ydolo grande de casi tres braças que llanauan La Luna; a la rredonda del auia muchos cues en vno de los quales, el mayor dellos, avia otros seis ydolos que llamaban Hermanos de la Luna (1), a todos los quales los sacerdotes de Montesuma señor de *Mexico* benian, con el dicho *Montesuma*, cada veinte dias a sacrificar: thenian todo el ano disz y ocho diestas, cada veinte dias vna fiesta, en cada vna de las quales tenian diferentes serimonias, como esta declarado en la discripcion del pueblo de *Aculma*, a que me rrefiero, al numero catorze: sobran cinco dias en vn ano que ese era bisiesto porque cada quatro anos serraban al numero de beynte que era vna fiesta en vna plaça grande que se hazia entre los dichos cues; en medio della avia un cu pequeño de dos estados en alto donde justiciaban a los malhechores y delinquentes (2)."

Confirmation of this documentary data has recently been established by an excavation of the Instituto Nacional de Anthropologia y Historia. The plaza in front of the Sun Pyramid during Early Classic times possessed a wide, processional stairway flanked by small pyramids which permitted free access from Main Street. In either the Toltec or Aztec Periods a crude stone wall was constructed, covering the front of the small pyramids which faced the main street and sealing off the entrance. This wall also continued along the southern side of the Sun Pyramid plaza covering Classic facades and controlling access on that side as well. Apparently, the later population walled off the plaza, controlled access more strictly than in Early Classic times, and converted the pyramid and plaza into a new ceremonial precinct. In view of the documentary reference above, the wall was either built or reused during the Aztec Period.

Possibly the urban core of the Aztec town was located within the archaeological zone in the area between Purificacion and the Sun Pyramid, but confirmation will have to await the results of Millon's survey.

Documentary data also suggest that the four villages now located on the archaeological zone, San Sebastian, Santa Maria Coatlan, San Martin de los Piramides, and San Francisco Mazapan were all Aztec villages. Today these communities form a single physical community; if the situation were similar in Aztec times they would have appeared as a great suburban settlement attached to the area postulated as the core of Aztec Teotihuacan.

If the above reconstruction is correct, a continuous band of Aztec Period settlement of variable density and ranging in width from 500-1500 m. would have extended for 5000 m. along the piedmont from Maquixco to San Martin. This would have been the largest Aztec population cluster in the Valley.

On the basis of the surveyed sites the following summary may be made about urban settlement patterns in the Valley for the Aztec Period:

1. All towns but Chiconautla are located in critical positions with regards to agricultural exploitation of the Valley. The distribution and variable density on the sites suggests that the small Aztec towns were transitional urban settlements, and that at least part of the population was at least part-time farmers.

2. The tendency of towns to be located near the lake is probably a reflection of the importance of trade in their growth. Chiconautla may have even been a professional transportation community as Chalco in the southern Basin of Mexico seems to have been.

3. All town sites are considerably larger in size and population than the rural units we are calling sites.

4. The towns (excepting Otumba, where evidence is lacking) all have formally planned civic precincts with more imposing ceremonial structures than rural sites. Such precincts were probably more imposing even than the archaeological remains indicate. A point that must be stressed is that Aztec towns became colonial towns and much of the civic architecture was systematically destroyed by the Spanish priesthood.

5. In each case (excepting Teotihuacan, where the evidence is lacking) the settlement pattern is one of bands of settlements of varying density with a tightly-nucleated, residential core and with the density gradually thinning out towards the edges. Furthermore, residences in the center were of superior construction with use of lime plaster, worked stone, and had more rooms. In the core, houses apparently were closer together, separated only by alleys and courts. Toward the periphery, houses were smaller and the pattern was probably similar to the modern dispersed houselot.

6. The population, size, and plan were all similar to modern urban communities in the Valley, especially to San Juan Teotihuacan. The calculations would indicate that towns had populations ranging from 1,000-10,000 (the latter figure is for Teotihuacan and includes the attached rural settlements).

7. The data from Otumba hints that towns were divided into wards of craft specialists as in the case of larger Aztec urban communities Texcoco and Tenochtitlan.

Rural Sites. According to the 1580 map, a series of sixteenth-century communities were located on the edges of and within the Lower Valley alluvial plain. Nearly all of these settlements are occupied today and their locations have not changed. These are Xometla, San Pedro Tepetitlan, Chipiltepec, Zocango-Cuanalan, Totolcingo, Tepexpan, Acolman, Nepantla, and Atlatongo on the edges of the plain; San Bartolo, San Juanico, and Santa Maria in the center. All are Compact High-Density Villages with adobe house construction. In such villages houselots are small, have less open space and the courtyard is usually of carefully swept, pounded earth so that conditions are very poor for archaeological survey. Only one of them was intensively surveyed, Cuanalan. Superficial survey indicates that the others were similar to Cuanalan.

At Cuanalan a row of relatively large houselots occurs along the southern and eastern edges of the village where some cultivation is practiced. These fields are either just within the plain or on the edge of it. Opportunities for archaeological observation are better here, therefore, than elsewhere. The southern band is about 800 m. long and 80-100 m. wide.

At the eastern edge of the village the area involved measures about 200 m. square (40,000 m²). Pre-Hispanic occupational remains in the form of sherds and stone tools are continuously heavy in this area, but few structural remains are present. Building stone is rare, suggesting adobe houses, a supposition supported by excavation since the lower walls of a part of a Zocango Phase house built of rectangular adobes was discovered.

The total occupation comprises three periods: Cuanalan (Late Formative), Toltec (mostly Xometla Phase), and Aztec. The Aztec-Toltec distributions are coterminous and run continuously for a distance of 500 m. along the southern edge to include all of the 200 m. square area of large houselots on the eastern edge of the village. In the rest of the modern village scattered Aztec-Toltec pottery and an occasional floor may be detected, but the houselots are small and so thoroughly swept that ascertaining the density of occupation from survey alone is impossible.

The Aztec occupation in the southern and eastern periphery is heavy enough to suggest a community as compact and tightly nucleated as modern Cuanalan. This nucleated area is about 10 hectares. The total area of Aztec-Toltec occupation is approximately 20-25 hectares, the size of the modern village. A few, widely-spaced, small sites are located on the lower flank of Cerro Tezoyuca adjacent to the eastern edge of the village.

The data would seem to indicate that the Cuanalan site was an Aztec village comparable in size and population to the modern village. Superficial survey of other modern, sixteenth-century villages in similar ecological locations demonstrates that this pattern is typical of villages in the Lower Valley-Delta area.

With the exception of these Compact High-Density Villages of the Lower Valley-Delta, most Aztec sites fit into a type we are calling strip settlements. Physically they appear as relatively compact clusters of 10-40 houses arranged along terraces and distributed like beads on a string, forming almost continuous bands of settlement in areas of gentle to medium slope. A few scattered houses between the clusters make delimiting one site from another exceedingly difficult in some areas. Therefore, the definition of a site has varied during the progress of the survey. Where obvious clusters are apparent, each has been designated a site; in cases where large numbers of mounds are almost evenly distributed through a much larger area, they have all been included in a single site number.

Sites of the latter type may be simply the product of the post-Hispanic erosion where only pieces of the pattern have survived. More probably, however, variations in Aztec settlements were based on varying relationship of social to physical communities and minor variations in topography.

As we have noted previously, four social groups had territorial significance in Aztec society: the nuclear family, the extended family, *barrio pequeño* and the *calpulli*.

The *calpulli* was the entire rural community in most cases and a tightly-integrated social group with multiple functions: religious, political, economic, educational, military and social. Each *calpulli* had its own patron god (possibly a deified ancestor), was governed by a chief, and possessed a school where young men were taught religious and military skills. Archaeologically, then, *calpulli* divisions should be indicated by pyramid temples, schools and chiefly residences. The *barrio pequeño*'s social functions, on the other hand, are very vaguely defined. The only definite

function assigned to it was that of tax paying. It was, however, clearly a territorial unit.

The extended family may have resided in a single building or in a group of buildings; the sources are not definite on this point. In the latter case extended family residences should be recognizable from survey; in the former case, excavation would be necessary to test it. The nuclear family might have occupied an apartment in a multifamily house, or an entire house. Here again excavation would be needed to resolve this point.

The small clusters noted above correlate very neatly in size to the *barrio pequeño* in both range and mode. No evidence of houses grouped in smaller clusters the size of an extended family was noted, indicating the probability that extended families resided together in one building or possibly several, very closely-spaced buildings.

Since the *barrio pequeño* had only incipiently political and no religious or educational functions, no civic structures should be expected. Only some of the archaeological clusters possess such structures.

In cases where the *barrio pequeño* clusters are arranged in linear bands, an occasional pyramid, group of pyramids, or multiroomed residence (probably 10-15 rooms) may be distinguished interspersed at widely-spaced intervals along the strip settlement. These structures are usually in a peripheral position to one of the *barrios pequeños*--above, below or at either end of it. Apparently, several *barrios pequeños* used these civic buildings; this larger group presumably equates with the *calpulli*.

In many cases, however, as was noted previously, the *barrio pequeño* is not definable; rather, the site consists of a great number of residences scattered evenly through a terrace system, but associated with the aforementioned types of civic buildings.

In the Lower Valley the compact High-Density Villages, almost certainly constituted entire *calpullec*. The *calpulli*, therefore, tended to be a compact physical community only when agricultural productivity and techniques were appropriate (as in the case of the Lower Valley villages), or when urbanization occurred (as in the case of towns where *calpullec* were ward divisions of the community).

In summary, the *calpulli* was the most significant social grouping that varied in plan and population density according to socioeconomic factors such as urbanization and productivity of agriculture, or geographic factors such as topography. To judge from the close relationship between land and site characteristics, the principal factor at work seems to have been ecological, based on the interaction between culture and environment. The *calpulli* tended to be a physical unit of varying degrees of compactness when ecological conditions permitted.

Houses in the more dispersed settlements appear as small, low, oval mounds of rock, earth, and sherds varying from five to 15 m. in diameter. When these were first noted, we supposed that they were house platforms similar to those of Maya sites, probably with small adobe or stone huts constructed on their summits. In a number of sites, however, partition walls were noted on the surface suggesting that, in fact, they were formed by the debris of collapsed walls and roofs of small two to four room houses of stone and earth.

At TA 40 one of these houses was completely excavated. The reader is referred to figure 13b for clarification of the following description. The house consisted of five rooms, not all of which seem to have been used

simultaneously. Rooms B-C form an obvious discrete apartment, and were constructed first, Room C apparently being used as a kitchen since it possessed a hearth. Room D was constructed next and, although it shared a wall with C, did not have direct communication with it and had an outside entrance. As it also had a hearth, it probably functioned as a one-room apartment for both sleeping and cooking. Room E was added next and ultimately A, the two forming another apartment with a hearth located in E.

At some time in the history of the house, the door between rooms B-C was intentionally filled in with rectangular adobes (a frequent occurrence in modern houses) and room B abandoned. Rooms B-C-D have two hearth and floor levels and traces of older buried walls, whereas E-A had only a single floor level. Sherds on room floors were abundant and in all but rooms E-A were almost entirely of the Chimalpa Phase (Aztec III). In rooms A-E the distribution was about half Chimalpa, half Teacalco Phase (Aztec IV).

The above data seem to suggest that the residential unit began with one nuclear family, expanded to two, possibly three and was reduced to one at the end. A single, alley-like entrance communicates with both apartments E-A and B-C. The mound itself was of a size typical of Aztec residential mounds in general, so that the data should be useful in estimating the population of Aztec settlements.

Very probably the residents of houses similar to the one excavated comprised patrilocal extended families. The generally small size of Aztec houses would indicate that such families were not large.

Construction materials and techniques used in the excavated Aztec house included pounded earth for floors, uncut stone laid in earth for walls, cut stone for doorways and corners, and mud plaster for finishing walls. The upper portions of walls were probably built of adobe bricks. Hearths are shallow rectangular pits rimmed by a low wall constructed of a single layer of stones and are filled with charcoal and ash.

Ceremonial Centers. A type of site common only in the Aztec Period is the isolated ceremonial center. All ceremonial centers are found on hilltops and have no apparent relationship to population clusters. They consist of a single pyramid or plaza complex; ceremonial pottery is abundant and residential structures absent. They are almost certainly connected with a mountain-rain-god cult. They occur on tops of large and small hills and many still function as Catholic shrines. Crosses, and in some cases rather elaborate chapels, have been built on the tops of Aztec pyramids.

Zonal Patterns. The relationship between the distribution of rural Aztec sites and variations in topography is extraordinarily close.

In areas like the southern and eastern piedmont of the Valley (where the topographical cross section includes a moderately wide alluvial plain bordered by a narrow piedmont, in turn succeeded by the steep slope of a continuous range of hills) Aztec sites form an almost unbroken chain along the piedmont, a huge strip settlement nearly 12 km. long. In this area, in addition to the piedmont strip settlement, Aztec occupation tends to trickle up the barrancas where the latter descend from the hills. Within the piedmont the band of settlement tends to occur at the upper edge, near the edge of the bordering steeper slopes. Sites of this type in the Lower Valley occur just above and parallel to the big, compact, plainside villages.

Cerro Chiconautla dominates the northern edge of the plain in the Delta, and produces a divergent topographical pattern. Most of the hill consists of gentle slopes merging with the lake shore on the west and southwest, or with a small area of alluvial plain to the south. The plain, therefore, is a minor factor in land use. Settlement occurs as a series of isolated clusters scattered all over the flanks of the hill on terraces (excepting the town site of Chiconautla), and with an overall attenuation of settlement density upslope.

The north piedmont in the Lower Valley is wider than that of the south, and is bordered by isolated hills separated by wide passes. Aztec settlement here is linear also, but occurring as strips encircling the hills. Along the edge of the plain itself are the two towns of Tepexpan and Acolman, and several, large, compact villages.

The close relationship of Aztec settlements to topography is beautifully illustrated by the case of Cerro Gordo. Aztec settlements are distributed in an almost continuous band around the base of this huge hill. Aside from this general pattern, however, the specific distribution on the northern and southern sides differs strikingly. Test areas eight square kilometers each were intensively surveyed on both sides.

On the southern side is a narrow, gently sloping piedmont between the hill and the highly productive alluvial plain of the Middle Valley. Aztec sites are distributed in a meandering band varying in width from 200-600 m. over a distance of six kilometers. Residential mounds occur five to 20 m. from each other in clusters of 10-50, each cluster thinning out on the edge, but merging into the next to form an almost unbroken chain of settlement. Each cluster was defined as a site, 11 being defined in all. Evidence, although not checked by intensive survey, indicates that the density drops off slightly to the west, where a similar band begins along the western flank of the hill. The 11 sites also seem to split into two divisions separated by the residential area of the modern village of Tolman (which was apparently thinly settled) suggesting two calpullecs.

The basic pattern of individual sites is similar on the northern slope, but their relationship to each other--the zonal pattern--is different. In this case alluvial plains that might have several as a focus of agricultural activity are absent, so that the hillsides and gentle slopes were the primary areas of cultivation. Drainage is radial with barrancas flowing downslope like spokes in a wheel, ultimately merging to form major streams separated by low ridges. Aztec sites are scattered in linear fashion down the ridges and associated with ancient terraces.

Aztec site distribution in the Upper Valley also reflects the delicate relationship of site distribution to land forms. In this area the topography, as stated previously, consists of a small alluvial plain bordered by a very wide, gently sloping piedmont to the south and southeast, the latter shifting abruptly to a continuous range of hills. To the northeast and north the piedmont is bordered by small isolated hills. The piedmont to the east and south is traversed by a network of barrancas that descends from the hills and converges near Otumba. To the north and northeast barrancas are fewer in number because of the absence of hilly ranges.

The town site of Otumba is located in the southern edge of the plain. Aztec rural sites in this area tend to string up the ridges between barrancas as on the northern slope of Cerro Gordo. In one test area a band of sites runs almost continuously from the edge of the town site to and

extending into the lower flanks of the bordering hills. Aztec sites on the northern side of the Upper Valley encircle the small hills in typical strip settlements.

Where low, flat-topped, isolated ridges occur in the Middle Valley, such as at Oxtotipac, Cuautlancingo, and Tlaltica, they were favored locations for Aztec settlement. Aztec occupation sites are rare on the steep slopes of hills like Cerros Malinalco and Gordo and are not common in the Patlachique Range. When they do occur in the latter area, they are situated on relatively flat-topped ridges, intermontane plains, or fronting on barranca flood plains, areas where erosion has been less severe (the only areas where modern cultivation occurs).

Formative Period.

Introduction. In 1955 Piña Chan published a general study of the pre-Classic or Formative occupation of the Basin of Mexico. In this report he listed the known number of sites and occupations. These included three for the period he called Early pre-Classic (El Arbolillo, Tlatilco, Zacatenco), 10 for the Middle pre-Classic (which included the above three plus the new sites of Atoto, Coatepec, Xaloztoc, Lomas de Becerra, Copilco, Azcaputzalco, Tetelpan), 18 for the Late pre-Classic Period (Ecatepec, Xaloztoc, Zacatenco, Ticoman, Azcaputzalco, Lomas de Becerra, Cuicuilco, Contreras, Tetelpan, Cerro de la Estrella, Cerro del Tepalcate, Tlapacoya, El Tepalcate, Chimalhuacan, Papalotla, Tepetlaoztoc, San Sebastian, and Teotihuacan). Discounting multiple occupations, recorded Formative localities up to 1955 totalled only 21 for the entire basin. In his 1958 monograph Tolstoy records the location of an additional seven Formative sites but as he does not phase them, they are not included in the following discussion.

This picture of a very small population was extremely puzzling, since it gave the impression of an extraordinarily feeble supporting population for the construction of such huge centers as Cuicuilco and Early Teotihuacan. Furthermore, no sites at all had been reported in the entire northern third of the Basin of Mexico (except the Tzacualli occupation at Teotihuacan). As a matter of fact, all but six sites were located within a short distance of the capital. Only one Formative site, and that dating from the final phase, was reported for the entire Teotihuacan Valley. Research after 1955 has located a Middle Formative occupation at Tlapacoya, two Late Formative sites at Cuanalan and Tezoyuca in the Teotihuacan Valley and a Terminal Formative site at Temesco (Dixon, 1963), near Chimalhuacan.

Although a detailed discussion of Formative chronology will not be presented at this time, the Teotihuacan Valley Project has resulted in a body of data that will significantly modify the Basin of Mexico chronology.

We are defining a very early Zacatenco Phase, called Altica, which Bennyhoff (personal communication) feels predates Vaillant's earliest levels at El Arbolillo. Temporarily the Altica Phase also includes Piña Chan's Early pre-Classic, since phase divisions have not yet been defined. In this report the phase name Chiconautla will be used for the segment of time Piña Chan calls Middle pre-Classic.

In the final phase of the Formative Period the situation is considerably more complex than suggested in previous studies. Without going into details of ceramic comparisons, the problem may be summarized as follows:

1. At Ticoman, Vaillant defined a Late Formative Period (Upper Middle culture) and divided it into three phases. Excavations at Cuicuilco demonstrated that the ceramics there fitted neatly into this system.

2. Prior to Vaillant's excavations, Kroeber in 1924 had excavated a tunnel into the Sun Pyramid at Teotihuacan and demonstrated the general Formative affiliations of the collected ceramics. He suggested that the material was from the oldest phase in the history of the city. In 1933, Perez excavated a second tunnel and Noguera did a detailed study of the relationship of the material to Vaillant's Upper Middle culture. In 1943, Noguera excavated another site near Chimalhuacan called El Tepalcate; and the pottery seemed to be closely linked to that from the Sun Pyramid. The ceramic complex was subsequently called Teotihuacan I, until in 1950, Armillas shifted the Teotihuacan chronology to a name system and renamed the phase Tzacualli.

Several crucial problems emerged concerning the Tzacualli complex. One was the question of its time position with respect to Vaillant's Ticoman sequence. Most researchers were in agreement that the complex fitted into the general Late Formative time period, but they disagreed on whether it was a regional variant of Ticoman, partially or completely contemporary with the latter, or Terminal Formative and post-Ticoman instead.

A series of arguments also developed around the following two questions:

1. Was there a cultural and population break between Tzacualli and Miccaotli (Teotihuacan II)? Many writers felt that the Tzacualli occupation represented a small rural population with no connection to the later Classic development. The latter was supposed to be the product of the immigration of a new population with more advanced cultural characteristics; some writers (Medellin 1953, Pina Chan 1960) thought that the new population came from the Gulf Coast.

2. Was the Sun Pyramid built in Tzacualli times? If so, it throws considerable doubt on the previous hypothesis and suggests definite architectural and artistic continuities between Tzacualli and Miccaotli. No one questioned the strong local affinities of Tzacualli to the other Formative complexes of the Basin of Mexico, although Noguera did postulate that strong influences from western Mexico were involved. If the Sun Pyramid were built during this period, it would seem to suggest that such influences went the other way.

Millon, in two papers (1960, 1961) based on survey and excavations, elucidated these problems with fresh data. He was able to demonstrate that the Sun Pyramid was undoubtedly built toward the end of the Tzacualli Phase at the latest, and that it was a single great building project, implying the presence of a substantial population for the general period. He also discovered a large Tzacualli Phase urban community with ceremonial architecture that covered several square kilometers within the border of the Classic city. In view of this data, continuities with the later Classic occupation seemed certain. As the product of their mapping project, Millon and Bennyhoff (personal communication) are defining a series of good transitional phases between Tzacualli and Miccaotli ceramics, thus substantiating the data from architecture and settlement pattern.

In this paper a body of new data will be presented from the rural survey that supports this conclusion. Also, data from excavations and survey of the Teotihuacan Valley Project demonstrate conclusively that no chronological overlap occurred between Ticoman and Tzacualli. Not only do

sites of Vaillant's final phase of Ticoman occur in the Teotihuacan Valley (several within a few kilometers of the city itself), but also the two phases are separated by a new, intermediate phase we are calling Tezoyuca-Patlachique. This phase shows strong continuities with both the Ticoman that precedes it and the Tzacualli that succeeds it and is similar to Noguera's pottery from his Chimalhuacan excavation.

The evidence strongly favors cultural and population continuity in the Teotihuacan Valley from the first occupation by Formative villages throughout the phases of the Formative, Teotihuacan and Early Toltec Periods. The western influences suggested by Noguera for Tzacualli actually began as early as the Cuanalan Phase.

The chronology to be used in the following analysis is presented on page 16.

The project has revealed, in comparison with previous research, an extraordinary number of Formative sites and occupations. There are approximately 150 separate localities recorded where remains of some phase of the Formative Period have been found, of which perhaps 100 have good substantial occupations. Of these about half precede the Tzacualli Phase. Over 200 occupations (counting each of the chronological phases in the chart as an occupation and including trace occupations) have been defined, and this figure will undoubtedly increase as the laboratory processing proceeds (many Early Classic sites have Tzacualli occupation and the samples have thus far been only cursorily examined). The approximate number of occupations per phase is as follows:

Altica	5
Chiconautla	18
Cuanalan	29
Patlachique	67 (including 5 Tezoyuca sites)
Tzacualli	95

Altica Phase. Only three definite sites are recorded for this phase, plus two localities with trace occupations. (See figure 4). All three of the substantial occupations occur within a single tributary basin (a tributary of the Barranca de San Lorenzo) well up in the Patlachique Range. The tributary has a deeply cut bed and is bordered by a narrow flood plain of deep soil. To the north this plain is bordered by a high, flat ridge with very steep sides. To the south a great number of smaller tributary streams, all of which have very deeply cut canyon-like beds, feed into the main tributary. On this southern side are steep, sloping hillsides and small valleys cut by the noted streams. All drainage today is seasonal, and erosion of slopes and stream beds is severe. Agriculture is limited to the flood plain and relatively flat ridge tops or small alluvial terraces bordering the streams. Two of the Altica Phase sites are located on the high north ridge, the third at the head of a tributary valley. All are of hamlet size and occupation is light, indicating small settlements of well-spaced houses. One of the trace sites is in the same area; the other is in a very odd locale for sites of this period--on top of the Santa Catarina hill. It is represented by a few sherds in one field within Classic site TC 4.

Chiconautla Phase. The Altica focus of population in the Patlachique Range continues and expands during this period. All three of the Altica Phase sites continued to be occupied and, in the case of two of them, the occupation increased in intensity. The Altica type site (TF 4) suffered

an apparent loss of population while one of the trace locations of the Altica Phase expanded into a substantial occupation during the Chiconautla Phase and three new sites appeared (see figure 4). All of the new sites are located at the upper piedmont near the base of the Patlachique Range on gentle slopes and near major streams. All the streams have deeply cut beds today. All the sites are located in severely eroded areas. In the general area of the Patlachique Range are a total of seven sites, plus a trace occupation.

Chiconautla Phase occupation has also been located in three localities on the archaeological zone of Teotihuacan, one of which is substantial. Two small, but heavily occupied sites are located on opposite sides of Cerro Gordo (TC 1 and 117), each in a location at the upper edge of the piedmont where gently sloping terrain shifts suddenly to steep slopes. They are also situated near the edges of deeply cut barrancas.

In addition to these, Chiconautla sites include a small lakeside settlement at Venta de Carpio (TF 1), traces of either Chiconautla or an early phase of Cuanalan occupation from the lower levels of the excavation at the Cuanalan Phase type site (TF 38), and one hamlet located in the Upper Valley on the piedmont edge near Hacienda Cuauhtenco (TF 209).

All of the settlements are small, fitting into our classification of hamlets, and the occupation generally is light over the site area. In some sites, where preservation is better, well-spaced, small areas of relatively heavy occupation probably represent destroyed house sites. No preserved structures have been found on any Altica or Chiconautla Phase sites. Survey revealed no evidence of specialized ceremonial buildings or community stratification. All sites, except those at Cuanalan and Venta de Carpio, are very severely eroded, so community patterns cannot be worked out in any detail. The community density was undoubtedly toward the lower range of modern communities in the Valley.

The focus of settlement apparently remained in the Patlachique Range, but with some colonization of Cerro Gordo and the establishment of small settlements in the plain and lake shore areas.

Cuanalan Phase. During this phase, several new patterns emerged: more diversification of community size; generally more nucleated, densely settled communities; and an apparently more evenly distributed population over the segments of the Valley as a whole.

Two basic community types may be defined for this period, the hamlet and the village. Both are compact, nucleated settlements, similar in density to modern Compact Villages in the area. The plainside communities in the Lower Valley-Delta were probably as densely settled as villages in the same area today. No definite ceremonial architecture is associated with any of the settlements, nor are there isolated ceremonial structures or complexes.

The largest community of this time period is TF 38, the type site at Cuanalan. It is located just within the edge of the alluvial plain in the Lower Valley (figure 5).

The site is deeply pitted by sand quarries. The pitting has exposed extensive archaeological profiles and the density of pottery, burials, house floors and walls indicate a settlement density equivalent to modern Cuanalan. The area covered by this dense settlement measures six hectares, so that the total population probably was between 250-300 people, a small village.

One complete house and part of another were excavated. Both houses had hard-packed earth floors and walls constructed of irregular lumps of adobe laid in earth mortar and covered by mud plaster. The completely excavated house consisted of a single room four meters square with an earth ramp or stairway entrance on the southern side and a lean-to kitchen on the northern side. Hillside communities of this period have heavy rock debris; the fragments are similar to those used in Classic and post-Classic walls. This would suggest a pattern in Cuanalan times similar to the post-Classic and modern and related to the distribution of raw materials, with adobe houses in the plainside communities and stone houses in piedmont and hilly terrain. Similar rock debris occurs on all Formative sites in hilly areas.

TF 35 is similar in size and density to TF 38 and the two are the only sites classified as villages. Both are located near the edge of the alluvial plain.

The rest of the sample includes 21 hamlets and six trace occupations. Two hamlets (TF 74 and 4) are located on the edge of the alluvial plain (one on the lake shore); the rest are in hilly terrain, so that the prediction of the Formative population for such areas apparently continues during the Cuanalan Phase. One major change, however, is a temporary decline (see next section) in the significance of the Patlachique Range as a focus of settlement.

The occupation of the Patlachique Range does include two clusters of hamlets, one near Cerro Xiquillo (six sites), the other above Santiago Tepetitlan (five sites). Of these, all but two are new localities, indicating a partial break in specific settlement location with the past; but the general ecological setting of sites is similar to that of the preceding Chiconautla Phase. Outside the Patlachique Range, all Chiconautla Phase sites except TF 1 have continuing occupation during the Cuanalan Phase.

Four hamlets and a trace occupation were located on Cerro Gordo (TF 32, 11, 115, 116, 132), and two on Cerro Malinalco (TF 39, 105). Three were located in the Upper Valley, two of which occurred near Hacienda Cuauhtenco (TF 65, 69) at the upper edge of the piedmont near the headwaters of deep barrancas and the other on the hill of Oxtotipac (TF 93).

Patlachique-Tezoyuca Phase. Prior to the Teotihuacan Valley Project and even as late as 1960 (see Millon 1960) a considerable temporal overlap was assumed between Vaillant's Ticoman and Armillas' Tzacualli Periods. The project has demonstrated conclusively that not only is this incorrect (since our Cuanalan Phase is primarily Late Ticoman), but also that an entire intermediate phase can be defined which separates them. Millon suggested (personal communication, 1962) the existence of this transitional phase based on a surface sample collected from TF 101 (located on the summit of Cerro Cuatepec, above the town of Tezoyuca). Excavations were conducted at the Tezoyuca site by the Teotihuacan Valley Project in 1962. A detailed comparison of the ceramics with the Late Ticoman material from Cuanalan and also with Tzacualli was made in the annual report for the 1960-1963 field seasons (see Sanders 1963).

The ceramics from Tezoyuca qualify very well as a transitional complex between Cuanalan and Tzacualli. Nearly all forms seriated well with trends characteristic of those two periods, especially in the composite silhouette bowls and jars. The Tezoyuca complex could easily be considered as either Terminal Ticoman or Proto-Tzacualli, and its characteristics argue

convincingly for population continuity between the local Formative in the Valley and the later Classic tradition. Several of the diagnostic traits peculiar to Tzacualli, such as white-on-red and negative painting, are common in the Tezoyuca complex; the local variant of Ticoman (Cuanalan) has a higher percentage of these traits than do sites located on the other side of the lake.

The Tezoyuca type site (TF 101, see figure 6) is located on top of a small isolated hill in the delta; a pyramid and a small area of very dense occupational debris are located on the top of the hill. Just below the hill and on its lower flank is a large Aztec town site (unsurveyed) with ceremonial architecture. Aztec pottery is sparse on the Tezoyuca type site itself, but there is a possibility that the pyramid may have been an Aztec hilltop shrine. It has been pitted, however, and all of the exposed pottery is of the Tezoyuca Phase. Most Aztec hilltop shrines or ceremonial centers have ritualistic pottery, none were noted here. In view of this evidence, the pyramid is probably of the Tezoyuca Phase.

Confirmation of the presence of civic architecture in this phase was established by the 1962 excavation. A large platform mound was uncovered that was approximately one meter high and 13 m. square. It has a single, sloping talud, with a facing of irregular blocks of tepetate, and rock and earth fill. It apparently included three stages of construction, and there are indications that the base at least was faced with roughly-trimmed stone blocks placed over the tepetate. No traces of summit structures were detected, but earth floors were found outside the structure at its basal level. No stairway was located on the three, well-preserved sides; the eastern side was partly destroyed so it may have been located there. The precise function of the structure could not be determined. The great quantity of occupation refuse on and around the mound suggest an elite domiciliary function.

In 1963, five Tezoyuca Phase sites were located. All are situated on the summits of small foothills at the edge of the Patlachique Range, facing the Teotihuacan Valley. All but one are identical in characteristics to the type site and have one or two ceremonial buildings and a small, densely settled, occupation zone. The site areas range from four to nine hectares.

Also in the same year, approximately 62 occupations were discovered that presented a complex set of problems for understanding the terminal phases of the local Formative. The pottery from these sites seems to seriate into the general Tezoyuca Phase, but resembled more closely the pottery from Noguera's Chimalhuacan excavation than that of the Tezoyuca complex. Decorated pottery generally is rare and when it does occur it is almost all red-on-buff; negative and white-on-red are almost absent. The sites are all similar in size and density of remains to those of the Chiconautla and Altica Phases and lack ceremonial architecture. This new ceramic complex will be referred to as the Patlachique Phase or complex.

Generally speaking, one can trace closer ties between Cuanalan and Tezoyuca than between Cuanalan and Patlachique. On the other hand, both Tezoyuca and Patlachique show resemblances to Tzacualli but in different ways. For example, the Patlachique complex with the small size and relative rarity of vessel supports, presence of wedge and grooved lip jars, and prognathous figurines show very close ties with Tzacualli; but the latter is linked to Tezoyuca by negative and white-on-red painting, plus close similarities in composite silhouette and flat-base bowl forms.

A major problem remains concerning the space-time relationships between the Patlachique and Tezoyuca complexes. They obviously were not far apart in time, and both clearly belong in the phase between Cuanalan and Tzacualli.

In 1963, one of the graduate students, Michael West, wrote a thesis on the general Patlachique-Tezoyuca problem and came to these conclusions:

1. The location of Tezoyuca sites on hilltops near the edge of the plain and the tightly nucleated settlement suggested an unstable, competitive, social setting. Locally the shift of settlement from the Cuanalan Phase site at TF 38 on the plain to a nearby hilltop location (TF 101, the type site) seemed to fit the interpretation.

2. The location of TF 101 on top of a small, isolated hill in the plain and other Tezoyuca sites on hilltops at the edge of the piedmont indicated that part of the agriculture took place on the piedmont and adjacent plain. The site localities would seem to be ideal for the double function of defense and use of the lower-lying agricultural land. This seemed also to check well with apparent beginning attempts of the population to shift from hillside to valley cultivation during the Cuanalan Phase.

3. The very close relationship of Tezoyuca ceramics to those of Cuanalan argued that the Tezoyuca potters were descendents of the older population.

4. The distinctive Patlachique ceramics and their close linkage with more distant Chimalhuacan suggested that the makers of this pottery were newcomers, whose arrival forced the older population into defensive settlement locations.

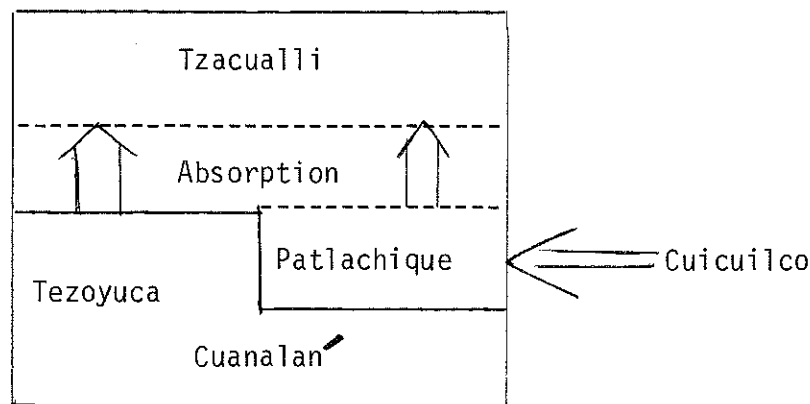
5. The Tzacualli ceramic complex has close ties with both Tezoyuca and Patlachique. West argued that there was an ultimate fusion of the two traditions at the inception of the succeeding Tzacualli Phase.

6. Moving further afield, he tentatively hypothesized that the Patlachique complex group moved from Cuicuilco after the eruption of Xitli.

The above argument is somewhat involved, but it does seem to explain some of the facts. However, certain problems are presented by this interpretation, and another possible explanation of facts does exist.

A glance at the map does not suggest a spatial separation between sites of the two complexes, which would seem to be needed to postulate two contemporary conflicting groups in the area.

Patlachique complex sites occur all over the survey area. Over half (37 of the 55) of the sites occur in the Patlachique Range where all but one of the Tezoyuca Phase sites are located. In his chronological chart, West summarized the situation as follows:



The chart indicates an absorption and replacement of the Tezoyuca populations by the invaders at the end. Following this argument, the Patlachique Phase sites in the Patlachique Range could be assigned to this absorption phase. No good evidence exists, however, for an early and a late division of the Patlachique Phase, and the great number of sites in the Patlachique Range would argue that at least some of them were probably occupied early in the phase. Furthermore the fact that all of the Tezoyuca sites have Patlachique occupation on them would cast further suspicion on the argument.

A final damaging fact is the absence (except possibly in the case of TF 36) of ceremonial architecture on Patlachique sites, all are dispersed hamlets. It would seem peculiar for the trait to disappear, and subsequently reappear in Tzacualli times, especially if the newcomers came from Cuicuilco or other southern Basin sites where ceremonial architecture was much more highly developed in the preceding Ticoman Phase.

The data strongly suggest that the differences between the Tezoyuca and Patlachique sites and complexes are hierarchial and symbiotic in nature rather than chronological, spatial or ethnic. Apparently, during this period in the Teotihuacan Valley elaborate cult practices and social stratification emerged in the local culture. The Tezoyuca sites may then be identified as the ceremonial-elite residential centers and the Patlachique sites as dependent rural communities. A parallel to this interpretation would be the apparent relationship between the cemetery and village site at Tlatilco.

TF 34, 33, 26, 25, 101 and possibly the hilltop component of TF 36 may be considered as centers of small organized states. A major problem of this interpretation is the absence of Tezoyuca sites in the great cluster of Patlachique sites at the eastern edge of the Patlachique Range. TF 22 has the densest occupation in that area, and two ceremonial structures are located near the site. The structures, however, have heavy Aztec occupation on them, but might be cases of Aztec rebuilding and reuse of older structures. The fact that the Tezoyuca complex was not identified on this site may not be significant. The site is very severely eroded and all of the pottery badly weathered. As has been indicated, the primary differences between the ceramics of the two complexes lies in surface treatment. Until the more detailed analysis of the sample is completed, either one of the two reconstructions is possible.

At any rate, on the basis of an evaluation of the settlement patterns of both Tezoyuca and Patlachique, the following generalizations may be made:

1. The phase witnessed the culmination of the Formative pattern of occupation of the Valley. The focus of population remained in the Patlachique Range with over half of the sites located there. A bias for hillside locations still existed.

2. The heavy concentration of population at TF 40, 101, and TF 36 and the location of Tezoyuca sites on the edge of the piedmont argue for an intensification of occupation and use of the lower-lying areas, a pattern that was initiated in Cuanalan times and sets the stage for the striking shifts in settlement patterns for the Tzacualli Phase to follow.

3. Judging from the number of sites alone, the total population of the Valley apparently doubled from the previous Cuanalan Phase.

4. Extraordinary continuity exists between Cuanalan occupations and that of the general Patlachique Phase, not only in terms of Valley sectors

exploited, but also in specific site locations. Few Ticoman localities were abandoned for settlement, although some slight local shifting did occur at TF 36, and from TF 38 to TF 40. The major changes lie in the increase of the number of settlements and establishment of new population foci. These facts seem to argue for strong population continuity between Cuanalan and Patlachique.

5. During the phase, two basic settlement types existed: fairly large but dispersed hamlets, and smaller, tightly-nucleated population centers associated with specialized religious structures.

The ceramics of the Tezoyuca complex are so obviously derived from the earlier Cuanalan Phase that one would expect settlement continuity as well. On the contrary, all Tezoyuca settlements occur in new localities, strongly supporting the interpretation as a new settlement type reflecting changes in social structure.

Tzacualli Phase. The problems of the relationship of Tzacualli to the preceding Formative Phases and later Classic Teotihuacan have been discussed. The work of Millon and Bennyhoff has demonstrated conclusively strong continuities in settlement pattern, ceramics, art and architecture between Tzacualli and the later phases. The reader is referred to Millon's 1960 and Millon and Bennyhoff's 1961 papers for a detailed presentation of their arguments. In this paper new data will be summarized on rural Tzacualli settlement patterns from the Teotihuacan Valley Project and on urban Tzacualli from Millon's preliminary report of his Teotihuacan Mapping Project (1964).

Urban Settlement Patterns. On the basis of Millon's research, a huge area measuring three square kilometers was defined as an urbanized zone during Tzacualli times. The local place name is Oztoyahualco and it is located within the perimeter of the Teotihuacan Period city. Overlying this Tzacualli settlement is a heavy Xolalpan Phase occupation, so that the settlement pattern during the Tzacualli Phase is not entirely clear. Ceremonial precincts of the Tzacualli Phase are present with earth-stucco-plaster and earth-tepetate and stone construction in the form of platforms arranged around courts. Surface evidence of Tzacualli occupation occurs in localized zones rather than evenly over the area of three square kilometers. Of course, the superimposition of Xolalpan occupation with its large multi-roomed houses would tend to cover and obscure the earlier pattern.

The area seems to show planning of ceremonial precincts during the Tzacualli Phase, but probably not of residential zones. Until Millon's Mapping Project is completed, evaluation of the settlement pattern is difficult. His 1961 map shows Tzacualli occupation only in areas near and on ceremonial complexes. The following possible settlement pattern alternatives are suggested by his data:

1. A ceremonial center in the Maya sense with little accompanying concentration of population.

2. A community comparable to Aztec towns in the Valley with a small, densely nucleated core and more lightly populated peripheral areas to the core. The Xolalpan occupation could conceivably cover much of the occupation area.

3. A large, densely nucleated, continuous settlement, probably unplanned. At the end of the period the Sun Temple was built and the population apparently shifted to a new locus in the center of the Early Classic city. Somewhat later Main Street was laid out.

Rural Settlement Patterns. Millon's Mapping Project disclosed a large area of Tzacualli occupation to the northwest of the perimeter of the later city and continuous with the defined town of three square kilometers (TF 42, 43, see figure 7). In his preliminary report, he includes this new area as an integral part of a huge town and estimates that the total area of this town was seven square kilometers.

Here as with the definition of the edge of the Early Classic city is a problem of site definition. The Teotihuacan Valley survey somewhat overlapped this postulated northwestern extension of the town. The density and distribution of remains is more similar to the rural site clusters we have located in other parts of the Valley. Before discussing the interpretation of his data, however, reviewing the situation in the rest of the survey area will be useful.

There is an extraordinary correspondence in rural settlement pattern between the Tzacualli Phase and the Teotihuacan Period, and a striking change of pattern occurred between the general Formative Period prior to Tzacualli and the Tzacualli Phase. The data is summarized below by ecological zone:

1. Patlachique Range. Not a single definite site was located in this area, perhaps one of the most striking facts about Tzacualli zonal patterns. This fact offers a startling contrast to the picture in the immediately preceding Patlachique-Tezoyuca Phase when over half of the population was located in the range.

2. Delta-Lower Valley. A small cluster of tiny, localized occupations was located on the lower edge of Cerro Chiconautla (TF 6, 14, 15); traces of occupation at TC 10 (TF 75), TC 6 (TF 136), TC 5, TC 13 (TF 140), TC 18 (TF 142); slightly denser concentration of sherds in the Classic samples from TC 4 (TF 135); a tiny, localized concentration at TF 11, and traces of occupation at TF 177. This summarizes Tzacualli occupation of the area. Most of the evidence of occupation consists of a light scattering of sherds in Early Classic sites. No substantial occupations occur in this area comparable to those of the Cuanalan and Patlachique Phases.

3. Malinalco Cluster. Cerro Malinalco is not defined as an ecological unit in our geographical survey, but because of the concentrations of Tzacualli sites on its lower flanks, it will be separated as a unit here. The hill is relatively large (maximum elevation 2600 m.), steep sided, isolated, and scantily occupied during the Formative Period as a whole (only two pre-Patlachique sites). During the Patlachique Phase, a cluster of settlements was located on the slopes of Cerro Colorado (a small attached cone just to the south) and in the saddle between the two hills, the first substantial occupation of the area. In the Tzacualli Period a band of small hamlets ran almost continuously from the edge of the Early Classic city to TC 5 along the piedmont, a linear distance of two kilometers. During the Tlamimilolpa and Xolalpan Phases, a dense concentration of large nucleated settlements was located in this same area. The Tzacualli occupation seems to have been in part the demographic base for this later Classic settlement. Local occupations are very small (varying in size from less than a hectare up to two hectares in size); in some cases they were probably occupied by extended family units. Partial survey of the lower edge of Malinalco's northern side indicates a strong possibility that this band may have circumscribed the hill. The parallel in ecological location to Aztec settlement is close but the density is

much less, a closer parallel would perhaps be to some Mazapan settlements. The new northwestern extension of the town that Millon refers to has in reality a settlement pattern quite similar to that of the piedmont of Cerro Malinalco and might just as easily be considered as an extension of this rural strip as an integral part of the town.

4. Cerro Gordo-North Slope. In contrast to earlier phases, a remarkable population explosion in the north Cerro Gordo area occurred. This explosion must be to a great degree linked to the even more remarkable demographic changes occurring south of the hill, i.e., the growth of the Patlachique Phase village into the town site and its associated rural settlements.

At least 30 sites are known for this phase within the test strip of eight square kilometers. It is difficult to say just how many sites actually exist, since numerous instances of small occupation areas separated by badly eroded terrain were noted; such areas may have been simply parts of a single, larger, badly preserved settlement. Furthermore, many of the large Aztec and Teotihuacan Period village sites have Tzacualli sherds mixed with the later periods, and the pattern is obscured by the more massive later occupations. Because of erosion and superimposed occupations, no house or site plans are available. Disregarding the problem of erosion, however, the typical Tzacualli settlement was probably similar to that of the earlier phases, small hamlets varying in size from several to a dozen houses. The sites occur fairly evenly dispersed over the survey strip; they string down the center of elevated ridges between barrancas, along barrancas, and along the bases of the isolated hills. The total pattern, in a demographically less intense way, parallels the later Aztec.

Adding up all the small sites and estimating approximately the occupation mixed with later sites, the total residential area occupied by Tzacualli sites is probably in the neighborhood of 20-25 hectares, a respectable population and a striking increase over the earlier periods. The largest individual site does not exceed two hectares, and most are less than one.

No ceremonial structures are known for this period in this area and the small variations in site size would seem to suggest no local community stratification. Presumably all were in a socially and economically dependent relationship to the central site at Teotihuacan. The sudden population growth has all the earmarks of an intentional, but not formally planned, colonization from that center. The density of ceramic remains in the Tzacualli sites would seem to indicate a settlement about as compact as a modern Low-Density Compact Village, i.e., 1000-2500 per km.².

5. North Tributary Valleys. Survey was limited to a few areas in this sector of the Valley. This point is emphasized here because of the dispersed character of Tzacualli rural settlement. All surveyed Tzacualli sites defined in this area except one (TF 29) are simply components of Teotihuacan sites. TF 29 has a pattern similar to that of the Malinalco strip. The setting consists of a small saddle between hills; the Tzacualli occupation occurs as a series of small, localized concentrations of pottery spaced along the perimeter of the depressed area. TF 29 lies within a typically Aztec strip settlement and is similar to it in plan but with a much less dense concentration of remains.

6. Upper Valley. The zonal distribution of Tzacualli sites corresponds strikingly to that of Early Classic sites in the same area. Some

Tzacualli occupation may be detected on nearly all Early Classic sites. With the exception of a relatively large, compact site at Oxtotipac, the Tzacualli settlement is quite dispersed; in some cases sites consisted of perhaps individual nuclear or extended families. The sites occur on low ridges or strips between barrancas, a setting quite similar to that of Aztec sites in the same area.

7. Middle Valley-North Piedmont. In the intensively surveyed strip along the northern piedmont of the Middle Valley four Tzacualli Phase sites were located, varying in size from a single house to a large hamlet of dispersed houses. The population was probably no larger than that of the Ticoman Phase and, as stated previously, the strip was abandoned for settlement during the Early Classic Period.

The following generalizations may be made with respect to occupation of the Valley during the Tzacualli Phase:

1. The emergence of the Early Classic zonal settlement pattern with a huge population cluster located partly within and extending well beyond the limits of the Early Classic city. Probably half of the population of the Valley was concentrated on the piedmont near and within the later city in a total area of perhaps 15-20 km.² with a focus of population within the northwest quadrant of the Early Classic city.

2. A concentration of ceremonial construction at one major site, with no known local ceremonial complexes comparable to those of the Tezoyuca Phase. The settlement pattern of this center is not known; the ceremonial precincts may have been an integral part of an urban community or a focal point for a large but dispersed population in the noted 15-20 km.² area. The lack of ceremonial architecture outside the center would seem to argue that the other population clusters (North Cerro Gordo, Upper Valley, North Tributary Valleys) also were integrated into a single society serving and served by the ceremonial precincts at the site of the Early Classic city.

3. A population clustering outside the central focus in the same sections of the Valley where Early Classic settlement tends to be concentrated.

4. A very dispersed rural settlement pattern similar in appearance (but much less dense) to Aztec settlements in the same ecological setting. These occur as linear strips along the bases of hills, between barrancas or on low ridges. The Tzacualli population showed a marked preference for gently sloping terrain.

5. A total population growth to perhaps several times that of the preceding Patlachique-Tezoyuca Phase. Approximately 90 sites are defined for this period, besides the big central community. At its end, the period is marked by perhaps the greatest single project in Mesoamerican history--the construction of the Sun Pyramid. The settlement pattern data demonstrate that the population was demographically capable of such a project. The highly dispersed nature of Tzacualli rural population also means that our sample probably does not include all sites actually present.

6. A sharp break with the past in ecological bias of settlement. Nearly all of the new foci of settlement on the Tzacualli Phase were areas of very light settlement in the preceding phases.

Teotihuacan Period.

Introduction. The following discussion is concerned with the long period between the inception of the Miccaotli and the terminus of the Metepec Phases, a total time span of perhaps 800 years.

The reader is referred to the chronological chart presented on page 16. for clarification of the following discussion. The variation in settlement patterns and population distribution was extraordinary during this period by both phase and ecological subdivision.

The major socioeconomic and demographic event during this long period was the spectacular growth of the gigantic metropolis of Early Classic Teotihuacan and the emergence of the Teotihuacan Valley as a major cultural center, not only in Central Mexico, but in Mesoamerica as a whole. Although approximately 100 villages, towns, hamlets, suburbs, ceremonial centers, and localized trace occupations are known for this period in the survey area, at least 60 percent, and in one phase (Metepc) 95 percent, of the population of the area was concentrated in this one, huge, physical and social community.

Before discussing the new survey data in detail, a brief summary of previous research on Teotihuacan Period settlement patterns is presented below.

Armillas (1950) was the first to realize the urban characteristics of the site. Previous writers (see Vaillant, 1944; Linne, 1934, 1942) had considered it a gigantic ceremonial center with a small, attached, elite, residential zone, Armillas described it as a true city and estimated its maximum size at 7.5 km.². He postulated that during the Miccaotli Phase it measured 2.5 km.² and expanded to its maximum size during the Tlamimilolpa-Xolalpan Phases. He furthermore postulated the existence of a regular street grid oriented to the axis of the Camino de los Muertos (Street of the Dead), and suggested the possibility that the Cuidadela was a combination secular palace-religious precinct, similar in plan, size and functions to the Aztec Tecpan. This interpretation was based on the presence of numerous rooms on the terrace near the Temple of Quetzalcoatl. North of the Sun Pyramid is a large plaza which he tentatively identified as the city market.

I first visited the site in 1951 and revisited it several times between 1951-1954. The data collected from those brief field trips plus Armillas' published studies were the basis for my 1956 paper (see Sanders, 1956). In that paper a similar plaza west of the Moon Pyramid was suggested as a market with associated obsidian workshops (based on the density of workshop debris). The presence of small, religious precincts scattered through the residential area was interpreted as an indication of cult centers for ward-like divisions similar to the calpullec of Tenochtitlan. These brief surveys confirmed the conclusion of Armillas concerning the urban nature of the site. A minimum population of 50,000 was estimated on the basis of the distribution, area, density of occupational debris and inference from comparative data from physically compact, modern communities in the Basin of Mexico.

In 1959 and 1960 Mayer-Oakes published a monograph and a paper with the first detailed discussion and analysis of Teotihuacan settlement patterns for the Basin of Mexico as a whole. The study was based on his survey and excavations at El Risco (a site situated across the lake from the Teotihuacan Valley), Tolstoy's surface survey of the Basin (op. cit.), excavations by Brainerd at Portesuelo (south of Texcoco) (unpublished), published and unpublished research by Vaillant at Azcapotzalco (Ahuitzotla-Amantla) and Teotihuacan, and published information of the general cultural characteristics of Teotihuacan, especially from the work of Linne (op. cit.).

On the basis of these data Mayer-Oakes postulated three types of communities in the Basin for the Teotihuacan Period:

1. Ceremonial-Elite Residential Center, of which Teotihuacan itself was cited as an unique example. This interpretation represented a revival of older ideas of the nature of the site, and was based primarily on Linne and Vaillant. It was directly contrary to the opinions expressed by Armillas, Millon, and Sanders. Mayer-Oakes' argument was based on the following considerations:

a. The lack of truly rustic, residential architecture: All known residences were large multiroomed structures with stone-earth-plaster construction with such fancy appurtenances as balustraded stairways, rooms built on platforms with talud and tablero facades; elaborate systems of courtyards, patios and drains; and accompanied in many cases by mural paintings. Small, poorly built houses of an industrial proletariat were absent.

b. In the residential complexes Linne reported an absence of kitchens, manos and metates (all the latter were above the final floor level and ascribed to the succeeding Mazapan Phase), and utility pottery. Mayer-Oakes suggested that the excavated residences (Tepantitla, Tetitla, Atelco and Xolalpan) were palaces or elite residences whose inhabitants were supplied with cooked food by peasant communities.

2. Proletarian residential communities of considerable size where "peasant craftsmen" resided and where residential and religious architecture was absent. Mayer-Oakes was bothered by the presence of large sites that were contemporary with Teotihuacan. He argued that the differences were functional and that the two types of communities played complementary socioeconomic roles, forming elements in a larger, Classic "community" that included all of the Basin of Mexico. Supporting evidence cited was the absence of ceremonial architecture at the sites of Portesuelo and Azcapotzalco, and the great size of the latter two sites, suggesting a non-agricultural function.

3. Rural settlements whose economic base was either the extraction of raw materials (salt in the case of El Risco) or agriculture. In the case of El Risco, the pattern was one of widely-spaced, small settlements dispersed along the lake shore.

In view of the results of Millon's Teotihuacan Mapping Project and the Teotihuacan Valley Project, this reconstruction requires drastic revision. It has obvious methodological and theoretical weaknesses, and the data from the above projects are in fundamental disagreement with the Mayer-Oakes interpretation. The hypothesis of an economically specialized and differentiated society made up of symbiotic units in which such units live in communities that are not only physically separated, but also widely spaced, seems unreal and aberrant. In all known societies of this type, specialized craftsmen live in the major centers close to markets and to the upper class that is their major clientele, forming what we have defined as an urban community. Farmers, of course, frequently do reside in smaller, socially dependent, but physically separated communities but professional craftsmen do not. Such rural communities may also have part-time craft specialties but professional full-time craftsmen always reside at the market center.

The supposed absence of manos, metates, and utility pottery is certainly the product of inadequate reporting of survey and excavation data. The

ceramic complex (Late Xolalpan), defined on the basis of the excavation of TC 8 and TC 46 (two villages), comprises a variety of ceramic types including the entire functional range of vessels from ceremonial to storage to serving and cooking food. All of these types are abundant in surface collections from the city. This is also true of manos and metates. Linne unfortunately published only gravelots of pottery, so his "sample" is indeed dominated by "ceremonial" pottery.

His arguments about the absence of hearths, and therefore of kitchens, and of rustic architecture, are not valid methodological supporting criteria. In the project excavations at TC 8, several houses were completely or partially excavated. The architecture is a duplicate of that in the city in plans, materials and quality. The same applies to the total range of technology; even such luxury items as Thin-Orange Ware, carved and fresco-painted pottery were found. Apparently Teotihuacan villagers enjoyed a relatively high standard of living, as did the Maya in the Belize Valley (see Willey, 1965). Curiously enough, with one possible exception, hearths are also lacking at TC 8. If we accept Mayer-Oakes' arguments, then villagers did not cook their own food either! This point will be elaborated on at a later point. Excavations conducted at TC 46 and TC 49 confirm this general picture.

Mayer-Oakes' arguments, with respect to Portesuelo and Azcaputzalco, also are unconvincing. Portesuelo does not seem to have been a large site during the Teotihuacan Period; its most extensive occupation was during the post-Classic. Azcaputzalco was of considerable size but several problems are involved in the assessment of the archaeology of this site. First, Vaillant and Armillas postulated that its maximum prosperity occurred during a period subsequent to the decline of Teotihuacan, so that it may well have been a much smaller site when Teotihuacan was a flourishing center. Vaillant called this period Teotihuacan IV, and Armillas renamed it Ahuitzotla-Amantla. Both Tolstoy and Mayer-Oakes have challenged the validity of this phase, and have suggested that Vaillant's Teotihuacan IV is simply a contemporary regional variant of the Xolalpan Phase. Data from the Teotihuacan Valley Project tend to support the Vaillant-Armillas hypothesis.

Second, the apparent absence of ceremonial architecture of the Teotihuacan Period at Azcaputzalco is surely an insecure base from which to derive conclusions. Parts of the site lie below the modern, colonial and Aztec towns, the first a community of over 100,000 inhabitants. Aside from the accidental destruction that must have occurred as the product of later urban growth, the accessibility to these later population centers would have made it an easily accessible source of building materials for later construction.

Finally, it seems to this writer that Mayer-Oakes has created an unnecessarily difficult problem out of an essentially simple situation. Even if large centers contemporary with Teotihuacan existed in the Basin of Mexico, their interrelationships may have been simply hierarchic rather than symbiotic. They may, therefore, have had overlapping functions. The situation may well have been similar to that during the Aztec Period in which Tenochtitlan was the major center. Large, local, dependent, city-state centers such as Xochimilco, Chalco, and Ixtapalapa paid tribute to it but otherwise acted and were organized as semi-autonomous states with their own political, religious, and economic institutions. The Teotihuacan survey has revealed several such provincial centers, as will be indicated next.

Mayer-Oakes' characterization of the rural component in Teotihuacan society suffers from a very inadequate sample, one site, and that a site with highly specialized characteristics (apparently a salt-making community near the lake shore). Mayer-Oakes (op. cit.), Tolstoy (op. cit.) who located only five new Teotihuacan settlements in his sample of 111 sites, and Hicks and Nicholson (1964) have all asserted that Teotihuacan sites are rare in the Basin of Mexico. The supposed paucity of such sites is surely the product of insufficient research. Nearly 100 such sites were located by the Teotihuacan Valley survey in the Teotihuacan Valley alone, an area comprising only 8 percent of the surface area of the Basin.

The previous discussion summarized what was known about Teotihuacan settlement patterns in the Basin of Mexico prior to 1960. Extensive excavations at Teotihuacan had been conducted by Batres, Noguera, Vaillant, Linne, Perez, Gamio, Armillas, Caso, Millon, Sejourne, Cook de Leonard, and others from which a great abundance of data was derived on many aspects of the culture of Teotihuacan and its history.

Since 1960, three major projects have yielded an abundance of new data on all aspects of Teotihuacan culture but especially with respect to settlement patterns. One project involved the reconstruction of the Main Street-Moon Plaza public architecture and has been conducted by the staff of the Instituto Nacional de Antropologia y Historia. The second project is directed by Rene Millon (the Teotihuacan Mapping Project) and is aimed at making a complete map of the ancient city with special focus on the history and patterning of urbanization. The third is the Teotihuacan Valley Project with its focus on rural settlement patterns. The following assessment is based upon the results of these three projects, with the bulk of the data derived from the last. Since Millon's project is still in progress, all evaluation of the city must be considered as highly tentative.

In the following discussion we are presenting only new data bearing specifically on the settlement pattern of the city. No summary is given of the characteristics of the ceremonial precincts or buildings. For this the reader is referred to the published literature.

The City (TC 1). One of the major problems of Millon's project has been the definition of the border of the ancient city. The problem is complicated by fluctuations in the periphery through time, and by an apparent tendency to the proliferation of settlements along highways leading out of the city. (See figure 8). Millon approached the problem from the viewpoint of an archaeologist working outward from the center; our project approached the periphery from the rural hinterland. The result is some disagreement on what is urban and what is rural settlement on the periphery of the city. Basically the situation may be summarized as follows:

1. There is a great rectangle of continuously dense settlement interrupted only by streets, plazas and religious structures that covers 12 km.² (four kilometers N-S by three kilometers E-W). This area is clearly urban. Occupational remains in the form of building debris, low mounds, potsherds, obsidian and ground stone tools are extraordinarily and continuously heavy all over this area.

2. To the north and northeast, the edge of this urbanized zone is sharply and clearly defined.

3. To the east and southeast are two bands of settlement, one distributed on both sides of an ancient and modern highway (TC 120), the other south of a barranca (TC 116). The former is physically joined to the city.

At the end of the TC 120 strip and apparently detached from it is another population cluster (TC 119). TC 116 is linked to the city only by a narrow, tenuous ribbon of dispersed settlement. The site itself is compact, densely settled and has several large ceremonial structures. In the Teotihuacan Valley Project these three occupation areas have been called sites; Millon, however, considers them as integral parts of the city.

4. The southern edge of the city may present a possible major area of disagreement between the two surveys. South of the Barranca de San Lorenzo is a solidly built-up area with settlement characteristics similar to those of the city and physically separated from the city by only the barranca (we have designated this band as TC 117). This band of dense settlement is perhaps 200 m. wide. South of this is an area 1000 m. wide of moderately deep-soil alluvial plain and beyond it a narrow piedmont ultimately succeeded by the steep slopes of the Patlachique Range. Occupation in this plain is sparse with a few scattered localities recording light to moderate density (TC 118 and the lower part of TC 14). On the piedmont is a small, compact village site, TC 14, and on top of a low knoll near the southwest edge of the city is another, TC 13. In Millon's survey the entire plain plus TC 13-14 is considered part of the urban zone. This we feel is a serious methodological error. The sharp difference in settlement density between TC 117 and the plain between it and TC 14 surely reflect settlement differences of great social significance. One of Millon's arguments is based on the fact that TC 14 is directly in line with the Camino de los Muertos and he suggests that it marked the termination of the street.

5. To the west of the urbanized zone a similar proliferation of peripheral settlements occurs along an axis (in this case there is an avenue that runs west starting from a point on the Camino de los Muertos opposite the Sun Pyramid, extending through the residential area of what we have called the city and extending beyond its borders). Millon considers this general area an integral part of the city; we have preferred to call the settlements in this area suburban. Sites included in this category are TC 11, 12, and 121, all of which appear to be arranged along or at the terminus of a projection of the noted avenue.

6. To the north of the clearly defined north edge of the city and located 1500 m. distant on the flank of Cerro Gordo is a site that was not considered part of the city. The site, designated TC 30, is a large compact village site without definite ceremonial architecture. Three, small, physically isolated settlements are located nearby.

7. The area embraced by the city and the above suburbs lies within a huge circle eight kilometers in diameter; within this circle perhaps the heaviest concentration of people in the history of Mesoamerica resided.

The only other comparable cluster in pre-Hispanic Mesoamerican history was the huge concentration of population during the final Aztec Period at Tenochtitlan-Tlatelolco and the satellite settlements of Tepeyacac, Azcapotzalco, Tlacopan, Tacubaya, Coyoacan, Huizilopochco, Mexicaltzingo and Ixtapalapa.

To recapitulate, the city consists of a central, continuously occupied area measuring 12 km.², of which perhaps eight square kilometers had a formal plan. This formally planned area probably includes about three square kilometers of avenues, markets, open plazas, ceremonial precincts and other civic structures and about five square kilometers of residences arranged on an orderly grid of 60 by 60 m. units. Proliferating around

this core is an additional three to four square kilometers of unplanned residences but apparently with the same, compact, tightly-nucleated concentration as in the grid.

Around this central area of 12 km.² is a series of physically discrete residential districts we are calling suburbs which were also densely settled compact communities, in some cases possessing their own ceremonial structures. With the exception of TC 119-120, the major period of occupation of these sites runs from Late Tlamimilolpa through Early Xolalpan with lighter Early Tlamimilolpa and Late Xolalpan occupations. Most of them were apparently abandoned in Metepec times.

TC 119-120 is somewhat aberrant in that there are good overall Miccaotli and localized but substantial Metepec occupations. Most of the other settlements seem to have been established in the Early Tlamimilolpa Phase and abandoned at some time during the Xolalpan Phase.

According to Millon the primary arteries of traffic in the city include the following: first, there is a main street (Street of the Dead) traversing it from north to south for a distance of three kilometers (from the Moon Pyramid to the Barranca of San Lorenzo). Following Millon, at least two main avenues in addition to the principal axis existed. One of these is really two, since they do not actually meet, although they run along the same east-west axis. One departs from a point at the eastern wall of the Ciudadela and runs east through the suburbs for at least four kilometers. Its western segment begins west of the market (across the main avenue from the Ciudadela) and runs for a distance of perhaps three kilometers, terminating at TC 11. The second avenue also runs east-west, departing from the western side of the main avenue opposite the Sun Pyramid and running west to the edge of the city for at least 1.5 km., and possibly as far as 2.5 km. Along both sides of the main avenue, a continuous series of multiroomed residences or religious precincts was arranged.

Rural Community Patterns. Excluding the noted suburban settlements, approximately 100 localities in the survey area have recorded occupation of the general Teotihuacan Period. All but 10 have substantial occupation, the exceptions being cases where only a few sherds were noted. The 90 sites may be classified into the following tentative types:

1. Small towns. These are relatively large, physically compact communities with fairly elaborate ceremonial complexes of pyramid temples, other associated structures built around plazas, and extensive attached residential zones. Sites of this type would be TC 83, 73, 40 and possibly TC 22-23. The site areas range from 10-30 hectares. In at least two cases, TC 73 and TC 40, planning of the residential area is evident. All are located in peripheral positions in the survey area as a whole. They are found eight to 10 km. from the city, either in the Upper Valley or north and west of Cerro Gordo. The rarity of this type of site and marginal location of those present is clearly a function of the socioeconomic dominance of the city.

2. Villages and Hamlets. The majority of the 90 sites are either villages or hamlets. Both are tightly nucleated communities with very dense concentrations of rocks, mounds and pottery. Several of the larger settlements exhibit formal planning (TC 8, TC 39, TC 42) and even possess small ceremonial structures. The primary distinction between village and hamlet is that of population size; settlements with fewer than 100 inhabitants are called hamlets, while those exceeding this population are

considered villages. All of the villages range from four to 30 hectares in area and probably had populations ranging up to 2000 in size. Hamlets are frequently less than one hectare in size, never exceeding two.

Approximately 35 sites were classified as villages, about 45 as hamlets. Although hamlets are well-represented numerically, the total percentage of the population residing in such settlements was very low. Furthermore, a high percentage of the hamlets dates from the Miccaotli-Early Tlamimilolpa Phases, at least in the area north of Cerro Gordo. They occur in two clusters, one north of Cerro Gordo, the other strung along the lake shore and Lower Valley.

Data from sites where the pattern is clear suggest that in the villages and towns multifamily dwellings similar to the urban grid units in plan and number of residents were typical. This pattern of large multifamily dwellings, separated only by courts, plazas and streets and forming physically congested settlements, offers a striking contrast to the Aztec pattern. The data from the hamlets are less consistent. Tentative evaluation of the survey data suggests that those in the Lower Valley-Delta were later in date, and some sites did consist of large houses.

3. Ceremonial Centers. Only two sites may properly be called ceremonial centers. Both are located on the tops of hills, one on Cerro Malinalco (traces of a single structure), the other, consisting of a complete plaza complex, on the much smaller Cerro Atlatongo. A number of other cases of sites on the tops of small hills are known in which no ceremonial architecture or pottery was found; these sites appear simply as small areas of ordinary sherd concentrations. The contrast with the Aztec Period is striking.

There are such peculiar and extraordinary variations in settlement patterns and population density from one segment of the survey area to the other that a detailed summary of each of these areas is presented below. The city and the suburban ring have already been analyzed.

Zonal Pattern, Middle Valley. The city and its suburbs were located in this sector of the survey areas and made up the largest population cluster by far. Very few sites in the Middle Valley occur outside this cluster. A strip of narrow piedmont along the north edge of the alluvial plain was intensively surveyed. In this area a light Formative, a fairly heavy Mazapan, along with an extraordinarily dense Aztec, occupations were defined. In startling contrast, not a single Teotihuacan Period settlement was located. With the exception of TC 118 and TC 14, the southern piedmont (also rich in Aztec remains) is equally barren of Teotihuacan Period sites.

Zonal Patterns, Lower Valley. In startling contrast to the richness of archaeological remains of the Toltec and Aztec Periods and the dense modern population was the poverty of Teotihuacan habitation sites in the Lower Valley and Delta areas. No definite sites have been found along the southern piedmont between Cuanalan and San Lorenzo. The northern piedmont is somewhat richer in total number of sites (1 large village; 6 small villages or hamlets; 1 ceremonial center; 2, possibly 4, salt-making sites on the lake shore; and traces of occupation in several other localities), but one can define an almost perfect gradient of population attrition proceeding downvalley from the city. TC 8 is a relatively large, substantial village site with a temple and a probable population of 500 people; TC 5, 6, 2, 4, 18 and 15-16 are all very small sites. Although several of them

almost fall into the village category, none of them had populations much over the minimal size of 100 inhabitants.

Aside from the general sparseness of occupation, the pattern has a number of peculiarities. The largest, most substantial population units (TC 8, 6, 5) are located not only nearest the city, but well back from the edge of the plain at the upper edge of the piedmont. Their location does not suggest a relationship to agricultural activity in the alluvial plain. The Aztec settlements in the same area, it should be noted, consisted of large compact villages and towns along the edge of or within the plain (that apparently possessed land holdings on the plain) and a second string of settlements at the upper piedmont, similar in ecological setting to those of the Teotihuacan Period (whose inhabitants presumably cultivated the piedmont). The locations of the Teotihuacan settlements suggest piedmont rather than plain cultivation. Further downvalley, TC 2, 4, 15-16, 18 are all very small settlements and are located at the edge of or within the plain. These sites may actually have included only one or a few houses; one has the impression that they had specialized functions and were not ordinary peasant villages. TC 4 is located on a small hill composed of tezontle gravel and is deeply pitted by Teotihuacan Period quarries. The situation is very similar to that of TC 112-113 in the Middle Valley where excavations demonstrated the existence of a Xolalpan Phase mining settlement.

TC 10, 3, 33 and 22 were in all probability salt-making stations. The evidence is most convincing at TC 3 where the mound appearance and types of soil and vegetation are identical to Aztec sites which have been definitely identified as salt-making stations. Furthermore, one of the mounds on the site was excavated by Litvak King (1964) and the ceramic assemblage is in strong support of the conclusion that they were salt-making sites. Of a total sample of 4,536 Teotihuacan sherds (out of a total of 4,775 sherds) 4,120 pertained to a single one of Tolstoy's ceramic types (San Martin Burnished Monochrome). This dominance of a single type does not occur on any other Teotihuacan site and is comparable to the high percentage of Texcoco Fabric Impressed on Aztec sites, a ware developed specifically for salt-making. Apparently, such a special pottery type was not developed in Teotihuacan times; rather, one of the established utility types was used. TC 33 is a trace site where a few Teotihuacan sherds were collected on an Aztec salt-making site; TC 10 and 122 do not have definite evidence of salt-making and surface pottery is scanty, but both are located near the same contour line as TC 3 and are clearly small sites.

In summary, such sites as are located in the area do not have a close relationship to cultivation of the alluvial plain and the total population (survey was intensive in this area and it is doubtful that any sites were missed), probably not exceeding 2000 people in all, was well below the agricultural capacity of the area. (In comparison with the modern or Aztec population this would be less than 10 percent of capacity). Another peculiarity of the occupation of the Lower Valley-Delta areas is the complete absence of sites of the Miccaotli and Metepec Phases. Most of the sites were apparently first settled in the Tlamimilolpa Phase; over half were abandoned before Late Xolalpan times; all were abandoned at the end of Xolalpan.

One of the sites in this area, TC 8, was extensively excavated in the 1961-1962 seasons. Its plan, appearance, and density are typical of large Teotihuacan village sites and the summary presented below may be applied to all such communities with slight modifications.

TC 8 is a large, compact village located on the lower flank of a cluster of small hills that borders the upper edge of the piedmont. It is situated only one kilometer west of the western suburbs of the city. A canalized barranca runs alongside and just below the site. The site lies in the middle of an Aztec linear strip settlement that runs around the hill cluster. Survey located 60 residential mounds in an area of 20 hectares plus an additional 13 mounds dispersed along the barranca.

A core area six hectares in size with almost continuous Aztec-Teotihuacan occupation is located in the center of the site. Approximately 15 residential mounds, all of large size (30-80 m. in diameter), are concentrated in this area. These structures are separated only by plazas (some of which are paved) and alleys. Perhaps two-thirds of the surface area is covered by residences.

Just above and on the upper edge of this core residential zone is a small plaza surrounded by four mounds that probably had civic-ceremonial functions. One of the structures may with certainty be identified as a temple platform since it was partially excavated. It was apparently built in two stages, the earlier one of which had a typical talud and tablero facade on all sides and a stairway facing a small plaza on the southern side. This earlier structure measures 14 by 11 m. and is approximately one meter high. A second stage was added to this (but apparently without increasing the height) and the form modified, i.e., the stairway was moved to the western side and the talud-tablero facade restricted to that side, the balance having a simple talud.

The balance of residential mounds outside the core are scattered over an area of 14 hectares. All of these are small and have scanty or no Teotihuacan occupation on them. The dominant component is clearly Aztec, and sherd concentrations are heavy only on and near individual mounds. They range in diameter from 10-20 m. and are dispersed haphazardly along the hillside; in some cases they are related to old terrace positions--in other words, a typical rural Aztec settlement. Further survey demonstrated that the Aztec settlement is simply a segment of a linear strip that encircles the cluster of small hills.

The Teotihuacan Period site, therefore, consisted of 15 large, multi-roomed houses and a ceremonial precinct concentrated in an area of six hectares. Excavation and survey recovered evidence of an orderly plan to the residential zone. A cluster of four of these large mounds grouped around a large central plaza was partially excavated (the reader is referred to figure 12).

Construction techniques and materials were similar to those used at Teotihuacan itself. The soil was removed down to tepetate before building, since all walls that were excavated rested upon it. Walls--at least the main walls--were constructed first. They were built of roughly-formed stone blocks laid in mud mortar; corners and doorways were faced with more evenly cut stone blocks. Apparently (on the basis of the great quantity of stone debris), most of the walls were built of stone and mud rather than just the base, as in many peasant houses today. The floors were added later by a process of filling in the box-like space formed by the

walls in a series of stratified levels composed of the following layers: large rough stones at the base, laid in earth mortar, superimposed by beds of increasingly smaller rock fragments capped off by a layer of gravel. (In some cases a layer of crushed tepetate was placed over the gravel). Both floors and walls were then given a coat of clay-lime-gravel stucco several inches thick followed by a finish of lime plaster. In some cases indications of red painting over the white plaster of the walls were found, and the relative abundance of fragments of wall plaster with geometric mural paintings in blue, yellow, and green indicates some use of mural painting with faint geometric design was uncovered. The floors are hard, well-made and well-preserved. The walls vary in preservation from several feet in height to cases where only the scar may be traced across the floor. In general, however, floor plans may be defined, although the poor state of preservation of some walls makes definition of doorways impossible.

In 1961, approximately 70 percent of Mound 1 was excavated. The basic plan included a large, unpaved, central patio entered by an unpaved alley from the outside to the south. The street and patio served as points of access into three discrete apartments each with its own kitchen (based on the concentration of cooking vessels, fragments of manos and metates on the floor and in one case, still standing hearth stones). Each apartment consisted of two to three very small rooms, and the central patio was five by four meters in surface area. Apartment 2 communicated directly to the patio by means of a broad porch-like terrace; a narrow doorway provided access to the patio for Apartment 1; and from Apartment 3 one entered directly into the alley, by way of a stairway with two steps. Apartments 1 and 3 were provided with tiny internal patios that probably functioned as light-wells, and Apartment 3 had a masonry bench. In the Apartment 1 patio, a drain was uncovered which had been constructed by placing a single stone, perforated by a round hole, at the base of the wall.

At the close of the 1961 season, we estimated that the entire house contained at least one more apartment. The total excavated area was approximately 360 m. sq. In 1962, the excavation was expanded to the west to complete the balance of Mound 1, to excavate the depressed area between it and Mound 2, and also to excavate Mound 2 which adjoins this depressed area to the west and northwest. The excavation completely altered our impression of the relationships between the two mounds. The large depressed area between the mounds turned out to be a paved court, measuring 12 by 10 m. The 1961 excavation and Mound 1 as a whole were simply the remains of a room cluster that occupied the eastern side of this court, and the extended excavation revealed the presence of rooms and stairways on all four sides.

It seems that Mounds 1 and 2 were simply part of a very large aggregation of rooms and apartments grouped around this central court. An additional 540 m.² of this huge house was excavated for a total of approximately 900 m.². The unexcavated portion of this house probably amounted to an additional 600 m.². The entire house covered approximately 1500 m.² of ground.

A glance at the plan reveals the principal features of the house. The remainder of Mound 1 contained a single apartment, which opened directly into the court by means of a badly destroyed stairway and was without direct communication to the section excavated in 1961. It also included a peculiar

architectural feature consisting of a paved, open alley (as indicated by a drain running its length) that communicated directly with the court, ran behind the apartment, and dead-ended into a narrow, unpaved, rectangular space. The plan of rooms on the northeastern side of the court is difficult to ascertain since several grid squares were unexcavated; but two apartments were uncovered in the excavated area with a single ascending balustraded stairway. To the northwest, the plan is more clearly defined with one complete apartment consisting of three rooms that communicate by means of a stairway into the court, and another of at least two rooms.

Because of the sharp dropping off of the mound to the south, no room clusters were expected on that side of the plaza. The final week of the excavation, however, revealed two beautifully preserved stairways which rose to an upper terrace. We suspect the presence of a single string of rooms on that side of the court. Of interest also is the fact that the terrace facade on this court side has a beautifully preserved, Teotihuacan style talud and tablero. Of great interest in terms of reconstruction of social and religious institutions was the discovery of the small rectangular altar, two meters square, in the center of the court. The excavated and unexcavated part of the house altogether probably had at least 40 rooms and 15 apartments along with small patios, light wells and porches.

Mound 3 is a huge rambling mound approximately the size of Mounds 1 and 2 together and undoubtedly comprised a similar aggregation of rooms. Approximately 340 m.² were excavated in 1962. Over half of this area is occupied by a large central court, almost identical in dimensions and character to the central court in Mounds 1 and 2. It measures 12 by 12 m. and also has (and in this case much better preserved) an altar of more complex construction that measured 2.5 by 3.5 m. Remains of the molding slabs indicate that it possessed a typical Teotihuacan molding, and that it had a little apron-like terrace on the eastern side. Traces of stairways, presumably for entering room complexes, were found on the western and northern sides of the court. To the east a little two-room apartment opening directly into the court was excavated. The excavation also revealed another puzzling architectural complex similar to that found in Mound 1, consisting of an unpaved alley that dead ends into a large, rectangular, unpaved room.

In modern villages in the Teotihuacan Valley each house is situated within a large houselot surrounded by either a stone, adobe wall or organ cactus hedge. The houselot usually has a nopal orchard, fruit trees, or animal stables. The wall, vegetation, and stables provide easily accessible space and insure privacy for sanitary functions. An Early Classic village with its multiroom houses situated within a few meters of each other must have posed certain problems. The two alley-back room complexes in the two houses may have served the function of communal latrines. The isolation of the rooms and lack of paved floors are arguments in favor of this interpretation.

An interesting feature found in Mound 3 consisted of nearly continuous benches along the eastern and southern sides of the court, that presumably served a social and recreational function for the house holders. In the case of this house the court did not have rooms on the southern side. A blank wall defined the house here and this, in turn, fronted directly on the earth plaza. The excavation also defined the limit of the house to the south, since the outer wall was excavated. Most of the rooms apparently

were located north and west of the court, judging from the topography of the mound and the results of the excavation.

Mound 4, a small mound, which delimits the earth plaza on the east, was completely excavated. The total excavated area covers some 23 by 23 m. or 529 m.². Although most of the room floors were situated within 20 cm. of the surface, and the southern side of the house was very poorly preserved, the plan is evident and differs in some respects from Mounds 1, 2, and 3. It was a much smaller house, more compact and more regular in plan. The residential group was presumably much smaller than in the other two houses.

The house is similar to the other two in that it has a large central court, in this case measuring six by 10 m., with a central altar, and is surrounded by room complexes. The surrounding rooms are all elevated on platforms well above the court and communicate with it by means of six stairways. Two of these occupy the entire shorter eastern and western sides of the court, while four are small, individual stairways, two each on the northern and southern sides, almost exactly opposite each other and serving apartments of two to three rooms each. All stairways have balustrades and are similar in style and quality of construction to those in the city. A well-constructed talud and tablero adorned the facade of the platforms that surrounded the court.

The central altar measured two and one-half by three meters in basal area and was more elaborate than those in the other houses, with a talud and tablero facade and an ascending stairway. The altar underwent at least two phases of construction.

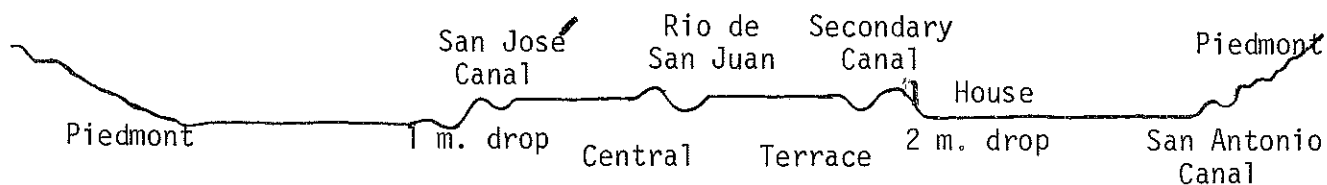
Each apartment was provided with a light-well and in one apartment one standing wall had traces of geometric mural painting. Traces of post molds were also found in the same apartment and chunks of stucco and plaster that were applied to a round wooden roof post. The outside doorway or doorways of the house were not definitely located because of the poor state of preservation of the walls. At both the eastern and western ends, however, rooms fronted on the long stairways and, in terms of movement of traffic and ease of access, they look like entry rooms to external doorways. On the plan (figure 12) external doorways have been tentatively located on the western and eastern sides of the house. The compactness and formality of plan, quality of masonry, liberal use of talud and tablero facade in the court, presence of mural paintings, quality and number of stairways, and complexity of the altar all suggest the house of someone of superior status, possibly the village chief and his immediate family.

In summary, TC 8 was a compact, planned village of substantial size with a probable population of between 500-800 people. Its location in the agriculturally marginal piedmont, the generally high quality of architecture and technology, and the unusual abundance of obsidian scrapers suggest a relatively prosperous peasant community specializing in maguey cultivation. As a result of the excavation, a large sample of artifacts of all types was collected; reconstructing life in an Early Classic village in considerable detail should be possible.

Chronologically, the primary occupation of the site is Late Xolalpan, but Tlamimilolpa and Early Xolalpan occupations are heavy along with traces of Tzacualli and Miccaotli occupation as well. It seems to have been abandoned before the Metepec Phase began in the city.

Previously the curious lack of hearths at the city of Teotihuacán was noted. With the possible exception of one kitchen, hearths were also lacking at TC 8. This, of course, was the basis of Linne's, later Mayer-Oakes' argument, that the population of Teotihuacán did not cook their own food. Mayer-Oakes suggested cooked food was brought in from rural communities. The data from TC 8, however, compound the problem since it would mean that even the rural population did not cook their own food. The answer, I believe, lies in the nature of Teotihuacán floors. They are exceedingly well made with polished lime plaster surfaces. To avoid smudging such floors, the inhabitants would not have built hearths directly on the floors. A peculiar type of pottery vessel called in the literature a "brasero" or "incensario" may well have functioned as a portable stove. They are thick-walled, low, flat-bottom bowls with slightly outflaring walls, are unburnished and unslipped, have a coarse paste and have a peculiar feature that provides a clue to their function. This feature involves three tubular prongs that are attached to the rim and project upward and inward, appearing somewhat like the grill on a gas range. The inside of the vessel usually has signs of burning and they are adapted admirably to contain a small fire like those used for cooking today. The prongs could be used to support cooking vessels; they are especially adapted as stoves for the pottery type called San Martín orange by Tolstoy. Vessels similar to the braseros in general form are still used in the Valley today as heaters. In some cases the Xolalpan ones have holes for inserting cords to move or suspend them. The numbers of fragments of these vessels in the TC 8 excavation suggest a domiciliary rather than a ceremonial function. Vessels of this type were found by Linne at Xolalpan.

In 1961, traces of Teotihuacán occupation were noted within the alluvial plain near modern canals. The alluvial plain between San Juan and Cuauhtlan comprises a great oval 30 km.² in area. It is not level, however, and the entire center appears as a low, flat plateau elevated several meters above the edge of the plain, a kind of gigantic central terrace. Several of the principal modern irrigation canals run along the edges of this terrace providing an extra gravity boost for the watering of the plain just below. The Río de San Juan runs through the center of this terrace. Scattered traces of occupation of the general Teotihuacán Period were found along the banks of the Río de San Juan in three localities, in no case extending far beyond the immediate river bank, and in two places along the Canal de San José. The following profile and plan illustrates the relationship of canals and the terrace to the Valley.



One of the most convincing evidences of Teotihuacan occupation occurs a short distance north of Calvario Acolman between the secondary canal and edge of the central terrace. Along the narrow strip between canal and bank is a string of isolated houses of Calvario Acolman residents, a thread-like prolongation of settlement that differs strikingly from the typical radial village so characteristic of modern settlement patterns in the area. Such linear settlements along irrigation canals do occur in other parts of the world. The fact that some Teotihuacan pottery occurs in this area suggests the possibility of linear settlement along canals for that period. The evidence is admittedly scanty, and the entire matter is part of the general problem of the effectivity of surface survey in the alluvial plain where deposition could have buried small settlements.

Further survey did not reveal any convincing evidence for this type of rural settlement, and in our opinion the survey was effective in locating all or most of the Teotihuacan sites in the Lower Valley-Delta area. The traces of occupation along the noted waterways probably is evidence of agricultural activity rather than occupation.

The big central terrace in all probability is a case of artificial remodeling of the Valley topography--the details of the course of its evolution are problems for future research.

Zonal Pattern, Cerro Gordo-North Slope. To recapitulate, this area is one of long, gently sloping ridges leading off the steep slopes of Cerro Gordo, separated by deep barrancas and today covered by self-flooding terrace systems in various stages of evolution and deterioration. At the close of the Formative Period (Tzacualli Phase), the test strip was densely settled--one of the few population clusters in existence at that time outside the city. Approximately 30 hamlets of this period were scattered up and down the ridges. They are especially thick at the upper edges of the ridge strips near the village of Maquixco Alto. All are small in size, possibly hamlets of 10 to 20 families with the houses well-spaced. No definite ceremonial structure is known for this period in the area.

For the Teotihuacan Period a series of extraordinary events are reflected in the local archaeology: marked community stratification, heavy population growth, shift in settlement pattern, and inferred changes in land use.

There are four, large, compact nucleated villages, a small town site, and 16 hamlets similar in size to the earlier hamlets in the test strip. One gigantic village, TC 46, covers 25 hectares of terrain, approximately the total surface covered by all the Tzacualli sites. Other villages were TC 58, 8 hectares; TC 49, 9 hectares; and TC 42, 4-6 hectares. All four are characterized by very heavy, nearly continuous, concentrations of rock debris and pottery; the population density was undoubtedly several times as high as in the Formative hamlets, probably comparable to that at Teotihuacan itself. TC 58 and TC 49 are reworked by Aztec and modern terrace systems, as is most of TC 46, so that specific data on community planning are not available. Two small excavations made in TC 49 and 46 revealed that the areas of heavy rock debris are the remains of multiroom structures similar to those at TC 8, with central courts surrounded by room clusters. Both houses, however, were smaller than those at TC 8, and the construction is much poorer: the plans are more irregular, courts are unpaved, walls are constructed of roughly-shaped blocks of tezontle, gravel, conglomerate and earth with mud stucco and no lime plaster. Stairways are

also much cruder. The construction is generally similar to that of rural Aztec houses in the same area, although the houses were considerably larger. A number of mounds are as large as those at TC 8. TC 49 has two small pyramids; such structures are either lacking or destroyed in the other sites.

TC 42 is better preserved, and the central part of the site seems to have an orderly plan composed of groups of mounds clustered around courts. Some indications are present of small ceremonial structures as well.

Although TC 40 is considerably smaller than TC 46, the architectural remains indicate a higher community status. Like the villages, it was a tightly nucleated residential site with a nearly continuous distribution of rock debris and pottery. The central third of the site and possibly all of it, was regularly planned, with a grid street system and open courts bordered by residential and ceremonial structures. Some ceremonial structures seem to occur at termini of streets, as at Teotihuacan, and most ceremonial mounds have small courts in front. In some cases the concentration of rock and sherds would indicate very large houses, like those of the urban blocks at Teotihuacan and would probably be similar in size to those at TC 8. Survey revealed a possible main street with a pyramid at the northern terminus, and the main pyramid located midway along the street facing it from the west. Excavation is urgently needed to check these observations. The pyramids range from 60-180 cm. in height with basal measurements varying from 10-30 m. There are eight such structures, and their small compact plan contrasts sharply with the low, rambling, residential mounds. In addition a large rectangular mound was found measuring 48 by 14 m. and one to eight meters high with traces of three ascending stairways. This structure looks like an elite residence. Some of the ceremonial structures probably resemble the temple platform excavated at TC 8 in 1961 in size and plan.

The 16 noted hamlets are all similar in size, ecological location, and architectural remains to Tzacualli settlements. The population density may have been higher, but most of them are so severely eroded it is difficult to say. In some cases, such as the village sites of TC 47 and 48, the density was certainly as high. Notwithstanding the large number of hamlets, the bulk of the Early Classic occupation occurs in the larger sites.

The total area covered by towns and villages in the Cerro Gordo, North Slope area is approximately 56-58 hectares; the total area of the 16 hamlets did not exceed nine to 10. The total area covered by Teotihuacan settlements is therefore 65-68 hectares.

The ceramic samples from the Teotihuacan Period sites have been cursorily examined to ascertain the time range and mode. Unfortunately, the problem of sorting Miccaotli from Early Tlamimilolpa on rural sites has not yet been solved, and will require more intensive analysis. None of the primary criteria used in isolating such occupations at the city seems applicable to rural sites. The general period between the end of the Tzacualli and beginning of Xolalpan on rural sites is dominated almost completely by the red-buff complex, which does not appear to phase out well during the city's early growth.

In the preliminary examination of the surface samples, few of the Miccaotli time markers from the city were noted. This suggests two possibilities:

1. That at the close of the Tzacualli Period the area was temporarily abandoned for 100 or 200 years and then reoccupied in Tlamimilolpa times.

2. That during the Miccaotli Phase, rural centers enjoyed to a minor degree some cultural independence, and most pottery was manufactured locally in the red/buff tradition. If such is the case this tradition might well be considered as rural with the polished black as a specialized urban tradition. As indicated above, the phasing of the red/buff is poorly defined in the early phases at the city.

This problem and the two possibilities apply to all rural sites in the Teotihuacan Valley. In none of the sites in either the Lower or Middle Valley (except TC 119-120) was a substantial Miccaotli occupation defined. The same generalization applies to sites in the Upper Valley, and North Tributary Valleys.

In terms of rural-urban relations the above data might be interpreted as follows. At the end of Tzacualli Phase (perhaps as a product of the construction of the Sun Pyramid and Main Street) the entire population of the Valley was not merely seasonally drafted for building projects but forcibly required to reside permanently at the city. Following this Miccaotli Phase (in Tlamimilolpa times), organized recolonization of the abandoned area occurred in the form of large, planned, nucleated settlements rather than hamlets. The formal planning and rather sudden and striking change of settlement pattern noted in the Maquixco Alto area would seem to support this hypothesis. The total period of abandonment may not have exceeded a century.

Against this argument is the extraordinary coincidence of the zonal distribution of Tzacualli and Teotihuacan sites and frequent coincidence of individual site location, suggesting no such break in settlement continuity. Also the shift in settlement pattern could have been directed from the city but involved populations already located in the area, rather than colonists from the city.

At any rate, until the ceramic analysis has been completed, a chronological system involving only the following phases is being used in this preliminary report: a general Miccaotli-Tlamimilolpa Phase without internal divisions, Xolalpan, and Metepec.

Applying this scheme to the Maquixco Alto area the following picture emerges:

1. All but one of the hamlets have occupations limited to the general Miccaotli-Tlamimilolpa Phase. There is an apparent bias toward the earlier part of the phase.

2. The four big village sites have Miccaotli-Tlamimilolpa occupations and the dominant occupation is definitely Late Tlamimilolpa.

3. The two villages TC 58 and 49 have very scanty post-Tlamimilolpa occupation.

4. The big TC 46 village site has substantial secondary Xolalpan occupation that occurs over approximately two-thirds of the total site area.

5. The town site shows a similar reduction of the residential area during the Xolalpan Phase. As in the case of the village, the heaviest occupation occurred during the general Miccaotli-Tlamimilolpa Phase with a peak in Late Tlamimilolpa times.

6. TC 42. Although its maximum population was achieved in Late Tlamimilolpa times, it had a substantial Xolalpan occupation over most of the site.

7. No substantial Metepec Phase occupation was recorded at any of the sites. Furthermore, no Early Toltec sites are reported in the same area (i.e., Oxtotipac or Xometla Phases).

Population densities on all sites were similar, so that direct comparison of surface areas with occupations per phase can be used to establish a relative population profile. These data will be presented in the following section on demography.

Four kilometers to the east of the population cluster noted is a smaller one that includes the huge site of Los Cuecillos de San Cristobal (TC 73), classified here as a town, and eight hamlets. All of the hamlets pertain to the Miccaotli-Tlamimilolpa Period. The decline of population in the Maquixco Alto area in Xolalpan times corresponded in a striking way to a very rapid growth of population at Los Cuecillos. This site was settled during the Miccaotli-Tlamimilolpa Period (presumably as a result of the nucleation of the population of the hamlets located nearby which all date from that period), when it became a village comparable in size to TC 42, 49, or 58. In the Xolalpan Phase it expanded into a town site with the largest ceremonial precinct in the Teotihuacan Valley outside the city. This ceremonial area is accompanied by a densely settled residential area composed of large, multiroomed houses ordered on a grid. In other words, the demographic trend is reversed. We suggest that the growth of the town and decline of the Maquixco Alto population represents the final phase of a general trend towards increased nucleation, characteristic of the overall Teotihuacan Period, and that the local population migrated from the villages to TC 73.

Xolalpan has been divided by Bennyhoff into two phases. Preliminary study of the samples demonstrates that nearly all of the Xolalpan occupation is Early Xolalpan, even at TC 73. By Metepec times the entire population had disappeared and the entire Cerro Gordo, North Slope area was abandoned.

Zonal Patterns, Upper Valley. The contrast between the Aztec and Teotihuacan distribution of sites in this area is a striking one. To recapitulate, the Aztec occupation included a large town site near modern Otumba on the edge of the plain, an almost continuous series of rural settlements strung up the low ridges between the barrancas south and east of the Aztec town, and great areas of densely clustered settlements ringing the isolated hills to the east and north of the plain.

Altogether, the Teotihuacan Period occupation of the area includes seven small site clusters, of which only one involved a substantial occupation comparable to those north of Cerro Gordo. The characteristics of the clusters may be summarized as follows:

1. TC 83, 84, 85, 86. TC 83 is a substantial site, classified tentatively here as a small town. It had a large pyramid three to four meters high and a densely nucleated settlement over an area of perhaps 40 hectares. It has a long time span, starting in the general Miccaotli-Tlamimilolpa Phase, reached its maximum size in the Xolalpan Phase and suffered a sharp reduction in population in Metepec times. TC 84 and 85 are both sites with small areas of sparse Xolalpan occupation on hilltops and were probably not occupied permanently. Although they do not have structures, they may have been hilltop shrines. TC 86 is a small detached area of localized occupation and TC 109 is a small compact village with a time range similar to TC 83 but with a striking decline of population in the final phase.

2. Sites TC 91, 92, and 93 form a smaller cluster of sites of which only TC 91 has good Teotihuacan occupation, primarily early. All three have heavy Tzacualli occupation, giving one the impression of a relatively large Tzacualli population followed by a rapid decline during the Teotihuacan Period.

3. Sites TC 24, 25, 26, 27, and 28 form a group of sites consisting of one small village (TC 25) site and three, small, isolated hamlets. The area is a severely eroded, low ridge top so that the precise pattern is not clear. There seems to be good Miccaotli-Tlamimilolpa occupation (the hamlets were occupied only during this period), substantial Xolalpan occupation at TC 25, and rapid reduction in Metepec. In the preceding Tzacualli Phase there was a string of small houses and house clusters in this same area.

4-5. Clusters TC 88, 87, 89 and 94, 95, 96 are similar to each other in character and chronological bias. Each consists of a series of well-spaced, localized occupations in gently sloping, badly eroded terrain. The occupation is almost entirely Xolalpan-Metepec with the latter as the dominant phase.

6. At the southern edge of Cuaytlancingo hill is a series of very small, localized, light Teotihuacan Period sherd concentrations.

7. On top of Oxtotipac hill is a small, isolated, Teotihuacan settlement dating from the Miccaotli-Tlamimilolpa and Xolalpan Phases with a population maximum in the latter phase. In all probability it was a community of specialized quarry workers. The hill of Oxtotipac is composed of volcanic debris, primarily of gravel size, ideal for floor construction. The entire north face has been partially excavated in the past to obtain materials for construction. Great numbers of caves are scattered along this face, that have abundant evidence of occupation of the Late Classic (Oxtotipac Phase), Mazapan and Aztec populations. Excavations in one of them demonstrated that they were Early Classic quarries, reused as residences in the later periods.

The above summarizes the Teotihuacan Period occupation of the Upper Valley. In no phase did the total population exceed that of the Aztec town site at Otumba. The only settlement that resembles the nucleated villages and towns north of Cerro Gordo is TC 83. Many of the sites resemble Formative, particularly Tzacualli sites, in size and density. One has an impression similar to that in the Lower Valley, of aborted growth. A quick glance at the map also shows striking differences from the Aztec in site location and, excepting Otumba itself, certain similarities to the modern settlement although the latter is probably denser than in the Teotihuacan Period. The Teotihuacan sites form a ring along the edge of the upper piedmont and avoid the plain and lower piedmont.

The population history of the Upper Valley during the Teotihuacan Period was strikingly different from that in any other part of the Valley. There was apparently continuous growth with a probable maximum in the later phases.

A final note in this area--there is a striking correlation between the distribution of Tzacualli sites and those Teotihuacan sites with substantial Miccaotli-Tlamimilolpa occupations.

Zonal Patterns, Patlachique Range. The Teotihuacan Period occupation offers a startling contrast to the pre-Tzacualli phases of the Formative Period and is in striking accord with the picture in Tzacualli times. Only

two occupation sites (TC 98, TC 39) occurred in this area, neither one in locations typical of Formative. TC 98 is located just above a modern and/or Aztec terrace system near the main barranca. TC 39 is on a flat or gently sloping intermontane plain near a huge, modern, possibly partly ancient, tezontle gravel quarry and may have been a specialized community. TC 98 is primarily of the Xolalpan-Metepec Period with Metepec the heaviest component; TC 39 ranges through the entire period. Several sites of the type classified as possible hilltop shrines, none with architecture, are located in this area.

Zonal Pattern, North Tributary Valleys. West and north of the main valley is a series of wide tributary valleys watered by a network of barrancas that ultimately feed into the San Juan River. Much of the area is similar in appearance to the piedmont and has been severely eroded. Bordering the broad valleys to the north is a series of small isolated hills, separated by small plains and gently sloping ridges. The modern settlements, with the exception of rancherias such as Ixtlahuaca, are relatively compact communities located on terrace systems at the base of the hills. Good terracing is common in this area; today the hilly border is undoubtedly more productive than the broad, open valleys to the south. Pre-Tzacualli occupation in this area is almost absent. Several Tzacualli sites, mostly concentrated on the north flank of Cerro Malinalco (TF 29) are located in this area. Survey in the area has generally been spotty, so that there may well have been numerous, small, undetected Tzacualli sites. Both Toltec and Aztec post-Classic occupation is very heavy; in the case of the former, it is probably denser than anywhere else in the Valley except the Lower Valley-Delta area. These settlements tend to be located in positions similar to modern communities, except that they occur as linear bands either along the bases of the small hills or on the lower flanks of Cerros Gordo and Malinalco.

In the brief surveys of the area, four substantial Teotihuacan village sites (TC 20, 21, 22, 102) and two small localized occupations on sites primarily of the other periods (TC 19, 18) were located. In addition to these, another site, TC 25, has the largest pyramid mound of any Teotihuacan site outside the city. Its attached residential area, however, leads us to classify it as a small village. The site in each case comprised a tightly-nucleated, compact community located in an ecological setting similar to that of modern villages. The chronological picture resembles the Cerro Gordo-North Slope area, with a maximum population in Miccaotli-Tlamimilolpa times, followed by a substantial reduction of population in the Xolalpan Phase and eventual abandonment of all sites before Metepec became well-established at the city. Preliminary study demonstrates that TC 22-23 increased or at least did not lose population in the Xolalpan Phase, possibly serving as focal points of local immigration. Since TC 23 was probably a local center for the district, the parallel to the situation north of Cerro Gordo is close. All conclusions about the history of Teotihuacan settlement in this area must be taken with caution, however, because of the small percentage of ground actually surveyed. We suspect that other Teotihuacan sites are located in the area.

In summary, the characteristics of the Teotihuacan occupation of the Valley included the following major patterns:

1. A continuous, gradual pattern of increasing nucleation into larger settlements, ultimately leading to a concentration of perhaps 90 percent of

the population in a single center. This process occurred at various rates of speed in various segments of the Valley and was initiated in the final phase of the terminal Formative (Tzacualli).

2. A shift of ecological bias from hillside locations to ones in the alluvial plain at critical positions with respect to the hydrographic system of the Valley.

3. A tendency for substantial non-urban populations to occur only in locations marginal to the alluvial plain of the central valley. Such concentrations occur in areas where there were substantial occupations in Tzacualli times.

4. Nearly all communities tend to be tightly nucleated and compact. In density of population they are probably similar to residential zones of the city itself. Considerable variation exists in size of settlements from perhaps one multifamily house to small towns. The presence of the city and its control of the most productive agricultural areas, however, inhibited the growth of the latter and, generally speaking, had drastic effects on zonal population distribution.

5. The general impression, when compared to the post-Classic and post-Hispanic settlement patterns (especially the former) is of a non-rural, non-ecological appearance to settlement. Rural sites look like miniature imitations of the city. Survey reveals even evidence of overall planning of whole clusters of rural sites. For example, the four contemporary sites of TC 58, 46, 49, and 40 appear on the map as though they were planned on a single axis. TC 83, 11 km. to the east-southeast is located on this same axis. That the suburbs and rural sites are oriented on the axes of urban avenues has already been noted. In actual fact, such axes could be extended even further. For example, sites TC 114 and the clusters TC 24, 25, 26, 27, and TC 87, 88, 89 are located on the same axis as the east avenue, TC 39 is on the south avenue axis, TC 7-8 are on the west avenue axis, and TC 30 is lined up with the Camino de los Muertos axis.

Toltec Period - Early Phase.

Introduction. The Toltec Period has turned out to be surprisingly complex with respect to internal phasing, sociopolitical implications of this phasing, and regional variations in settlement patterns and land use. Equally complex is the problem of the relationships of the ceramic complex called Toltec to Teotihuacan and the interrelationships among Teotihuacan, Tula, Cholula and Xochicalco.

The chronological intricacies of this period will not be discussed in any detail in this report. For this the reader is referred to Acosta's reports of excavations at Tula (1956-57), Armillas' 1950 summary of Teotihuacan and Toltec interrelationship, and Tolstoy's more recent evaluation of Toltec chronology (op. cit.). Toltec chronology will be exhaustively treated in the final report. Some basic problems of Toltec chronology must be discussed in this section, however, before the settlement of the Teotihuacan Valley may be dealt with.

On the basis of previous research, various types of decorated pottery were assigned time positions between Aztec II (Tenayuca) and Teotihuacan. Of these decorated types, two high distinctive complexes of red/buff pottery were selected as key types for defining the period. One was called Coyotlatelco, after a site near Azcapotzalco excavated by Tozzer (1921), the other Mazapan, after a type site at the modern village of San Francisco

Mazapan located within the ancient city of Teotihuacan and first defined by Vaillant (1944).

Both complexes occur at Teotihuacan but in different stratigraphic association with the Early Classic buildings. Armillas states that the Mazapan complex dates from a time period prior to Aztec II when the Teotihuacan Period buildings were in ruins, and that the Coyotlatelco complex occurs mixed with pottery from the final phase of the Teotihuacan Period in the collapsed debris of the buildings. The implication here is that the makers of Coyotlatelco pottery were still using the older buildings as residences. He therefore felt that Coyotlatelco was earlier than Mazapan and that both were post-Ahuitzotla-Amantla (Teotihuacan IV in Vaillant's system) and pre-Aztec II.

Recent work at Tula and Teotihuacan tends to confirm the relative positions of the two types. At Tula, for example, what Acosta has termed Coyotlatelco was present only in the lower levels of excavated trenches; most of the buildings that the Instituto restored apparently pertain to a phase when Coyotlatelco was replaced by Mazapan (Acosta, op. cit.). Sejourne (1959), in her Zacuala excavations found great quantities of Coyotlatelco pottery associated with Teotihuacan ceramics and the use of the final floors of a Teotihuacan house.

Unfortunately, Tolstoy has confused the issue by denying the chronological discreteness of the two complexes, and in one of his types, "Tula red/buff", he has combined various distinctive types from each of the two complexes.

On the basis of excavations and survey in the Teotihuacan Valley, we have no doubts concerning the chronological distinctiveness of the two complexes. At least 50 sites of the general Toltec Period were found with a great abundance of sherds of the Mazapan complex and not a single sherd of Coyotlatelco. On the other hand, very few sites having Coyotlatelco ceramics lacked Mazapan, but this in part is because the total period was one of population increase and displacement from the city to smaller sites, so few sites were abandoned. Excavations of a structure from TT 21 (see figure 9), however, demonstrate conclusively that a phase with only the Coyotlatelco complex present did exist. Furthermore, each of the two decorated types is associated with a complex of other types covering the entire functional range of pottery and each of the two complexes taken as a whole is quite distinctive. Two basic time divisions of the Toltec Period are evident, an earlier phase in which the Coyotlatelco red/buff is dominant that we are calling Xometla, and a later phase dominated by the Mazapan complex. For the latter, the name Mazapan is being retained because the type site is located in the survey area.

A number of other chronological complications developed in the course of the project that will require further research for resolution. In 1961, excavations were conducted in an artificial cave (part of a Xolalpan Phase quarry) at Oxtotipac and a ceramic complex defined that seems to have close ties with the Metepec or final phase of the Teotihuacan Period, with Armillas' Amantla-Ahuitzotla Phase, with the Xometla complex, and further afield, with Xochicalco in Morelos. The complex shares a great number of traits with Xometla and several pottery types are identical to it, but it retains many more Metepec elements than does Xometla. Generally speaking, even the Xometla complex does not represent a sudden break with the older Teotihuacan tradition and shows considerable continuity with it. As a

matter of fact, we see more of a break between Xometla (Early Toltec) and Mazapan (Late Toltec) than between Xometla and Metepec! In this portion of the report the two complexes Xometla and Oxtotipac will be treated separately. The significance of this distinction will be reserved for the discussion in Part VII.

On the basis of preliminary studies, the Mazapan Phase may sort out into two shorter time periods, an earlier, for which the phase name Mazapan will be retained and a later phase to be called Altatongo, which has some interesting transitional traits to Aztec. Since the laboratory phase of the project has not been completed, the distinction will not be used in this report.

Further discussion of the socioeconomic, political, and ethnic aspects of the occupation of the Valley during the general period will be reserved for Part VII.

Lower Valley-Delta. If one were to draw a line between TT 29 and a point immediately west and south of TT 82, it would bisect the survey area. Not a single Xometla complex site was located east and north of this line. This is probably the most extraordinary fact about Xometla complex site distribution. Other distinctive traits are the concentration of population in the Early Classic city and its environs on the one hand, and along the edge of the Lower Valley alluvial plain on the other. For the first time in the history of the Valley a substantial occupation (referring here to living sites) was located on the Lower Valley piedmont. With a few exceptions, preferred locations were similar to those of modern villages in the same area. The total number of sites and total population were relatively small, not much heavier than the Teotihuacan occupation of the area. The distribution, however, differs in that the Teotihuacan sites were located well back from the plain at the upper piedmont. Three Xometla Phase sites in this area (TT 21, 19, 28) are considerably larger than the others and might be classifiable as small towns.

The largest and best preserved site in the area is probably TT 21. TT 21 is a huge sprawling site located on the eastern piedmont of the Lower Valley between the two modern villages of Xometla and Tepetitlan. The piedmont in this area is only 600-800 m. wide and was originally a gently sloping plain. Today it is covered by stone and maguey terraces, and the soil cover varies in depth from exposed tepetate to one meter behind terrace facings. To the east, the hills of the Patlachique Range rise steeply and are nearly bare of soil and vegetation, to the west is the alluvial plain.

The site consists of over 100 mounds and light to heavy concentrations of rock debris and sherds dispersed over the piedmont in a band 1200 m. long by 400 m. wide or a total area of 50 hectares.

TT 21 is one of the few Toltec sites with ceremonial architecture. At the upper edge of the site near the center of its long dimension is a large pyramid 12 to 15 m. in diameter and three to four meters high that has been dissected by the construction of the railroad. Immediately west and south of it are two large plazas. The west plaza is bordered along its northern side by a large, low, rambling mound that looks like a large multiroomed structure. The other mounds are comparable in size and elevation to Aztec domestic mounds. Most of the sherds from the pyramid pertain to the Xometla Phase, and nearly all of the mounds have Xometla occupation on them. Estimating their former number is difficult, but the

abundance of rock debris and sherds in areas where no mounds occur today demonstrates that the number of structures intentionally or accidentally destroyed by modern terrace construction was considerable. The settlement pattern was certainly not as compact as in the Teotihuacan Period villages or city but it was probably at least as densely nucleated as modern San Martin and perhaps approached modern Xometla. This would yield a total population of 1250-2500. TT 21, unlike Aztec towns, did not, however, possess an urban core.

One of the better preserved and larger mounds was excavated. The surface had been plowed up and no summit floors or walls were preserved. The preserved structure turned out to be a solid, single-terrace platform with a sloping talud and was similar in size and form to Maya house mounds. It was apparently constructed in four phases. The dimensions of the various phases are presented in the following chart.

Platform	East-West Dimension	North-South Dimension	Basal Area
Phase 1	9.8 m.	7.0 m.	68.6 m. ²
2	10.5 m.	8.3 m.	87.2 m. ²
3	11.6 m.	10.2 m.	118.0 m. ²
4	17.1 m.	13.6 m.	232.6 m. ²

On the west side of the platform was a beautifully made stairway with balustrades. The technique of construction was peculiar in that the stairway was built first of flat slabs upon which were placed large, well-cut, stone blocks. The stairway apparently functioned throughout the history of the structure and amplifications during the various phases involved only the other three sides.

Each of the retaining walls for the various phases rests on tepetate and varies in height according to undulations of the tepetate surface. The total height varied between 1.25-1.85 m. above tepetate. It was probably slightly higher before plowing destroyed the summit features. The nucleus, in all phases, consisted of irregular chunks of stone in earth, the basal portions including relatively large fragments, the upper part smaller ones. The retaining walls are battered and made of small, roughly shaped rectangular stones. In phase 4 they were tabular, almost brick-like in size and form; in phases 1, 2, and 3 larger, more squarish stones were used. Some facing stones had traces of lime plaster laid directly on the stone surface.

Hard packed earth and gravel floors a few centimeters thick found resting on tepetate outside the phase 3 and 4 platforms were probably patio or plaza floors. Traces of floors, probably of summit rooms, were found on the surface of the platform, but no walls. Also found, however, was a puzzling feature, tamped earth floors within the body of the platforms (including even the phase 1 platform) and situated well below the level of the upper courses of masonry of the retaining walls. Presumably they relate to techniques and stages of construction of the platform rather than representing living floors.

Surface samples on and around the mound included Aztec and Toltec pottery, and among the latter were both Mazapan and Xometla Complex sherds. The excavated ceramics are presently being analyzed, so only a tentative statement may be made. Samples were collected from trenches within the body of each construction phase and from trenches excavated along the retaining walls. In nearly all samples examined to date, what has been defined as the Xometla Phase is dominant. Although the Mazapan Phase seems to be scantily represented in the samples, the Aztec is considerably heavier. Perhaps 80 percent of sample pertains to the Xometla Phase, 15 percent to the Aztec, and only 5 percent to the Mazapan. This means that all construction is probably of the Xometla Phase. The sharp difference in architectural style, however, between the phase 4 platform and those of the first three suggests that the former pertains to the Mazapan Phase, since the tabular construction resembles Late Toltec construction at Tula.

TT 28 (Cuanalan) was another large site comparable to Aztec towns. The Toltec occupation was coterminous with the Aztec. At the eastern edge of the village, as has been previously described, is a 200 m. square area of relatively large houselots with heavy prehistoric occupation of the Aztec and Toltec Periods. The heaviest Toltec component pertains to the Xometla Phase with some concentration of rock, marking the location of former stone buildings. One large, low mound may be a temple base. In this area, recent sand quarrying has cut through, partially destroyed, and uncovered plaster floors of a multiroomed residential structure. The entire surface of this area had been leveled for use as a village plaza and the walls of the building obliterated. Nowhere is there more than 25 cm. of debris over the floor. An area of 120 m.² was cleaned down to this floor level. Traces of the lime plaster floors and the scars of walls, apparently constructed of stone and earth and covered by lime plaster, were found in this area. Apparently the few rooms cleared were parts of a multiroomed structure similar to the Xolalpan houses at TC 8. Superimposed over this were traces of an earth floor and rectangular adobe walls of an Aztec house or house group. The walls had stone-earth bases similar to those of modern adobe houses in the village.

The plaster floor dates from the Xometla Phase, and its presence, plus the possible pyramid and general density of remains in this section of the village, suggest an urban core similar to that found in Aztec towns. Obviously, excavation is needed to establish this point. The area of this postulated core is four hectares. The Xometla Phase remains as a whole occur over a total area of 20-25 hectares.

The settlement pattern of TT 10, the other possible town site, is difficult to evaluate since it underlies the Aztec town. Light to heavy Xometla Phase occupation seems to coincide with those portions of the Aztec town that have been labelled as "Definite Nucleated Core," "Possible Nucleated Core," and with at least a portion of the area referred to as "High-Density Compact Settlement." The pyramid and its associated plaza have good Xometla occupation. The fact that more than one level of structures are present in the urban core and the plaza, and the abundant surface evidence of both Toltec and Aztec occupations would seem to indicate that the Aztec pattern (with most of its characteristics) was actually initiated during Xometla times.

Along with the three possible towns, a number of smaller rural communities were located in the Lower Valley-Delta areas during this phase. TT 20

would perhaps be classified as a small Compact Village, possibly TT 22 and TT 23 as well. All are located within or on the edge of the alluvial plain, and are the prototypes of the nucleated Aztec villages found in the same area. Approximately 10 smaller sites are comparable in size and sherd densities to Formative hamlets, some on the edges of the plain, others at the base of Cerro Colorado or the flank of Chiconautla.

The overall occupation of the Lower Valley-Delta during Xometla times was of only moderate intensity, but in all respects the period can be characterized as the Formative Phase of the post-Classic, post-Conquest settlement of the Valley. Subsequent changes are primarily in the direction of population increase.

Middle Valley. One of the largest Xometla Phase settlements is TT 25, located within the modern barrio of San Juan Evangelista. The site is overlain by Mazapan and Aztec occupations and is superimposed over a Teotihuacan village site so that sorting out the occupational density of a single phase is impossible without excavation. Xometla pottery occurs continuously over an area of 30 hectares on the edge of the alluvial plain. A second site of equivalent size and density, TT 27, is located at a distance of only 500 m. Both of these sites are comparable in size, density, and ecological setting to the western suburbs of the Teotihuacan city and Late Aztec town. There is also heavy Xometla occupation at TT 20 and TT 84, overlying the eastern suburbs of the city.

Within the Early Classic city, Xometla complex pottery is abundant, usually mixed with Metepec sherds on floors of residential structures of the Metepec Phase or occurring in the debris of buildings along the Street of the Dead. The evidence suggests that the city continued to function as a major population center during much of the Xometla Phase and that a high percentage of the population continued to reside in one major center.

Outside the Early Classic city and its suburbs and the Lower Valley-Delta piedmont, Xometla Phase occupation of the survey area is feeble or absent. Not a single site was located in the Patlachique Range, Upper Valley or North Slope of Cerro Gordo. In the case of the latter, this represents a continuation of the general population decline that characterized the later Teotihuacan Period occupation of the area.

Two known settlements are located in the north tributary valley; TT 65, a typical linear strip village similar to Aztec sites in the same area, and TT 29, a small compact settlement superimposed on an earlier Teotihuacan village. In view of the low percentage of this area actually surveyed, we suspect that more sites of this phase will be located in the area.

Oxtotipac Complex Sites. With the exception of the Teotihuacan Period city, Oxtotipac and Xometla Phase sites do not occur in the same sectors of the Valley. Oxtotipac occupation is heavy at the city (but not in the suburbs) and is identical in stratigraphic association to Xometla. Apparently, during the phase when pottery of this complex was used, the city was still a going concern. No known Oxtotipac sites exist in the North Tributary Valley, North Cerro Gordo Slope, Lower Valley, Delta or Patlachique Range. Other than the type site TT 82, Oxtotipac sites are limited to a number of caves (actually quarries) within the archaeological zone. One has the impression of a ritualistic usage in these cases, but pottery is abundant and all the utility wares are represented. At the Oxtotipac type site, along with surface remains, the cave quarries have heavy occupation for this phase.

No really convincing case of an isolated settlement of this complex has been found in the Upper Valley; most of the Metepec villages and hamlets yield a small, consistent sample of sherds that approach the characteristics of the Oxtotipac complex but have a more Teotihuacan appearance.

In summary, the two complexes Xometla and Oxtotipac and this possible Terminal Metepec possess strong similarities among themselves, but vary along a continuum in degree of Toltec versus Metepec traits. Each has distinctive spatial distributions within the survey area.

Toltec Period - Late Phase.

Introduction. The post-Classic, post-Hispanic settlement pattern, in a zonal sense, is well-established during this phase. Sites are more numerous than in any preceding phase of comparable duration (95 plus an undetermined number of trace localities) and occur in all ecological segments of the Valley. Compared to the preceding Xometla Phase and the earlier Teotihuacan Period, the extraordinary ruralization of the population is impressive. Although a substantial population still resided at the site of the Early Classic city, it certainly did not involve more than 10 percent of the total population of the Valley and was undoubtedly considerably smaller than in the Xometla Phase. Most Mazapan sites are quite small, comparable to Formative hamlets, except in the Lower Valley-Delta where the Xometla Phase compact villages and small towns continued to be occupied. A diagnostic, general trait of Mazapan settlement patterns is the tendency for sites to group in clusters, each consisting of a village or town with ceremonial architecture as a kind of cabecera, dependent hamlet and villages. There are perhaps 12 such clusters in the survey area. Four of these are in the Lower Valley-Delta, and each includes a small town with dependent villages and hamlets; eight in the rest of the survey area include small villages with pyramids as centers and dependent hamlets. The map is somewhat deceptive with respect to the size of the Mazapan population. Most Mazapan sites, even small ones, were apparently quite dispersed in plan with densities ranging from Compact Rancherías to Scattered Villages. House remains are rarely detectable, possibly indicating residences less substantial than those in rural Aztec sites where mounds and walls are abundant. In a few Mazapan sites house remains, where preserved, are similar to Aztec houses. The overall impression one has of the Mazapan occupation of the Valley is that it was extensive rather than intensive, that settlement was distributed in all sectors of the Valley, but that the total population was considerably smaller than in 1519. These conclusions are supported by the relative paucity of ceremonial architecture outside the Lower Valley-Delta and within the Teotihuacan Period city. The above noted site clusters frequently possess only a single temple mound. Furthermore, the temple mounds are not the high-terraced, steep-sided pyramids so typical of Mesoamerican sites, but usually consist of single, low, but fairly large platforms similar to the one excavated at TT 21. Plaza complexes occur only at TT 21 and TT 10 in the Lower Valley. Of course, the matter of ceremonial construction is complicated by the possibility of continued use of Early Classic structures at the city and additions to them. Millon (1961) describes ceremonial building in the Oztotyahualco zone, apparently pertaining to this phase, which involved the addition of a platform to a Xolalpan structure. A few cases of isolated hilltop shrines were noted in our survey, all of which continued to be used in Aztec times. Several of

these are located on the summits of the major hills--Gordo, Chiconautla, Patlachique, and Azteca.

Of considerable theoretical interest is the relationship between the Mazapan occupation and the phases immediately preceding and succeeding it. These interrelationships may be summarized as follows.

An extraordinary continuity exists in settlement location between Early and Late Toltec. Of the 26 Xometla Phase sites in the Lower Valley-Delta, all but two (both tiny hamlets on the slope of Chiconautla hill) were occupied in Mazapan times. In most cases where the two phases occur at a single locality, one has the impression that the Mazapan community was larger, but less densely nucleated.

No such continuities can be demonstrated between the location of Mazapan and terminal Metepec sites in the Upper Valley; a cultural break is obviously indicated. The one good cluster of Oxtotipac sites outside the city does have a substantial Mazapan occupation.

A striking negative correlation may be demonstrated between the Mazapan and Teotihuacan occupations of the Valley. Mazapan Phase site clusters frequently occur in areas where Teotihuacan is absent or feebly developed, or where Teotihuacan occupation vanished before its terminal Metepec Phase.

On the other hand, an extraordinary positive correlation exists between Mazapan and Aztec settlement. Most Mazapan sites have Early Aztec (Zocango Phase) remains. All of the Mazapan site clusters are in areas of dense Aztec settlement. The distribution of population as to ecological segments and variations in community patterns closely parallels the Aztec. The changes between Mazapan and Aztec are primarily cases of intensification of existing patterns, and may be explained primarily as the product of total population growth. Aztec towns are bigger and more densely nucleated than the Mazapan site cluster centers, and changes in rural settlement are essentially related to demographic expansion. The old Mazapan site clusters coalesce as the population grows.

More specific characteristics of Mazapan occupation of the various ecological segments are as follows.

Lower Valley-Delta. This area was the scene of intensive occupation and continued population growth from the preceding Xometla Phase. The total number of sites does not increase markedly, from 20 to 28; the increase of size over the older sites, in some cases, may have been accompanied by decreases in site densities, so that population growth was only moderate. Site distributions suggest four clusters, based on the spacing of ceremonial precincts, the relative spacing of small sites to large, and the propinquity of sites.

TT 21 was probably a socioeconomic center for the cluster of sites along the east piedmont, including TT 23, 22, 24 and possible TT 28. In this case the central community was a large village or a small town (50 hectares) with hamlets as dependent communities.

TT 5 (see figure 10) is a very small site but has a large, unusually well-preserved pyramid with definitely three and possibly four stages of construction. Most of the construction is Aztec, but a possibility exists (since Mazapan occupation occurs around it) that one or two of the earlier constructions were of Mazapan age. If so, TT 5 may have been the center of a cluster of villages and hamlets on Chiconautla slope that included sites TT 4, 3, 7, 6, 2, 26, 109, 10, 111 and possibly TT 18. Another

possible center was TT 4, the site of the Aztec town of Chiconautla. The massive Aztec ceremonial precinct on the site could completely cover a smaller ceremonial complex of the Mazapan Phase. It is the largest, most compact Mazapan site and the only one classifiable as a village. The other sites in this group are all hamlets.

TT 10 continued to function as a large village or small town and was probably the center of a complex of sites that included TT 11, 12, 1, 19 and possibly TT 18, 14, 15 and 16. Between the Xometla and Mazapan Phases at TT 10, the size of the site definitely increased, but as at TT 21, this may have been accompanied by a decrease of population density.

TT 25, the San Juan Evangelista site, is large enough to have served as a center for another district that probably included TT 14, 15, 16 and 112.

Generally speaking, in this sector of the Valley the community types included hamlets, small villages, and either large villages or small towns. The latter clearly were not as urban as Aztec towns, so that their classification as urban is tentative. Sites located on the piedmont have a tendency toward the linear pattern diagnostic of Aztec settlement; the pattern on Cerro Chiconautla consists of a series of small, well-spaced settlements evenly distributed over the slope. Plainside settlements tend to be compact and radial in form.

Archaeological Zone of Teotihuacan. The largest community in the Valley continued to be the one located within the Early Classic city; nevertheless one does have an impression of a continuing decline of population from the Xometla Phase. We suspect that major Early Classic structures such as the Sun and Moon Pyramids continued in use. As noted previously, Mazapan occupation occurs on top of the ruins of the Classic city and seems to be concentrated in the area east of the Sun Pyramid. One could, even though the data are deficient, define a large, fairly continuous area of settlement and religious precincts covering 150 hectares, and including the two pyramids and noted occupation areas. Besides this settlement, other localities are known with Mazapan occupation, possibly representing a series of smaller, isolated settlement areas. If this reconstruction is correct, the cluster of sites on the zone was probably the social and demographic center for the Valley.

Upper and Middle Valley. The location of many of the Mazapan sites in the area above the zone is such that it is difficult to say whether the residents of such sites cultivated land in the Upper or Middle Valley. For this reason the Upper and Middle Valley are discussed as a unit in this section. This is particularly true of the Tolman, Cuautlancingo and Oxtotipac clusters.

Sites in this area, more than any other, show a striking tendency to form discrete, well-defined clusters. Each cluster apparently included a small village with ceremonial architecture (either a single, low, temple platform or pyramid) and dependent hamlets. There are five such clusters in this section of the Valley.

Tolman Cluster. A gently sloping piedmont is located on the south side of Cerro Gordo, bordering the Middle Valley alluvial plain. A strip six kilometers long was intensively surveyed, as was previously noted. A nearly continuous band of Aztec settlement is located along this strip. Approximately 17 Mazapan Phase sites are dispersed through the Aztec strip. They increase markedly in number as one proceeds east along the piedmont,

reaching a maximal density immediately west of Axapusco. This pattern strongly suggests a focus of agricultural activity toward the Upper rather than Middle Valley. All the sites have light occupation except where preserved house mounds occur. One has the impression that the population density for the whole cluster was similar to that of modern Compact Rancherías; for the zone of occupation within what we are calling sites, it was probably as high as modern Scattered Villages.

TT 51 was probably the "cabecera" of the cluster since it is the largest site and has a large low mound that may have been a temple platform. The total surface area of the sites in this cluster is approximately 40 hectares; individual sites range in size from one to six hectares.

Cuautlancingo Complex. This consists of a group of 10 small areas (one hectare or less) of settlement dispersed over the top and slopes of an elongated isolated hill, plus several similar areas in the Upper Valley plain. As with the Tolman cluster, the Mazapan complex is scattered through a larger, more densely settled Aztec site. The overall density of the cluster and of the individual sites was probably similar to that of the Tolman strip.

Oxtotipac Complex. This complex consists of four large hamlets located on the summit and slope of a low isolated hill, another site on the summit of a small adjacent hill, and another strung along a barranca that flows south and west of the hill. The cluster may include three other unsurveyed sites. This group is more compact than the Cuautlancingo and Tolman clusters. Although no religious structure may be definitely assigned to the Mazapan Phase, survey located a large temple base, partially of Aztec construction, under the church in Oxtotipac. It is possible that this Aztec structure covers an older Mazapan temple.

Northeast of Otumba, near the hacienda of Soapayuca is another site cluster that includes nine sites (TT 60, 61, 70, 63, 64, 67, 68, 69). Of these, TT 69 is clearly the nuclear settlement. Approximately 14 preserved house mounds and a small pyramid (two to three meters high) were recorded for this site. The occupation varied in intensity from light to medium, with some heavy concentration on and near the structures. TT 69, 68, and 67 occur in a strip along the base of a small isolated hill at the upper edge of the Otumba piedmont. These sites lie within an Aztec strip settlement that almost circumscribes the hill. TT 66, 60, 61, and 70 are located along the barrancas immediately downslope on the piedmont, whereas TT 63 and 64 are located at the base of a nearby hill immediately below another Aztec strip settlement. All the dependent sites in this cluster are classifiable as hamlets; several are small enough to have been occupied by a single nuclear or extended family. The settlement pattern is strikingly similar to the Aztec in the same area; the major change again is one of population growth and demographic "filling in".

North Tributary Valleys. This is one of the least known sectors of the survey area. Since the Mazapan Phase settlement pattern is so rural, this fact is especially important. We suspect that there are probably at least a score of more sites in the area. At least four are known on the lower flank of Cerro Gordo similar in size, appearance and ecological setting to those on the southern piedmont. One site is located on the edge of the Barranca of San Martín in the center of the broad tributary valley. In the area of small hills north of the latter valley only three sites are known. One, TT 65, was probably a local center, since it has a pyramid

and is the largest settlement in the area. This was the major site for the preceding Xometla Phase and is similar in size and plan to Aztec strip villages.

Cerro Gordo, North Slope. In the Cerro Gordo, North Slope survey area no sites with any of the three Early Toltec ceramic complexes were found; it appears that, after the heavy Early Classic occupation, the area was abandoned for several centuries.

During the Mazapan Phase, a respectable occupation of the eight square kilometer test zone occurred. The survey revealed the presence of one large village and nine to 10 hamlets, plus five hamlets near Colhuacan outside the test zone. The village occupied approximately the site of modern Maquixco Alto. Because of this, the site pattern is somewhat obscured by the modern settlement; furthermore, it underlies an Aztec component as well. In spite of the problem of sorting out the three occupations, the houses were at least as dispersed as the modern village, and more probably approximated the density of Scattered Villages in the Teotihuacan Valley today. The probable total area of occupation of the village was between 15 to 20 hectares.

Six of the hamlets are located along modern barrancas. All are about the size of the larger Tzacualli settlements in the same area. Pottery tends to be only light to medium in concentration, indicating again fairly widely-spaced houses. On a low interfluvial above Teacalco is a string of four small hamlets spaced at 200 m. intervals. The total area covered by the hamlets would roughly approximate the village area, or a total of 30 to 40 hectares of dispersed settlement.

Mazapan architecture is equally difficult to define, since so much of the occupation is overlain by and mixed with Aztec. On the northern edge of the village is a large, low mound that is either a low temple platform or an elite residential structure. The debris consists of chunks of tezontle and earth. Two smaller mounds, identical to Aztec house mounds, are located nearby.

In summary then, the Mazapan Phase witnessed the establishment of the post-Classic, post-Hispanic settlement pattern in the Valley; population was extensive and all ecological segments of the Valley were almost equally utilized (except the Patlachique Range, although we did locate several small hamlets in that area). Both zonal and community patterns resembled the later Aztec in a demographically feeblar way. Territorial patterns involved a series of small sociopolitical units, each consisting of a small town or a village as a center, with a series of dependent hamlets or villages. None of these clusters involved more than a few thousand people, and more probably had a population in the hundreds. TT 122, located on the ruins of the Early Classic city, probably functioned as the provincial center for the Valley.

Demography

Methodology and Problems.

One of the objectives of the Teotihuacan Valley Project was to reconstruct a population curve for each of the ecological divisions of the survey area covering the period between first occupation by sedentary farmers to the present day. Such an objective is admittedly ambitious and difficult and has numerous methodological problems.

A careful study was made of recent population history, size, density, and spatial distribution which was to serve as a bench mark for the estimation of pre-Hispanic population. The expectation in this case was that the modern population would serve as a measure of the demographic capacity of the Valley. Also the study of modern agricultural practices, productivity, and land tenure may serve as a rough gauge of the creditibility of estimates of pre-Hispanic population. Of course, a number of problems are involved here. First, modern agricultural technology and techniques are conceivably more productive than ancient ones. Kroeber seemed to suggest this in his assessment of Mesoamerica population as a whole when he states:

"All these ratios are no proofs; but they do suggest that if our figures up to this point have been tolerably reasonable, the allowance of 3,000,000 for cultural Mexico is also reasonable and perhaps liberal. The actual population in 1500 A.D. may have been more. But it may also have been less... But the illustration shows that we may not infer from present-day populations to native large ones. And to assume that there was a large population, that this was reduced to a mere small fraction by the Conquest, and that then it built itself up again, is gratuitous. The Conquest no doubt did cause a shrinkage in numbers; but in the well-settled regions this effect seems to have been transient, and probably began to be made up by an increase attendant on the new experience of internal peace under Spanish Colonial government."

(A.L. Kroeber, 1947, p. 159-160).

Gamio (1922 English abridgement) made a statement with similar implications:

"The artificial production of this region, which comprises domesticated animals and vegetables, obtained by cultivation, was doubtless much smaller prior to the Conquest than during the colonial epoch or the present time." (p. XIV).

I disagree completely with this position. Certainly the introduction of winter wheat has increased the productivity of the Lower Valley by extending the growing season and permitting double cropping. This is, however, the only new plant that has directly affected productivity. Other crops simply replaced pre-Hispanic ones in the same areas. We see no reason to assume a priori that the introduction of the plow resulted in higher yields. The plow simply enables the farmer to cultivate more land, increases the production of crops per family and elevates his standard of living. It does not necessarily result in an increase of population density or regional productivity. On the contrary, plow agriculture encourages extensive rather than intensive methods of cultivation and may actually result in a decline of production per unit of land planted as contrasted to hand tillage. (Note the shift from cajete to al tubo planting in recent times). The densest rural population in the world today occurs in the Far East where hand tillage is characteristic. Of course, if such hand cultivation were not accompanied by irrigation or terracing in pre-Hispanic times the result would have been a low productivity. Evidence of such techniques is conclusive for the Aztec Period.

One major problem in using the modern population as a point of departure for evaluating pre-Hispanic estimates is presented by the fact that a sizable percentage of the modern population in some segments of the Valley

has urban occupations in Mexico City and is composed of either nonfarmers or part-time farmers. They live in villages in the Valley and commute to the city by bus or bicycle. Although a complete survey was not made of all the communities, the data indicate that this pattern primarily affects those in the Lower Valley and Delta and involves a substantial population only in the Delta. Furthermore, some control over this problem can be exercised by a comparison of the 1900-1930 census with those between 1940-1960, since the industrial growth of Mexico City has occurred primarily since 1940.

The overall impression of this author is that the Valley has suffered a striking decline of productivity since the Aztec Period. In a huge area so severely eroded today that it is of very marginal value to agriculture, convincing evidence was found of effective agricultural activity in the same areas in Aztec times. Aside from the loss of productivity of large areas, the Aztec farmer probably had a lower standard of living, produced a smaller surplus, and cultivated less land than the modern peasant.

In summary, the modern population size and density is well below the potential in terms of aboriginal agricultural techniques and geographical conditions. Recent censuses are useful as minimal estimates of the former demographic capacity of the Valley. Modern censuses will also serve as a useful comparative measure of the probable population in those pre-Hispanic phases where archaeological data suggest maximal use of the resources.

An even more useful control is offered by the sixteenth-century tax data, summarized in a previous section. The major conclusions derived from this data are as follows:

1. A sharp decline occurred between 1519-1580, the product of several processes of which the introduction of foreign diseases was paramount.
2. In 1580 the total population of the survey area was between 35,000-40,000. Based upon specific areas and detailed data from all over the central plateau, the 1580 figure was probably one-third or possibly as low as one-fourth of the 1519 population.
3. The population in the survey area in 1519 was probably between 105,000-120,000 and might have been as high as 160,000.
4. The 1580 population was approximately the same as that for 1930-1940.
5. In 1519, the population density for the survey area (600 km.²) was probably between 175-200 per km.², possibly as high as 267. This was about the average density for the Basin of Mexico as a whole (total population 1,200,000-1,600,000 in an area of 8000 km.²).

In the following analyses of pre-Hispanic population, the twentieth and sixteenth-centuries censuses will be used as the basis of a relative scale for pre-Aztec Phases. Before discussing the pre-Aztec population, however, a final check on the 1519 estimate will be made by means of a series of calculations of Aztec population derived from an independent source of data, archaeological survey.

Aztec Archaeological Data.

A number of relatively large areas (five to 10 km.² each) were intensively surveyed for archaeological remains using a field by field technique and all structures were located on the maps. Such test areas were defined in all of the Valley's ecological divisions. For this preliminary report, two areas will be selected for detailed treatment to illustrate the method.

The population estimates to follow are based primarily on counts of residential mounds. Several problems are involved in the use of this method:

1. The piedmont and slope areas where Aztec settlement was concentrated are severely eroded and all sites have suffered heavy destruction. Only well-defined structures were plotted on the maps. Numerous areas of heavy to medium concentrations of sherds, obsidian, manos and metates were noted with no traces of associated residential structures; these concentrations frequently occur on tepetate surfaces. The presence of cooking and storage wares and stone tools, aside from the heavy density of remains (sherds and rock debris), demonstrates conclusively that these concentrations of cultural debris were living areas, and not simply refuse deposits from agricultural activities. To resolve the problem of partial destruction, the density of mounds in the better preserved sections of sites was used (checked by noting variations in occupational debris) to calculate the probable original number of residences. Controls were also used in such calculations derived from the population densities of modern villages in similar ecological settings. The extraordinarily close resemblances between Aztec and modern settlement patterns were noted in a previous section.

2. Another problem is that of estimating the average population residing in a residential structure. All sources agree that the Aztecs were organized into extended families. Several variations of settlement patterns are possible for a social group of this type. Each nuclear family could have occupied a single house and the extended family have resided in a small group of such houses, or the nuclear families could have occupied apartments in a communal house. The survey data suggest the latter, since groupings of several mounds do not occur and the house mounds vary considerably in size (from five to 20 m.), suggesting a fair range in the size of the residential group who resided in a house. This observation was supported by the excavation of a house at TA 40. The mound was approximately 10 m. long and was composed of three apartments, each with its own kitchen. The mound was about average size as compared to Aztec residential structures as a whole. The previously cited sixteenth-century source (ENE Tomo II, p. 124) would suggest an average of 2.5 families per house in a large population sample. We are estimating therefore that the average residential group consisted of 10 persons.

3. A final problem in all such population calculations is that of residential stability. Post-Hispanic population history of the Valley as a whole would suggest a highly stable pattern, even in the face of demographic disasters and economic pressures. Nearly all modern settlements in the area were also settlements in Aztec times. Many small Aztec settlements were abandoned, but only as the product of the sixteenth-century demographic disasters, planned and organized migrations as in the case of the Spanish congregacion policy, or absorption of village lands by the growth of the nineteenth-century haciendas. None of these factors were operative in Aztec times. The extraordinary coincidence of settlement location for the entire post-Classic Period and evidence of continuous growth throughout the period to its end also argue for community stability. The history of the excavated house at TA 40 demonstrated definitely that continued residence in a single house over a long period and expansion of floor space as the population increased was the normal process. The present-day agricultural system is permanent in type with a continuous symbiotic relationship of an individual's house to specific fields, an ecological

system that would tend to promote community stability. Data on agricultural techniques and economy for the Aztec Period strongly imply that this was true during that period as well.

In most modern villages, however, in any given year, a low, but consistent percentage of houses are unoccupied generally attributable to the extinction of a family line or urban migration. Also common is reuse and renovation of abandoned houses. If a stone or adobe house is abandoned for a generation or two, the lower halves of the walls are generally restorable. In such cases, the debris from the collapsed upper walls and roofs is removed, a new floor level constructed and the upper wall and roof rebuilt, frequently using materials from the old structure. In such villages the percentages of unused houses may reach as high as 20, but is usually between 5-10. Very likely Aztec communities were similar, houses were temporarily abandoned and reoccupied as extended families died out and new ones established, but the archaeological picture of continuous population growth during the post-Classic and of site stability makes it extremely unlikely that large areas of sites were abandoned for lengthy periods.

As an illustration of this archaeological method, detailed data on two test strips are summarized in the following chart:

San Martin Strip, North Piedmont of the Middle Valley

Site Number	Surface Area (Hectares)	Surviving House Mounds	Probable Number	Quality of Data
TA 60	16	22	40-50	good
TA 61	10	17	25	good
TA 62	20	35	50-60	good
TA 63	24	25	50	poor
TA 64	30	16	30	poor
TA 65	15	4	?	poor
TA 66	10	10	?	poor
TA 67	3	0	?	poor
TA 68	5	8	15	fair
TA 69	20	22	40-50	fair
TA 70	30	10	?	fair
	<u>183</u>	<u>169</u>	<u>250-280</u>	

Taking the average density of those sites for which estimates were made of "probable number of mounds" and applying it to those for which no estimate was possible, the probable number of mounds totals between 330-360. Assuming that all were occupied contemporaneously (all do have Teacalco-Chimalpa occupation), and using the figure of 10 persons per house, the population may be calculated between 3300-3600. If we assume that between 10-20 percent of the houses were temporarily abandoned, following the modern pattern, the population would be between 2640-3240 (i.e., 3300 reduced by 20 percent, 3600 by 10 percent). Community population density would range from 1440-1771 per square kilometer or approximately that of modern Low-Density Compact Villages.

A direct comparison of the classification of modern communities by the population density used in Part IV with variations in archaeological sites is difficult, but the Aztec piedmont sites do give one the subjective impression of having possessed a population density similar to that of modern Scattered and Low-Density Compact Villages.

In the section on Aztec settlement patterns, many individual Aztec sites were equated with the *barrio pequeño* in the documentary sources. The average population of this type of site in the survey strip is between 240-294, two to two-and-a-half times the size of the *barrio pequeño* of Yecapichtla in 1550. (See previous discussion of this data).

In terms of Aztec site spacing and distribution of modern population, almost certainly the residents of this strip of sites cultivated the piedmont and adjacent alluvial plain. The distribution of modern settlements in the area shows an extraordinary correlation to that of Aztec sites. Today the same area, postulated as the agricultural hinterland of the Aztec settlement strip, is used by Santiago Tolman and San Pablo Ixquitlan. In 1940 these settlements had a combined population of 1000. The 1519 population as postulated from archaeological data varies between 2.8-3.2 times the modern. The 1940 population of the whole Valley, as has been previously noted, was similar in size to that for 1580 (the *Relacion de Teccistlan* does not give figures by community). From documentary data the Valley's population in 1519 was estimated to have been three to four times that of 1580. The correspondence between the archaeological and documentary data is close.

Maquixco Alto-Teacalco Strip. The data for this test zone may be summarized as follows:

Site Number	Surface Area (Hectares)	Surviving House Mounds	Probable Number	Quality of Data
TA 40	12	20	30-40	good
TA 41	9	23 and reocc. of Teo mds.	35-40	good
TA 42	25	20	40-50	good
TA 43	7	9	12-15	good
TA 44	3	1	?	poor
TA 45	30	8	?	poor
TA 46	10	12	30-40	fair
TA 47	2-4	1	?	poor
TA 48	2-4	0	?	poor
TA 49	3	12	15-20	good
TA 50	3	3 & 80 m. diam. area of rock debris	10	poor
TA 51	10	25	40	good
TA 52	1.3	0	?	good
TA 53	5	0	?	poor
TA 54	5	0	?	poor
TA 55	6	6	12-15	good
TA 56	6	6	10-12	good
	<u>141.3</u>	<u>146</u>	<u>234-282</u>	

Adding 140-170 mounds for TA 44, 47, 48, 52, 53, and 54, the total probable number of mounds would be between 374-452. The population, assuming contemporaneity of all mounds, would be 3740-4520. Subtracting 10-20 percent for abandoned houses, the figure would reduce to 2992-4068. Community population density would range from 2117-2879 per km.², the upper limits of modern Low-Density Compact Villages. Modern Maquixco Alto

in the same area has a density close to this estimated Aztec community density. The average site would have had a population of between 176-239.

The modern population utilizing this survey includes two villages with a combined population of 1400 (Teacalco, Maquixco Alto). Of this total approximately 1000 depend primarily on the area included in the survey for their livelihood. In 1571 (Descripción del Arzobispado de Mexico, P.N.E. Tomo III, 1905) the same two villages had a population of only 860, well below the 1940 census. The population decline in this area was apparently more severe than over most of the Valley. The data suggest that the Aztec population was three to four times the modern and perhaps three and one-half times that for 1580.

Generally, the Aztec archaeological data justifies the assertion, based on the independent documentary evidence, that the population in 1519 was considerably higher in 1580 or 1940. The total was probably close to the higher estimate of 120,000. In the final report, the method presented above of direct comparison of intensively surveyed areas with sixteenth and twentieth-century data will be further developed.

In estimations of the population for the pre-Aztec Phases and Periods, the problems are different for the various time periods. For this reason the phases are grouped into three segments of time for separate analysis in the discussion to follow. The three divisions are (1) Late Toltec, or the Mazapan and Atlatongo Phases, (2) Tzacualli through Xometla, and (3) pre-Tzacualli, or most of the Formative Period.

Late Toltec Population.

In this report the two Late Toltec (Early post-Classic) Phases will not be differentiated since the details of seriation have yet to be worked out. The two phases together will be referred to simply as Late Toltec or Mazapan.

Approximately 95 sites of this phase have been located in the survey area. They are distributed in all of the ecological segments of the Valley, for the first time in its history, and test areas covered by intensive survey are available for analysis for each of the ecological divisions of the Valley, except the North Tributary Valleys. The overall distribution of the sites, relative density in the ecological divisions of the Valley, and community patterns are very similar to that for the Aztec Period. We see no reason to assume that the surveys were less or more effective in locating Mazapan sites as compared to Aztec. On the basis of these considerations, therefore, the problem of estimating the Mazapan population would seem to be a simple matter of comparing total residential areas of Mazapan to Aztec sites in the various areas of the Valley for which intensive survey data are available and of establishing a population based on the proportion.

However, two problems complicate the method. Within the same area of the Valley, one has the impression that Mazapan sites are always less nucleated than Aztec. This seems to apply to towns as well as rural sites. Mazapan rural sites probably had densities close to those of modern Scattered Villages. This means that a population estimate based simply on relative size of areas of occupation would be somewhat higher than the true population.

Another problem is the size of the Mazapan occupation of the archaeological zone of Teotihuacan. The problem revolves around the question of

the final phases of the population decline of the Teotihuacan city. Data from both the city and the rural survey indicate a sizable population for the Xometla-Oxtotipac Phases (Early Toltec-Terminal Teotihuacan), a kind of epigonal persistence of the Early Classic settlement pattern. In view of the obvious ruralization process that was going on in Mazapan times (note the contrast between figures 8 and 10), we doubt that the population was any larger than in the final Aztec phases and it was probably not much greater in size and density than the modern (approximately 4500 people in 1940 in the villages of San Martin, San Francisco, Santa Maria and San Sebastian).

A simple ratio of numbers of Mazapan versus Aztec sites is not an adequate measure, since Aztec sites generally are larger and have heavier concentrations of occupational debris. A detailed comparison of test areas plus general observations on the total pattern is more useful. In this report the same two areas used in the discussion of Aztec population will serve as tests.

Maquixco Alto-Teacalco Test Zone. One village and 10 hamlets of the Late Toltec Phases are located within this test strip. The total surface areas occupied by these sites is between 30 to 40 hectares. Aztec sites in the same area total 133 hectares or 3.4-4.4 times the Mazapan. Considering the fact that occupational debris on Aztec sites is heavier, the Mazapan population was probably no more than one-fourth the size of the Aztec and it may have been only one-fifth.

Middle Valley - North Piedmont Test Zone. In this survey area are located one Mazapan village and 19 hamlets with a total surface area of 40 to 50 hectares. Aztec sites in the same areas total 183 hectares and again the occupation is heavier. The data suggest that the Aztec population was at least 3.7-4.6 times the Mazapan.

The above proportions seem to hold very well for most of the Valley. It is difficult to escape the conclusion that the population in Mazapan times was no more than 20-25 percent that of 1519. This would yield a figure of 22,000-27,000, which is well below that for either 1940 or 1580.

Tzacualli-Teotihuacan-Xometla Population.

This long period of time is discussed as a unit because in all phases the problems of population estimates for the Valley as a whole are compounded by the presence of a single, large, demographic focus--the city of Teotihuacan. Since the city was not included in the survey, all the following estimates must be extremely tentative, and accurate measures will have to await the completion of the Teotihuacan Mapping Project.

The Tzacualli Town. The problem is especially acute for the Tzacualli Phase since a variety of interpretations of the settlement pattern of the center are possible with the data at hand. Millon's core site of three square kilometers could have had any one of the following three patterns:

1. It may have been a typical ceremonial center in the Classic Maya sense with a resident population numbering only in the hundreds, and the balance of the supporting population dispersed over the Valley in small rural settlements.
2. It could have been a semi-urban or transitional urban community like the Aztec town with a varying population density. This would mean between 5,000-10,000 people in the three square kilometer core.

3. It might have been as congested as the later Classic city, but lacking the formal planning of the residential areas. This would yield a total of perhaps as high as 20,000-25,000.

Millon's Mapping Project has disclosed a large attached area covering four square kilometers of more lightly populated suburb located outside and northwest of the Early Classic City. Although this area is severely eroded and the pattern somewhat obscure, the overall density was not heavy, probably somewhere between a modern Scattered Village and the Low-Density Compact Village. This would yield an additional 2,000 to 6,000 people.

Our personal bias would be toward a conception of the three square kilometer core as having characteristics similar to Aztec towns. This would yield a total population for core and suburb of between 7,000 and 16,000, a respectable concentration that provided a substantial demographic base for the growth of the Early Classic city. The major problem with respect to definition of the pattern of the core is produced by the heavy superimposed later occupations (Tlamimilolpa-Xolalpan). How much Tzacualli residence is buried from view is not known. The refuse seems to be abundant enough to indicate a sizable population but is not as heavy as the Early Classic. The assumption of a relatively large resident population is also supported by the light, rural Tzacualli occupation of the Middle and Lower Valley, suggesting that a sizable population resided in the city and used the alluvial plains for cultivation. An argument in favor of the ceremonial center interpretation, however, is the fact that nearly all of the known areas of dense Tzacualli occupation located by Millon are directly associated with ceremonial precincts. Of course, such groups are loci for intensive building and rebuilding and there would be more disturbance of occupation levels than in strictly residential precincts.

Almost certainly the Tzacualli occupation within the borders of the Early Classic city was at least as heavy as it was in Mazapan times. For the rest of the Valley the problems of estimating Tzacualli population are equally difficult. First, the pattern is strikingly rural, perhaps even more so than the Mazapan. Some sites consist of a single isolated house or group of several houses, judging from the size of the occupation areas (very few house mounds are preserved). The zonal distribution is also very uneven when compared to that of the post-Classic. Unlike the latter phases, sites tend to be concentrated in some sectors of the Valley, absent in others. Only in cases where clusters occur together can the density be directly compared to the post-Classic phases (north piedmont of the Middle Valley, Upper Valley around and southeast of Oxtotipac, North Slope of Cerro Gordo). In such areas the occupation tends to be slightly higher, lower, or equal to Mazapan occupation in intensity and is always well below the Aztec. Since the Tzacualli population tended to be selective with respect to the Valley as a whole, however, such comparisons are meaningful only for the local area in question.

The major problem then is the degree of completeness of the survey. In areas where no sites were reported, was the survey effective enough so that the negative results were significant? In the areas where sites were reported were some sites missed? These questions are so crucial to any attempt to estimate the total Tzacualli population of the Valley that an evaluation of each ecological division will be presented.

Lower Valley-Delta. Survey control here is probably excellent. The only problem is that of buried sites in the plain, but this is a problem

for evaluation of occupation for all phases. Conceivably, in the Tzacualli Phase and only in that phase, great numbers of hamlets were concentrated in the plain but we found no evidence that this was true. Almost every field in the piedmont and lower slope of the hills were examined in this area. The paucity of sites checks well with a similarly feeble population for the succeeding Early Classic and suggests that the picture of a feeble resident Tzacualli population is accurate. The post-Classic occupation was heavy.

Middle Valley. Survey control, with the exception of the south piedmont, is excellent. The general pattern of Tzacualli occupation of the Valley indicates that probably many small sites are located in this unsurveyed area. General survey also has revealed a heavy Aztec and substantial Mazapan occupation so that it is improbable that the Tzacualli-Mazapan ratio is much different from that in other areas where both occupations do occur.

Upper Valley. The Tzacualli occupation of the Upper Valley is substantial and extraordinarily dispersed. Approximately one-half of the area has been intensively surveyed. The probability that other Tzacualli sites are located in this area is high. The data from the surveyed area suggest a Tzacualli population comparable to the Mazapan in size and well below the Aztec.

Patlachique Range. Although only small areas of the range were intensively surveyed, the almost complete absence of Tzacualli sites and the feeble Early Classic occupation in those areas suggest very light population.

North Tributary Valley. This is the poorest known segment of the Valley. All indications are that the Tzacualli occupation is extensive and probably comparable to the Mazapan.

Cerro Gordo-North Slope. One of the intensively tested survey areas was a section of the north slope of Cerro Gordo. In the test area, the Tzacualli occupation was substantial and involved a total surface area comparable to the Mazapan. More Tzacualli sites were located than Mazapan, but all of the former were hamlets and no village was found comparable in size to TT 35.

In summary, the substantial population probably resided within and immediately outside the limits of the Early Classic city. Including the rural settlements along the base of Cerro Malinalco, the population was probably several times that of the Mazapan Phase in the same area. In parts of the Valley where both Tzacualli and Mazapan rural occupation occur, the intensity of settlement is similar. Many parts of the Valley are known where Mazapan occupation is substantial and Tzacualli feeble. In total, the Tzacualli population of the Valley was probably comparable in size to the Mazapan, but with striking differences in distribution.

The Teotihuacan City. For the various phases of the Early Classic or Teotihuacan Period only rough estimates may be made of the city's population. From a base population of 7,000-16,000 during the Tzacualli Phase, a long period of rapid, steady growth occurred that probably reached a maximum in Xolalpan times. Whether the succeeding Metepec Phase witnessed a final growth or the beginning of the decline is not certain. This picture is based upon events in rural areas as well as in the city itself.

Dense occupational debris and religious precincts for the Teotihuacan Period as a whole are continuously concentrated in a total area of 12 km.². Data from Millon's preliminary report and Armillas' previous research

indicate that the central seven square kilometers (possibly a somewhat larger area) was formally planned during the Xolalpan Phase. This then would be the minimal size of the city during its phase of maximum growth. The chronological history of the five square kilometers of physically attached, peripheral settlement is probably complex and as yet not well-defined. It was clearly a residential area but apparently unplanned. Probably a portion, possibly all of it, was also occupied during Xolalpan times.

The following analysis of the planned core will provide at least a minimal population figure for the Xolalpan Phase. Of the seven square kilometers, at least five are composed of residences. To judge from the excavated residences, each grid was 60 m. square and was occupied by a large communal house with a complex of courts, patios, light wells and room complexes. In some cases it seems to have been occupied by a lineage type group (Yayahuala) and was divided into 10-12 small apartments, each presumably the residence of a nuclear family. Others (such as Tetitla) were probably residences of individuals of upper class status, but the entourage of servants and relatives was probably not much more or less numerous than the population of the lineage houses. This would suggest 40-50 persons residing in an area of 3600 m.². This would yield a figure of 1390 grid squares for the five square kilometers of residences or a total population of, in round numbers, perhaps 55,000-70,000. This figure does not include the elite residences aligned along Main Street or the priestly population residing in the temple precincts. The density of population in the residential area calculates at 11,000-13,000 per km.² or very close to that of the more urbanized parts of the modern Villa of San Juan Teotihuacan.

With respect to the history of the city's population, two basic alternative growth patterns are suggested by the data:

1. The maximal spatial limits of the Early Classic community were established in Miccaotli times and, either the maximal population size was also reached then, or the population was smaller and more dispersed. Subsequent population growth in the latter case would involve primarily a filling-in process and increasing nucleation.

2. At the end of Tzacualli a rapid shift of population from the northwest to the center of the Early Classic city occurred and from the beginning of Miccaotli, the settlement was densely nucleated. Later growth would be visualized not as one of increasing density but of increasing size as the population grew. At any case it seems certain that most of the pre-Xolalpan growth was unplanned and that a master plan was imposed over some seven square kilometers of the city during Xolalpan times.

Closely related to these two possibilities in growth patterns is the problem of how much of the unplanned periphery was occupied during the Xolalpan Phase. If the entire area was occupied this would have meant a population nearly double the previous estimate of between 105,000 and 125,000. The possibility exists, however, that during the Xolalpan Phase the entire residential area was planned, and that this process was accompanied by one of nucleation and retraction of size to the seven square kilometers. At any rate the city during the Xolalpan Phase had a population of at least 60,000 and possibly as high as 125,000 people.

Rural Teotihuacan Population - Problems. The rural population history is extraordinarily variable from sector to sector of the Valley, but

certain basic patterns of growth are clearly defined. This data will be summarized by ecological divisions. Before doing so, however, a number of problems must be discussed. One is the degree of thoroughness of survey. The situation closely parallels that of Tzacualli. We doubt (excepting as always the problem of buried sites in the plain) that the survey missed any substantial occupation in the Lower and Middle Valleys or the North Slope of Cerro Gordo. The rarity of sites in those portions of the Patlachique Range surveyed argues that that area was feebly populated. At least half of the Upper Valley has been intensively or extensively surveyed; therefore, the possibility of unlocated sites exists in those areas cursorily examined or not examined at all. The poorest control was over the North Tributary Valley. The limited amount of survey done there suggests a substantial population.

A specialized problem with respect to this period is that of the character of rural sites. In sharp contrast to earlier and later periods, Teotihuacan sites are tightly nucleated and compact. The density of mounds, rock debris and sherds is comparable to that in the city itself. In estimates of population of such sites, therefore, a density of 10,000 per km.² will be used. It could have been as low as 5000 (that of modern High-Density Compact Villages), but this is the absolute minimum. Adequate numbers of surface samples were taken in larger sites (up to 60) to resolve the problem of phasing of occupational areas within a single site.

Lower Valley-Delta. The total surface area of all sites in this area does not exceed 20-25 hectares. Nearly all sites reached their maximal population in Early Xolalpan times (TC 8, 5 in Late Xolalpan, TC 10 in Tlamimilolpa), and all were abandoned by the beginning of the Metepec Phase. The maximal population in the Xolalpan Phase for the entire area could not have exceeded 2500 people, and if the lower density is used for calculation it could have been as low as 1000.

Cerro Gordo, North Slope. The heaviest concentration of rural Teotihuacan sites occurs in this area. A small town, four villages and 16 hamlets are located in the eight square kilometer test strip. The total area of the town and villages is approximately 60 hectares, of the hamlets 10, for a total of 70. Nearly all of the hamlets are Miccaotli and/or Early Tlamimilolpa in data. The villages and town have a maximal concentration of remains during the Late Tlamimilolpa Phase. Following this in Xolalpan times, a sharp decrease occurred, terminating with complete abandonment of all sites in the Metepec Phase.

If the density of 10,000 per km.² is applied, there may have been a local population of 6000 in the Late Tlamimilolpa Phase; if the lower figure is used, this reduces to half. My preference here is for the upper figure since sites in this area have heavier occupational debris than normal. If the higher figure is correct then the area is the only one in the Valley where the Teotihuacan population markedly exceeds the Aztec. To judge from the spatial distributions of sherds, the population was reduced to about one-third this number in Xolalpan times. This loss was made up in part by local migration to TC 73, but even considering that site, there seems to have been considerable population loss.

Upper Valley. The feeble occupancy of the Upper Valley contrasts sharply with the Aztec occupation of the same area. It perhaps compares favorably with the Mazapan. TC 83 is a substantial site, the balance of the sites are all classifiable as hamlets or isolated hilltop shrines

(without architecture). Furthermore, several have occupations restricted to one or two phases. We doubt that the population was much higher than in the Lower Valley-Delta at any single time phase. The population in the general Miccaotli-Tlamimilolpa Phase was apparently very small. It expanded in Xolalpan times and, contrary to the picture elsewhere in the Valley, reached a climax in Metepec times. The only good surface samples encountered in the survey for this phase were from this area.

Patlachique Range. Only two small villages were located in this area; both have substantial Xolalpan, one a fair Metepec occupation. Conceivably, other settlements were not detected in the survey, but that the population in the range totalled more than a few hundred is extremely doubtful.

North Tributary Valleys. The control is poor for this area. Brief surveys in the areas reveal the probable presence of a substantial population and a curve of growth very similar to that for the Cerro Gordo North Slope area. Possibly the density and number of sites in the cluster of small hills approaches that of the latter area.

Middle Valley. Nearly all of the sites in this area are suburbs physically attached to the city or villages located within a kilometer of its periphery. In all cases the occupation is very heavy and the densities must have been close to those in the city. The total surface area covered by these settlements is approximately three square kilometers, about half of which comprises the big suburb TC 119-120. Most of the sites in this group have a similar population curve: a small Tlamimilolpa population, heavy Xolalpan, and near abandonment in Metepec. TC 119 and 120, however, apparently have a heavy pre-Xolalpan occupation and the Xolalpan-Metepec Phases are lightly represented. During the Xolalpan Phase, therefore, about 150 hectares were heavily occupied. This would mean a population of between 7,500-15,000, depending upon which density figure is used.

Summary. In glancing over the above data a trustworthy estimate of the maximum Valley-wide population for the Teotihuacan Period and especially a phase by phase history will obviously have to await the completion of the Teotihuacan Mapping Project. In a gross way the total peak population would appear to have been pretty close to that estimated for 1519 distributed as follows:

	Probable Population	Minimal Population	Maximal Population
Urban Core	60-75,000	60-75,000	60-75,000
Urban Periphery	?	0	45-50,000
Suburbs and near villages	15,000	7,500	15,000
Lower Valley Delta	2,500	1,000	2,500
North Slope-Cerro Gordo	6,000	3,000	6,000
Upper Valley	2,500	1,000	2,500
Patlachique Range	500	500	500
North Tributary Valleys	6,000	3,000	6,000
	92,500-107,500	76-91,000	137,500-157,000

Excluding the urban periphery, the most probable figure would seem to be around 100,000. The Aztec population in 1519 was estimated as somewhere between 75,000-110,000. If at least a portion of the urban periphery was occupied in Xolalpan times and the upper estimate of the Aztec population

is accepted, then the Teotihuacan Period peak population was very close to the Aztec.

A main difference between the two periods would lie in the distribution. Not more than 25 percent of the Aztec population resided in population foci with populations in the thousands. In Xolalpan times at least two-thirds, possibly five-sevenths, of the population resided in a single large center, according to the various estimates in the preceding chart. This fraction may have been higher in Metepec times.

Pre-Tzacualli Population.

Only minor variations in community settlement patterns characterize the pre-Tzacualli Phases. The only exceptions to this statement are the Cuanalan plainside villages and hamlets, which seem to have been tightly nucleated. Most Formative sites are similar to Mazapan or Aztec sites in density and can therefore be compared directly to them. A salient characteristic of the zonal pattern is its unevenness. The Patlachique Range was the primary focus of settlement in all phases except Cuanalan. The range was only partially surveyed and nowhere is there a large continuous area tested by intensive survey. Since it was a focus of Formative settlement, the chances for the existence of many unlocated sites are high. On the other hand, the majority of the known sites are on slopes, tributary valleys, or high ridges that are a part of the drainage of the Upper San Lorenzo Barranca, a unique topographical feature in the range. This would suggest that the density of sites is greater here than over most of the range. The range is so severely eroded and Formative sites so small, however, that entire sites may have been washed away. Many barrancas are wider than the diameter of the average site of this period and lateral erosion could have completely destroyed sites. A final problem, here a more serious one, is that of contemporaneity of sites. If the reconstruction of agricultural systems for the period to be presented in the following section is correct, the probabilities of frequent shifting of communities was very high. This pattern is suggested by the gaps in occupational phases in many of the sites in the range. Bearing these difficulties in mind, the list of occupations for each of the phases of the overall period presented on page 92 can be used as a basis for the calculation of a relative population curve. The three hamlets occupied during the Altica Phase increase to 18 in Chiconautla (but this is the longest of the time divisions and should be divided into two phases to make the data comparable to the other phases). From this point on, each phase is of equivalent length and the data suggest a doubling of population in each succeeding phase. Between Patlachique and Tzacualli, the population undoubtedly more than doubled since this was the period in which the large town was established.

The data presented above is summarized in figures 14 and 15. In the former the absolute population curve of the Valley as a whole is estimated, along with an attempt to sort "urban" from "rural". Also noted in the chart are those factors thought to be responsible for the growth and decline of population. Figure 15 demonstrates, on a relative scale, the variation in occupational density per phase for each of the ecological segments of the Valley.

Agricultural Techniques and Land Use

Methodology and Problems.

General Considerations. One of the major objectives of the project was to define the history of land use and agricultural techniques in as much detail as possible. The data collected with regards to this objective is, in many respects, the least satisfactory. In this section the problems involved in the application of archaeological method to this problem will be discussed and a tentative reconstruction of agricultural history attempted. Four basic methods of collecting data were used: ethnographic, documentary, archaeological, and palynological.

1. The methodological assumptions with respect to the applicability of ethnographic data to archaeological settings were as follows:

- a. The problems faced by ancient cultivators living in the Teotihuacan Valley were undoubtedly similar to those faced by present-day farmers and the solutions therefore were likely to have been similar.
- b. Adaptive responses in peasant societies are highly resistant to change, unless major changes in basic technology or geography occurred that affected the subsistence aspects of the culture. The plow, draft and grazing animals, iron tools, and some new crops were all introduced in the sixteenth century. None of these, however, significantly increased agricultural productivity (and may have actually reduced it); nor did they have any effect upon the basic problems of adjustment to the environment. The pollen studies cited previously show evidence of only minor changes in those geographical characteristics that would have effected agriculture during the span of time between 800 BC and 1960 AD except those produced by man himself.

2. The documentary data have great value in reconstructing the situation during the final decade before the Spanish Conquest and the century immediately succeeding it.

3. By use of the palynological approach we hoped to resolve two basic problems, the data of inception of the permanent irrigation system and sequence of introduction of domestic plants.

4. The primary method was archaeological. Archaeological methodology and evidence with respect to the problems of defining pre-Hispanic agricultural patterns are discussed below under two headings, direct and indirect. Direct evidence refers to the actual evidence of agricultural activities, such as plant remains, and structural features such as canals, dams, and terraces. Indirect evidence refers to inferential data as to the kind, intensity and distribution of agricultural activities.

Since the primary objective of the project was to correlate the trends in agricultural history to the evolution of the elaborate manifestations of Mesoamerican culture in the area, not all aspects of pre-Hispanic agriculture were explored or analyzed. The project was specifically concerned with those aspects of agriculture that relate to the growth of large social systems and urban centers. Two basic aspects of agriculture seem to relate to such growths, the productive or economic aspect and the integrative or social. In the Teotihuacan Valley the aspects of agriculture most closely linked to productivity are those that relate to soil and water conservation. The history of irrigation and terracing is therefore of crucial significance. A dense population cannot be maintained in this type of environment without control of erosion and resolution of the twin problem

of droughts and frosts. With respect to social integration, the focus would be on those aspects of agriculture that promote tension and competition on one hand, and the need for cooperation, organization and regulation of human behavior on the other. The agricultural technique that most closely relates to these processes is undoubtedly irrigation.

The kinds and qualities of crops available in the pre-Hispanic Periods are also closely related to productivity. The presence of maguey and nopal, for example, adds an entirely new dimension to the productivity of the Valley. One of the major problems in applying data on productivity of crops from the modern to the pre-Hispanic, and not resolved by the project, is the possibility that lower yielding varieties of maize were used in earlier periods. Modern maize, especially that used in the irrigated areas, is a very productive, large-eared variety; conceivably this is a relatively new type and less productive varieties were used in Teotihuacan times.

Irrigation - Direct Evidence.

Most major barrancas in the Valley today exhibit evidence of artificial straightening or alteration of courses. Small barrancas are frequently, completely canalized. Numerous cases of aborted barrancas were observed, i.e., where the stream bed is preserved from its headwaters to a point part way downslope or to the edge of the plain, and where the lower course has disappeared as the result of tapping the water upstream and consequent sedimentation of the abandoned channel. The present-day drainage of the Valley is undoubtedly natural, and parts of it of great age, but its specific form is partly artificial. This suggests a long history of water control for the Valley and a respectable antiquity.

The remains of abandoned canals, drainage ditches and dams are abundant all over the survey area and offer striking testimonial to the problem of water conservation and the extraordinary significance of this crucial resource. Evidence of a "hydroagricultural" civilization in Wittfogel's terminology is incontrovertible. The major problem is one of archaeological method: How does one date an old ditch?

The Valley of Teotihuacan for historical and geographical reasons offers a special set of problems to archaeological method. Before entering into this theme, we will discuss the situation faced by Gordon Willey in his attempt to write the history of irrigation of the Viru Valley of Peru.

The hydrographic basin of Viru is similar to that of Teotihuacan in size. The population there apparently reached a peak in the Gallinazo Period (0-300 AD) and went through a long gradual period of decline until the arrival of the Spaniards in 1533. Subsequent to the Conquest, a demographic disaster followed parallel to that which occurred in Lowland Mesoamerica, and the population was almost destroyed by the end of the sixteenth century. Since then, the recovery has been extremely slow and the growth of large mechanized haciendas in recent times has prevented any substantial demographic recovery. As a result the amount of land under cultivation today is well below the potential of the hydrographic system and has been so since the Spanish Conquest.

The Viru Valley, unlike the Teotihuacan Valley, has a desert climate. The Viru River receives a permanent flow of water from the Continental Divide via several tributary streams. The Valley proper is a triangular plain bordered by low ranges of desert hills and traversed by the main

stream. Agriculture is impossible on the hilly flanks because of their elevation above the canal system, lack of local water resources for irrigation, and absence of rainfall. Agriculture in the plain is almost impossible without irrigation (except in a few localities near the river and ocean where perpetually humid subsoils are found).

The history of agriculture in the Valley was therefore one of expanding control over the hydrographic resources, and use of irrigation and of outward expansion of irrigated land into the desert as the population increased. The lack of rainfall and generally flat terrain meant that erosion and deposition of abandoned canals was considerably slowed down and prehistoric structures therefore are well-preserved. The problem of dating is greatly simplified by this process of expansion of the agricultural land. As the population grew, new areas were reclaimed from the neighboring desert and new settlements established within or on the desert margins of the reclaimed land. The dating of canals is therefore simply a matter of plotting the localities of habitation sites on a map and determining the age of the new settlement by surface sampling.

The situation in the Teotihuacan Valley is quite different. The Valley was lightly populated in the Early, Middle and Late Formative Phases, well-populated in Terminal Formative times and densely populated in all succeeding phases with at least two maxima of population growth (Xolalpan and Teacalco Phases). Although the population loss was heavy in the sixteenth and seventeenth centuries, a substantial population survived this period of demographic depression, which has steadily increased up to the last census.

The probabilities are higher (although marginal lands were abandoned in periods of demographic decline) that the most productive lands and their canal systems have been in continuous use since the inception of irrigation. During the nineteenth and early twentieth centuries, an extraordinary growth of haciendas occurred and a florescence of hydraulic systems constructed by them. The present form of the hydrographic system is either the product of their canalization schemes or modifications and re-establishment of older ones. Most of this manipulation involved the floodwater drainage of the Valley primarily. The 1580 map and relacion demonstrates that the permanent irrigation system was in full use even after the demographic disasters of the sixteenth century, and that the major outlines of the system were similar to those in existence today. The Abecedario de Visitas dating from the period 1531 to 1544 testifies to the existence of the system within one or two decades of the Spanish Conquest.

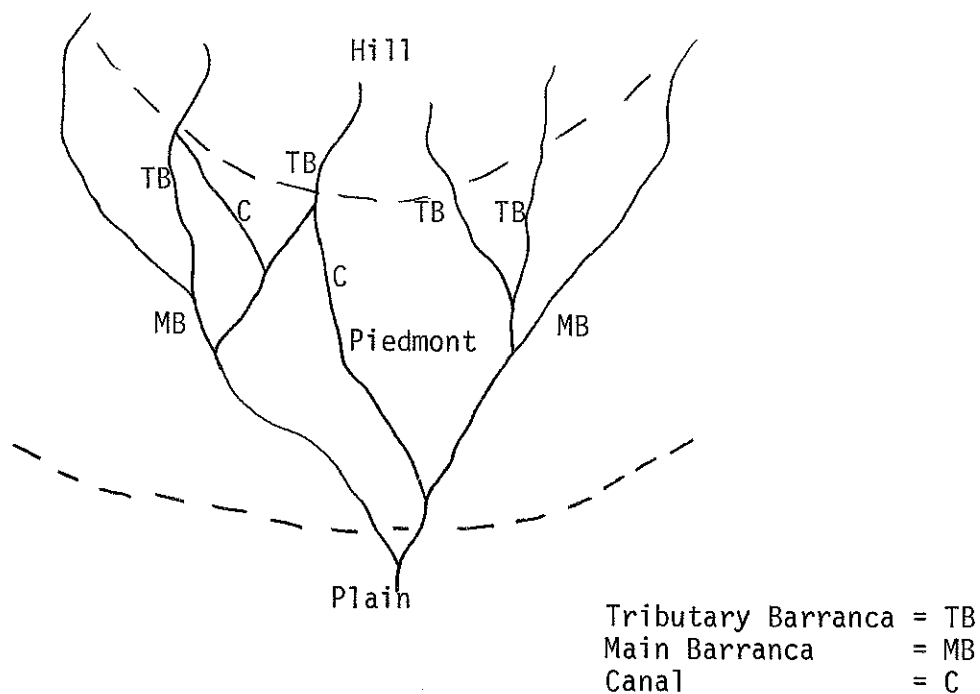
The relationship between population growth and land use in the Teotihuacan Valley has been very different from that in Viru. Agriculture without irrigation can be practiced and be made to support a substantial population. Because of the presence of seasonal rainfall, the slopes and hills are cultivatable. Crop security and productivity are strikingly improved with irrigation, however. As populations grew in the Valley, the gross area of cultivatable land was not artificially expanded as in the case of Viru; individual plots were simply cultivated more frequently and the use of land became more intensive as population pressure occurred. This means that spatial distributions of sites per phase are meaningless as direct evidence of the expansion of irrigation, and canals cannot be dated simply by site association.

In the Teotihuacan Valley the twin problems of erosion and deposition must be faced; both are relatively minor factors in the preservation of ancient hydraulic structures in the Viru Valley. The locations of archaeological sites throughout the long span of time between the Altica and Teacalco phases suggest that most of the major barrancas are old streams and have functioned as such throughout the history of agricultural exploitation of the Valley. They have their headwaters well up on the slopes of the surrounding hills and ranges, flow through broken topography in their upper courses, and ultimately cross the alluvial plain. They are the primary sources of water for floodwater irrigation today. All of the modern dams and canal outlets are located at the edge of or within the alluvial plain where the barrancas beds are shallower and narrower. Along much of their upper courses the barrancas are severely eroded, both vertically and laterally. In cases of streams that formerly had beds which were only a few meters deep and wide, erosion has frequently resulted in down cutting to depths of 20-30 m. and lateral erosion has increased their width to over 100 m. Any hydraulic features like dams or outlet canals that were built to divert water from them would have been completely destroyed and washed downstream. Very probably ancient systems did tap the streams further upslope.

Fragmentary remains of abandoned canal systems were frequently encountered on survey, but were rarely traceable for any distance because of partial destruction. Conceivably the degree of erosion of a canal might be used in a general way to assume antiquity, but this kind of evidence is a very insecure basis for dating. In the discussion of modern land use, the extraordinary rapidity of erosion was noted. Nearly all sloping terrain in the Valley shows scars of this destructive process in various degrees of severity, and therefore all of the old terrace and irrigation systems have been at least partially affected. Normally an abandoned ditch will fill in with sediment, as is the case in the alluvial plain. Abandoned canals on sloping terrain, however, because of the overall pattern of erosion, frequently continue to function as natural drainage channels. The seasonal flow of water over the relatively soft tepetate bed of the canal forms a miniature barranca. In the early phase of the Teotihuacan Valley Project, the extraordinary rapidity of this process was not really appreciated by the survey teams and they recorded only features that appeared as abandoned canals.

In the final years of the project it became obvious that most of these were relatively recent systems and certainly post-Hispanic. We then realized that ancient canals in this environment were much more likely to resemble barrancas than canals. The possibility that some of the smaller barrancas in the area were, in fact, the remains of old canals became apparent in September, 1963, when the test strip on the north slope of Cerro Gordo was surveyed. Several cases of small barrancas whose topographical relationships were divergent from the natural hydraulic pattern were noted in this area. Normally barranca systems, as they flow down a conical hill like Cerro Gordo, have a pattern like the letter Y; that is, each tributary has an independent source, and they converge as they go downslope. Several cases were noted of structures that appeared like small barrancas but in which the flow was inverted; that is, a barranca would feed off a large barranca at its source and diverge from the path of the main barranca as it ran downslope. In several cases the small barranca would run from one large

barranca to another, a pattern that never occurs in natural drainage, but which is typical of floodwater canals today. The following diagram will serve to clarify the situation.



We feel certain that they are not natural features and the probability that they are ancient canals is very high. They have no functional relationship to modern floodwater irrigation and terrace systems in the Cerro Gordo area and, in fact, are considered as obstacles to cultivation in the same sense that natural barrancas are. The system of building check dams in barrancas was described previously. Several of these old canals have check dam systems in them as well! In the case of one canal, parts of it disappear under a modern terrace system and reappear in spots where erosion has destroyed sections of the system, thus its use clearly predates the construction of the terraces. Such barranca-like canals have been located on the south slope of Cerro Gordo as well. They are certainly ancient, but their precise age is uncertain. We suspect the existence of numerous others that were not detected by the survey.

Dating the growth of the permanent irrigation system, which is at least of Aztec age in its present form, was a major objective of the project. The topographical characteristics of the area are such that the possibilities are strong that its main structural features have not been altered since the system's inception. Since all of the canals are in a depositional plain, erosion or downcutting is not a serious problem for the maintenance

of the system. Deposition of sediment in the canal is the normal pattern; annual cleaning of this debris is a characteristic feature of its maintenance. The stability of the canals, however, would be a characteristic of the main canals only. Secondary and tertiary canal positions would depend on the form and size of land holding units and these would change from period to period. Any abandoned ancient canal in the plain, however, would quickly fill in with silt and not be detectable on survey (in reality abandoned canals were probably filled in intentionally since they would be obstacles to cultivation). Excavation could locate such canals, which if used for a short period, could probably be dated as well. (Since open ditches fill in quickly and the sediments should contain some sherds of the period of their use). The problem here is a simple one of time and expense. The only positive way to locate such canals would be to dig a long trench across the plain or at least for a considerable distance. Perhaps this would be one archaeological problem in which earth moving machinery could be used effectively. The excavation of a long trench across the Valley could be accompanied by small excavations at spots in the profiles where canals had been exposed in order to establish their data.

In a few areas on the lower piedmont small abandoned canals are observable on the aerophoto. These canals have escaped destruction since they are located in areas where the depositional process has been faster than the erosional one. Armillas discovered a small floodwater canal system and Millon excavated the sediments in the canal bed. Millon was able to show that the canal had been used and abandoned in pre-Hispanic times with its first definite use in Mazapan times (see Armillas, Palerm and Wolf, 1956 and Millon, 1957).

The most convincing case for dating of hydraulic features would be one in which the system had a precise and direct relationship to an archaeological site. For example, if a dam had been constructed across a barranca in the hilly flank area, a primary canal excavated to lead the water to a set of terraces, secondary canals constructed to bring water to individual terrace complexes, and if each of the terrace complexes were directly associated with an archaeological site (all of the same time period), then the association would be proof of contemporaneity of settlement and hydraulic works. If small canals were detected that had been excavated to bring water to reservoirs for ordinary daily use, then the argument would be incontrovertible. No such definite associations are known for the Teotihuacan Valley. Of course, partial erosion of such a system in the Valley would make the demonstration of the interrelationships of the system parts exceedingly difficult.

Hypothetically, an ancient hydraulic system might require components that would involve more formal architectonic qualities. For example, in the fifteenth century Nezahualcoyotl brought water via a canal from springs near San Pablo Ixayoc (see Palerm and Wolf, 1955) to terraced fields near Texcotzinco. Two deep ravines had to be crossed along the canal route. Huge sedimentary embankments were built across the ravines and a masonry canal was constructed on their summits. The masonry was of lime cement and tezontle gravel very similar in its structural characteristics to the facings on Aztec pyramids. In the case of the Teotihuacan Valley, all of the canals in use today and all those abandoned are simply excavated ditches. A complicating problem furthermore is that many modern

dams are built of the same materials and use the same construction techniques that were known to the pre-Hispanic population.

A final method that could produce more or less direct evidence of irrigation is palynology. Previously we referred to a pollen core collected from El Tular, a spring near Atlatongo. The sample was taken specifically for the purpose of dating the inception of the irrigation system. The supposition was as follows: The modern irrigation system is essentially a drainage project in which water is collected from the springs and drained out of the local area and carried down the Valley. The present high-water table in the vicinity of the springs has been noted. Before the irrigation system was installed, the area around the springs must have been swampy. Under such conditions the vegetation would have been dominated by water-loving plants. The pollen profile should therefore demonstrate the existence of a period in which water-loving plants dominate the plant assemblage, succeeded abruptly by a period in which they were rapidly replaced by agricultural plants and weeds. The profile in figure 16 demonstrates that this is precisely what happened. The samples from between the three and five meter levels are dominated by a group of plants of the family Cyperaceae, the pollen frequency ranging between 30-37 percent of the sample. Between the 3.0 and 2.5 m. level, the frequency drops rapidly to 5 percent of the sample and remains between 2-10 percent for the balance of the graph. With one slight discrepancy, an almost continuous decline in frequency of this family of plants follows that corresponds to an equally gradual and continuous increase of domestic plants and of types of plants that occur frequently as weeds in agricultural fields. One of the families of plants, Compositae, includes a number of species that are commonly found along the banks of canals today. We have stressed previously that the evidence from both lake levels and pollen demonstrates conclusively that no major changes in rainfall or temperature have occurred in the Valley since its occupation by sedentary farmers.

The precise data of the drainage cannot be determined but according to the correlation worked out with the Cuanalan core, it should date towards the end of the Formative Period. Furthermore, the evidence from the Cuanalan core strikingly confirms the argument that the drainage related to irrigation downvalley since a sharp rise in percentage of Cyperaceae occurs at a time when this type of plant declines in the tular core!

Terracing - Direct Evidence.

Three basic methods of terracing are used in the Valley today, adapted to areas of varying angles of slope. For gentle slopes, earth banks planted in maguey are used; moderately steep slopes have retaining walls of stone-earth-tepetate on which maguey is also planted, and in areas of steep slope and little soil, maguey is planted in closely spaced rows parallel to the slope, at times with a halfmoon terrace faced with stone for each plant. The possibilities of dating the first and last of these types of terraces by archaeological method seems remote, but in the case of stone-earth-tepetate faced terrace systems it is possible to date them even by survey. The most secure evidence based on survey would be the discovery of an associative situation noted previously in the sample of the irrigation system, i.e., a system with structural components built of formal masonry in pre-Hispanic style. In the case of terracing, the general associational approach would seem a more secure basis of dating than in the case of canal systems, and the possibility of a system being totally destroyed is less.

Second, and more important, houses may frequently be built on terraces, therefore, a simple functional relationship between the two exists. An excellent example of this type of evidence is that furnished by the Aztec site survey. Most Aztec sites are located on the gently to medium sloping piedmont. The individual settlements are fairly dispersed and every Aztec site noted in the survey has house remains and badly ruined stone-faced terraces in the same specific area. Many of the terraces are located in areas where post-Aztec land use has been feeble. These were marginal lands that were abandoned after the Conquest, and suffered so heavily from erosion that they are still abandoned. In some Aztec sites, the houses are located on low platforms and one of the retaining walls of the platform serves as part of an agricultural terrace facing. In the case of Aztec sites, the sample is so large (over 100 sites), and the general association of house clusters and destroyed terraces in the slope areas so ubiquitous, that it is in itself a convincing argument.

Dating Teotihuacan terrace systems by this method presents a major problem. Sites of this period are small, compact, and tightly nucleated and the houses are not distributed through the agricultural holdings of the community. The pattern is more like that of the villages in the Lower Valley today, a small area set aside for residences surrounded by agricultural fields. Nearly all Teotihuacan sites also have Aztec components, thus complicating the picture even more.

Indirect Data.

Indirect data refers to those cultural and demographic characteristics that are indirectly related to agricultural productivity and intensity. The main problem in the use of such data is that there are always alternative possibilities of interpretation that must be considered. The data must be handled in the same way as the inferential archaeological evidence for reconstruction of socioeconomic aspects of culture, that is, levels of specificity of interpretation. Certain broad levels of generalizations about land use may certainly be made from indirect data, highly specific conclusions may not.

The reconstruction to follow is based upon the following two considerations:

1. The lands used for subsistence by peasant or folk farmers residing in small communities tend to be close to the residences. This is true of all modern settlements in the Valley and is probably a universal. This rule may be modified by factors other than land use. For example, the Spanish government in the sixteenth century did congregate rural populations into relatively large, compact communities in areas like Yucatan where agricultural practices were extensive. The result was that farmers did go as far as 20 km. from the community to farm. Today the Maya in Yucatan go even further distances but use bus transportation and reside in temporary shelters for extended periods of time in the fields during the various phases of agricultural activity. Of course, this can be controlled archaeologically by plotting the distributions of sites and defining the areas that were probably cultivated by each settlement on the basis of their spacing. The statement is somewhat redundant since farmers that reside in a large number of small settlements do so primarily to get as close to the land as possible.

The levels of relationship, however, may differ considerably. Terraces in the Teotihuacan Valley require a very close association of house to terrace for effective maintenance. Therefore an evenly spaced distribution along the piedmont is a strong argument in favor of terracing. The relatively close spacing of sites and houses suggests very intensive use of such terraces. Since so few cases are known of farmers traveling great distances to their lands in this environment, a settlement pattern consisting of large compact communities also suggests intensive agricultural practices. Widely-spaced, small hamlets would on the contrary indicate extensive agricultural practices. Of course, beyond the peasant community the arguments break down. A large center like Teotihuacan, for example, could have drawn food resources by trade or tribute from a much larger area than the Teotihuacan Valley and therefore generalizations about local agricultural practices are not as secure as when one is considering a rural population center.

2. The size of the rural or farming population must relate in a general way to the productivity of local agriculture. If the population in a past phase was larger than today's, obviously they must have been as successful in using the resources of the Valley as is the present population. If individual settlements were occupied for a long period of time, this would clearly imply that a stable system of agriculture had been developed in the local area. We have demonstrated that the climate has not changed drastically, therefore such stable relationships had to involve adaptations to the same problems faced by the modern population. The size of the population as a whole, relative permanence of settlement of individual sites, and the size of individual sites are all good indirect data that may be used to reconstruct the agricultural system.

By using the modern and Aztec land use patterns as controls and applying the above principles, one can resolve the following basic questions:

1. In what zones of the Valley was agriculture practiced; what areas were unused?

2. How intensive was land use in the areas cultivated?

Tentative History of Land Use and Agricultural Techniques.

Bearing in mind the methodological problems discussed in the preceding section, the following is a tentative reconstruction of changing patterns of land use and agricultural techniques for the Valley.

Pre-Tzacualli Phases. One hundred and nineteen occupations were defined for the long period between the beginning of the Altica and Tzacualli Phases. This figure includes approximately 40 trace occupations. The focus of occupation during this period was in the Patlachique Range and hilly flanks of the Valley generally. Sites that occur on the piedmont are located consistently at the upper edge or well above the strip of post-Classic settlement. This generalization applies to all local areas where Aztec and pre-Tzacualli sites occur together. The only Aztec sites that do occur above the pre-Tzacualli ones are hilltop shrines. The distribution of the 119 occupations is summarized in the following chart:

<u>Location</u>	<u>Altica</u>	<u>Chiconautla</u>	<u>Cuanalan</u>	<u>Patlachique</u>	<u>All Phases</u>
Elevated southern flank	4	9	14	42	69
Cerro Gordo-Upper Piedmont	0	2	6	6	14
Cerro Malinalco-Upper Piedmont	0	1	2	8	11
Chiconautla Slope	0	0	0	1	1
Elevated Areas	<u>4</u>	<u>12</u>	<u>22</u>	<u>57</u>	<u>95</u>
Upper Valley-Lower Piedmont	0	0	0	7	7
Lower Valley-Lower Piedmont	1	3	5	2	11
North Tributary Valley	0	0	1	1	2
Archaeological Zone	0	3	traces	0	4
Low Lying Areas	<u>1</u>	<u>6</u>	<u>7</u>	<u>10</u>	<u>24</u>
Total	5	18	29	67	119

Fifty-nine percent of all pre-Tzacualli sites were located on the elevated southern flank of the Valley and 81 percent in terrain located above the major Classic and post-Classic settlement. This predilection for hilly or elevated terrain obviously reflects a strikingly different pattern of land use than in later times. The following generalizations may also be made about the pre-Tzacualli settlement:

1. Communities tended to be small, only nine of the 119 settlements were larger than hamlet size. None of the latter had populations exceeding 500.

2. Zonal population stability was high but site stability low; in the sample are frequent cases of site abandonment for entire ceramic phases.

3. Most sites are located near present-day barrancas, frequently in rugged headwater topography.

4. No definite terracing can be assigned to any pre-Tzacualli occupation.

5. The total population of the Valley can be classified as feeble-to-light throughout the total time period. Even at the end it did not exceed 10,000 and during most of the period it was probably only a few thousand.

6. Beginning in the Chiconautla Phase, but of increasing importance through the overall time period, was a very light but consistent occupation of the alluvial plain and nearby piedmont, the embryonic phase of a development that was to reach extraordinary significance in later times.

7. The heaviest concentration of sites in all phases was in the southern flank area, and all but one (that a trace) of the sites pertaining to the oldest phase were located there.

During at least the earliest phases of the overall period of time, the hilly terrain probably had a respectable soil cover. This fact plus

the heavier rainfall and the relative freedom from frosts in the 2300-2600 m. band would have made the higher areas of the Valley ideal for settlement for a pioneer population in their early stage of adaptation to the area. The Patlachique Range is the largest continuous block of high terrain and would have had the greatest potential of all of the high terrain areas.

In many parts of Highland Mexico today, especially in areas of hilly terrain and relatively high rainfall, a modification of lowland slash and burn agriculture called tlacolol cultivation is practiced. The vegetation is cleared with axes and machetes, allowed to dry, and then burned off. The land is then prepared with a hoe and planted with a digging stick. Several weedings follow and then the crop is harvested. Such lands are usually cultivated two to three years in succession and then fallowed for an equal or longer period of time. The exact number of years in cultivation versus years in rest varies considerably according to population pressure, soil fertility, competition of natural vegetation and amount of erosion. The system is characterized by an inherent centrifugal force since yields on new fields are considerably higher than in succeeding plantings. In areas where population is light, new fields may be opened every year. The same basic system (but excluding the use of hoes) is practiced in the lowlands and is a productive, stable mode of land use. In the highlands, however, erosion is a serious problem and it is generally less productive a system. It works best in areas of heavy rainfall, since the rapid growth of crops and weeds provides a protective cover for the soil.

The characteristics of the pre-Tzacualli occupation of the Teotihuacan Valley point convincingly in favor of tlacolol cultivation as the primary system of land use during this long period. The light population, small size of settlements, settlement instability, and lack of evidence of terracing all suggest an extensive system of cultivation. In a virgin territory, such as the Teotihuacan Valley during its pioneer stage of occupation, tlacolol cultivation would have been highly productive in terms of the relationship between work and yield. The strong probability that the headwater streams had a permanent or semi-permanent flow of water would have been an added attraction to settlement in such areas. The vegetation at that time was probably scrubby, but dense, and would have required a method of removal similar to tlacolol.

A major problem in using tlacolol cultivation on the slope areas of the Valley would have been the relatively light torrential rainfall as compared to that in most parts of Mesoamerica today where this cultivation is practiced. Erosion would have been a much more serious problem in the Teotihuacan Valley than in most areas. Today the areas of pre-Tzacualli settlement are severely eroded, and in much of the Patlachique Range the slopes are nearly denuded of soil. If our arguments are correct, much of the erosion and deforestation of the steeper slopes of the Valley probably occurred during the pre-Tzacualli occupation. This conclusion is strikingly supported by the post-Tzacualli settlement of the Valley. Very few of the areas that were heavily settled in the pre-Tzacualli Phases were well-populated in the Classic and post-Classic Period. It is difficult to escape the conclusion that such areas were no longer available for agricultural use, especially when considering the ubiquitous character of Aztec settlement. The only exceptions are cases of relatively flat, high

ridges where erosional processes have been less severe. The size of the Patlachique Phase population would have been sufficient to have had such a disastrous effect on the hillsides, especially when combined with the effects of the preceding thousand years of lighter settlement, and could easily have been responsible for the presently denuded state of such areas. The population history suggests that the initial colonization of the Valley was in the southern flank area and that a later expansion occurred to the isolated hills along its northern edge. This latter colonization, however, did occur early.

This reconstruction of the agricultural system is very convincingly supported by the distribution of Aztec versus pre-Tzacualli sites in the Patlachique Range. To recapitulate, the drainage basin of the upper Barranca de San Lorenzo was a foci of pre-Tzacualli settlement. The sites occur at the headwaters of small barrancas that feed into the principal stream, well up on the slopes of the bordering hills or on the tops of relatively flat, high ridges. With the exception of the last, all of these localities are badly eroded today and Aztec sites are almost absent. In the case of sites near the headwaters of the small streams, the streams have cut extraordinarily deep, canyon-like beds and some of the sites are at least partially destroyed by lateral erosion. Considering the condition of the area today and the profusion of Aztec sites in the Valley as a whole, the lack of Aztec settlement is significant. Aztec sites in this area tend to occur in two settings. One is a kind of mirror image on a small scale of the characteristics of Aztec settlement in the main valley. Small floodplains exist along the main barrancas. Aztec sites are located immediately above such flood plains on small terrace systems, many of which are still in use. The other setting is on top of the high ridges where Aztec and pre-Tzacualli sites occur together. As noted previously, this area is less eroded and some modern cultivation is still practiced.

Tzacualli Phase. Between the Patlachique and Tzacualli Phases, striking changes occurred in the patterns of land use. The population probably tripled between the end of Patlachique and the end of Tzacualli, and (depending on the size of TF 200) may have increased even more. The first really monumental architectural expression and the first large urban or semi-urban community appeared in this phase. Almost certainly such changes are correlated with a much more productive agricultural economy. The size of TF 200 and its architecture implies that it was the center of a single, valley-wide, socioeconomic system.

The major changes that seem to demonstrate that a new approach to the exploitation of the Valley was under way were in zonal settlement pattern. At no other point in the history of the Valley did such a revolutionary shift of population occur. The Patlachique Range was almost abandoned for settlement; the only populated parts of the southern flank of the Valley were the low foothills and ridges around Oxtotipac and Tlaltica.

The bulk of the population was concentrated on the northern piedmont of the Middle and Lower Valleys in a band extending between Cerro Maravillas and Santiago Tolman. This strip includes rural communities plus the big town site and coincides exactly with a similar strip of post-Classic settlement. A secondary concentration of population occurred on the gently sloping piedmont of the Upper Valley, again in precisely the same location as the post-Classic. A third population cluster was located on the north slope of Cerro Gordo and the sites are located in the same areas as Classic

and post-Classic sites. A fourth concentration probably existed in the small hills bordering the North Tributary Valleys.

The only area where the Tzacualli pattern does not duplicate the post-Classic is the Lower Valley-Delta. Sites are very rare in this area, but the locations of TF 177 and 141 suggest the possibility of the existence of a band of settlements along the eastern piedmont that was similar to the Aztec. The area was examined in general survey in 1961 before the characteristics of Tzacualli ceramics were understood, and the possibility that small Tzacualli sites were missed is high. Only a small portion of the area was resurveyed intensively in 1963.

In specific localities where Tzacualli and pre-Tzacualli sites are located on the piedmont, the former are always found at a slightly lower elevation. This principle applies, curiously, even in situations like that of the north piedmont of the Middle Valley where the piedmont is only a few hundred meters wide. All the Tzacualli sites are located at the lower edge of the Aztec strip settlement; all the pre-Tzacualli sites are located at the upper edge of or immediately above the Aztec settlement.

The overall impression of Tzacualli occupation is that of a valleyward, plainward orientation as opposed to the hillward bias of occupation in the earlier phases. The zonal distribution of Tzacualli sites is even closer to that of the Teotihuacan Period than to the post-Classic. For this reason further discussion of the possible ecological significance of the pattern is reserved for the following discussion. One major difference between Tzacualli and Teotihuacan settlement patterns is the community pattern.

Teotihuacan Period. The indirect evidence for intensive agriculture for this period is overwhelming and we believe conclusive, but direct proof is to a great extent lacking. The rural settlement and land use cannot be understood without reference to the single, most important event in the history of this period, the growth of the city. Its exploitive relationship to the Valley will therefore be analyzed first.

The city was located within and on the edge of the alluvial plain, precisely midway along the long dimension of the Valley. Its specific location has obvious ecological significance. It is located midway between the two deep soil plains of the Lower and Middle Valleys at a convenient position to exploit both. It, and its western suburbs, lie astride the most important, single, ecological resource of the Valley today, the springs; and it lies in an area where all of the major barrancas of the Middle Valley converge. In Early Classic times two of these streams, Los Muertos and San Lorenzo, were artificially straightened and canalized where they traversed the city.

The city then is located in a strategic position with respect to both land and water. Its location makes little sense except in relationship to the agricultural significance of the plains. Of great significance is the extraordinary manner in which the rural sites avoid and retreat from positions along the edge of the plain in sharp contrast to the post-Classic tendency to nestle along its border. In the Upper Valley nearly all sites are located at the upper edge of the piedmont, well back from the deep soil plain, sites are almost absent on the southern and northern piedmonts of the Middle Valley, and in the Lower Valley all the substantial settlements occur well back of the edge of the plain. The fact that the only major clusters of population occur nearly outside the Valley in the Cerro Gordo,

North Slope and North Tributary Valley areas is one of the most significant facts about zonal settlement patterns.

In the discussion of peasant land use principles, the tendency of farmers residing in nucleated settlements to live in communities located near the cultivated lands was stressed. By applying this principle, it would be theoretically possible to roughly define the boundaries between community lands in an archaeological setting. In the Upper and Middle Valleys, for example, the Teotihuacan rural settlement pattern indicates that the villagers cultivated land only on the upper piedmont. The spacing of sites in the Upper Valley is consistent with this assumption. The obvious conclusion from the pattern is that a sizable percentage of the population of the city, probably involving the suburbs and unplanned fringe of the main site, was cultivating the two alluvial plains. This interpretation explains the peripheral proliferation of settlement around the planned core to a remarkable degree. The most productive land of the Valley therefore was owned by either corporate kin groups living at the city or religious or political institutions and farmed by tenants living in the city. Following this interpretation, the growth of the city was related in part to the resolution of the problem of cultivation of the alluvial plain.

Continuing with this argument, exact definition of the size of the land holdings of the city should be possible. The location of a major, rural, population cluster 10 km. to the north of the Sun Pyramid implies that the lands controlled directly by the city did not extend beyond the Valley in that direction. The northeastern limits would be defined by the upper piedmont village holdings, the southwest by Lake Texcoco. The area south of the Patlachique Range was not included in the survey, but several brief reconnaissances were made just south of the range. One Teotihuacan ceremonial complex which is comparable to TC 73 in size is located on a low rise within the plain near the Rancho de San Antonio 14 km. south of the Sun Pyramid. Its presence indicates a substantial rural population in the area. Furthermore, the intervening Patlachique Range would make cultivation of the Texcoco plain difficult for farmers residing in the city. On the basis of the above distributions of sites, the lands directly controlled by the urban population seem to have been limited to the alluvial plains and adjacent piedmonts of the Teotihuacan Valley proper.

The growth of the city, in its early phases, must have been correlated therefore with an increasingly intensive utilization of this area. If the population estimates are reasonable, the city would have surpassed this local land resource toward the end of the Miccaotli Phase. (This is assuming the existence of an intensive system of agriculture involving floodwater and permanent irrigation in the plain and terracing of the piedmont). Using the data on maize productivity from studies of present-day peasant economy, and assuming that the flow of water from the springs was about as high as in Gamio's day, the demographic capacity of the postulated urban holding might be estimated as 40,000-50,000 people. During the phase of maximum growth, the urban population probably imported food from outlying rural areas by trade or taxation. Actually, even in its final growth phase, the city could have been supported by an area only slightly larger than the Teotihuacan Valley. The Aztec population certainly was self-supporting and it was as large or nearly as large as the Early Classic.

Based upon the previous considerations, the Valley probably was as intensively cultivated as in Aztec times and the same basic techniques were used. This assertion is supported by the local data from the heavily occupied Cerro Gordo-North Slope test area. In this strip the Teotihuacan population was estimated at at least equal to the Aztec and probably substantially higher. The pattern of settlement was different between the two periods, but the implication of the population data is that land use was equally intensive. Several of the barranca-like canals discussed previously are located in this strip. They are undoubtedly pre-Hispanic, but to which period do they pertain?

The functioning modern terrace system involves a relatively small part of the area. Erosion has destroyed much of the agricultural land. The distribution of Aztec sites and houses and the remains of the eroded terrace systems associated with them give one the distinct impression that the modern system is of Aztec age, and is simply the surviving remnants of the more extensive Aztec system that escaped erosion. What has happened since 1519 apparently is a gradual loss of parts of the system, but with little change in its morphology. Documentary sources referring to the area mention large, deeply-cut barrancas as early as 1571, and the larger barrancas in 1519 probably appeared then as they do today. All of this means that the old canals must be pre-Aztec. The fact that the only pre-Aztec occupation comparable in density to the Aztec was that of the Teotihuacan Period makes it probable that they are Early Classic canals.

One major problem, however, in comparing Aztec to Teotihuacan population in this area is the fact that the Aztec population was simply a segment of a nearly continuous band that probably encircled Cerro Gordo, whereas the Teotihuacan population tended to be dense only in a few localized areas. Conceivably, therefore, the Teotihuacan population of the North Cerro Gordo test area cultivated a more extensive area than the Aztec and practiced a less intensive system of farming. The existence of a substantial Teotihuacan population immediately west and southwest of the cluster and the large size of the Teotihuacan settlements are strong arguments against this interpretation. In the Late Tlamimilolpa-Xolalpan Phases the population resided in large, compact, nucleated communities. That such settlement would occur with extensive agriculture is possible, but improbable. One would rather expect a retention of pre-Tzacualli settlement patterns.

Aside from the canals in the area cited above, nearly all of the large, Teotihuacan rural sites have defunct canal systems or canalized barrancas in their vicinity. This consistent association seems to confirm the picture of intensive agriculture.

In summary then, although direct proof of irrigation and terracing is lacking, the demography, community and zonal settlement patterns overwhelmingly support their probable existence. The only direct evidence known to this author is the case of the Tepantitla mural painting cited by Armillas (Armillas, 1950). Below the painting of Tlalocan there is a complex of solid green rectangles separated by interconnected bands of rectangular blue spaces. The painting is very similar in appearance to the chinampas around the springs of San Juan and to sixteenth-century maps of the chinampa area in the southern part of the Basin of Mexico. On these maps the chinampas are shown as green rectangles and the canals are painted blue as in the Tepantitla painting. This identification is further strengthened by a blue,

whirlpool-like object on the Tepantitla painting that is similar to Aztec drawings of springs and seems to be feeding water into the canals.

This brings us back to the pollen graph and the dating of the apparent artificial drainage of the spring area. The amount of deposition above the level that correlates with the drainage makes it unlikely that the event occurred as late as Late Classic or post-Classic times. In terms of shifts of settlement pattern, and the Cuanalan pollen graph, a likely date for the inception of the permanent irrigation system would be Late Formative with a rapid expansion in Tzacualli times. The growth of the city in this and succeeding phases then would seem to be functionally related to the evolution of a more productive agricultural economy.

Aztec-Toltec Periods. In the discussion of the sixteenth century, the documentary references to agricultural practices and techniques were summarized. This data may be applied to the final Aztec Period with confidence. The permanent irrigation system was certainly functioning at that time. The complex of soil preparation and planting methods used in the area today was also present. The crops grown in the sixteenth century were the same as today except that amaranth and chia were major crops at that time; today they are cultivated only in small patches in houselots. Millon's excavation of the floodwater system near Atlatongo demonstrates conclusively that this technique was also known in Aztec times. Statements by the Spaniards about the intensity of agriculture in the Basin of Mexico as a whole at the time of the Conquest and the demographic data point convincingly toward a much more intensive land use pattern than has been practiced recently. The picture one has is that of a system comparable in intensity to that practiced in much of southern and eastern Asia with simple hand tools, small parcels of land, continuous cultivation, and extraordinarily careful cultivation. The Aztec pattern involved the peculiar combination of a very dense population with a near subsistence level of economy, so characteristic of modern Asia.

The Teotihuacan Valley Project data confirm this picture conclusively. The archaeological data strongly support the documentary tax data as to population density. All Aztec sites in sloping terrain are associated with almost destroyed floodwater, canal-terrace systems. The Aztec settlement pattern represents an ideal adaptation to the intensive agricultural systems previously described and to the geographical characteristics of the Valley. In contrast to the Classic, the Aztec pattern is ecologically oriented and ecologically based.

The following basic relationship of settlement patterns to land use may be summarized:

1. Large communities tend to occur in the most productive agricultural areas. All but one of the towns were in the Lower Valley-Delta areas.
2. The better agricultural lands were consistently avoided for settlement; preferred house locations were close to, but not on such lands.
3. Favored areas for settlement were those with gently sloping terrain, called piedmont in this report. Settlements on the piedmont were within short distances of alluvial plains, the piedmont itself and steep slopes, the three major components of the landscape.
4. All of the socioeconomic units referred to here as city states included land in all three of the noted components of the landscape. All of the crops that the Valley was capable of producing could be produced within the border of each unit. Each state was therefore a more or less balanced, self-sufficient, economic unit.

5. The positioning and spacing of sites seem to indicate that the urban communities were transitional in characteristics, both semi-argicultural and semi-commercial. For example, note how the alluvial plain, and the eastern and northern piedmonts near Otumba are without rural sites, whereas the southern and southeastern piedmonts are covered with them. This probably means that the first three areas were directly held by the townsmen at Otumba (TA 80). In the Lower Valley the spacing of villages and towns along the edge of the plain implies that some townsmen as well as villagers were farmers. The socioeconomic structure of small Aztec towns was apparently quite complex and included farmers and part-time farmers-craftsmen as well as nobles, priests, merchants, and full-time craftsmen.

6. Because of the completeness of the survey, the spacing of sites in Aztec times should enable one to plot approximately the land boundaries for each community. The varying zonal distribution of population suggests the following patterns:

a. In the Lower Valley-Delta were located two strings of communities on each side of the plain. One was located at the upper edge of the piedmont, the other at the lower. Probably the upper communities utilized the piedmont and steep slopes, the lower ones the alluvial plain. The former were typical Aztec strip communities, the latter large, compact, radial settlements. In all probability a close symbiotic relationship existed between them. Probably a lion's share of the plain was owned by the townsmen.

b. In the Middle Valley only a single strip of population existed on each side of the plain, each on the piedmont. Here each house is located on and directly associated with terraces on the piedmont, and within a short distance of the steep slopes on one side and alluvial plain on the other. The residents apparently held land in both areas. It should be emphasized, however, that a sizable portion of the plain was probably owned by the town of Teotihuacan.

c. In areas where alluvial plains were small or absent, settlement is more evenly distributed through terrace systems (i.e., Upper Valley, North Tributary Valley, North Slope of Cerro Gordo).

7. One of the major problems in reconstructing Aztec agriculture is the problem of soil restorative techniques. Today animal fertilizers are used extensively. In the southern part of the Basin of Mexico, green fertilizers are used in the chinampas and also on hillside terraces. Some villages also use human fertilizer, especially for chile pepper cultivation. Irrigation, especially the floodwater type (since it carries more soil in solution), also has a restorative effect on the land. If human refuse, vegetal composts, and refuse from corral animals were used combined with irrigation, they would probably be sufficient to keep the more fertile lands in constant production. The soils do have high natural fertility to begin with.

The linear strip village, whether scattered along a piedmont, dispersed down interfluvies, or circumscribing a hill is admirably adapted to the problem of soil maintenance. It not only permits the residents to be close to their terraces (and the need of full-time maintenance has been pointed out), but is closely related to the problem of maintaining land fertility.

In Guatemala, Stadelman (1941) and in northeastern Puebla, Palerm (1955) describe a system of farming called calmil in Puebla. The villages

are quite dispersed (as in the case of Scattered Villages in the Teotihuacan Valley) and each house has a large houselot. Household refuse and refuse from corral animals constantly accumulates in the houselots and permits continuous cultivation, a kind of pantry-field symbiosis as Palerm characterizes it. The Aztec settlement pattern with houses widely spaced and associated with irrigated terraces is admirably adapted to calmil cultivation.

This basic Aztec pattern of cultivation and settlement is probably the primary historical source of the modern Scattered Village. The Spaniards apparently moved Indians who had been residing in linear strips of *barrio pequeño* settlements to single radial villages focused around the church. Conceivably, the *barrio pequeño*, the basic territorial unit in Aztec times, was still physically recognizable as a ward of the new villages in the early Colonial Period. With its subsequent loss of functions, however, the physical separation would also ultimately vanish. When such communities were founded by the Spaniards, the Indians apparently retained the large houselots to maintain the calmil system. The result is the modern Scattered Village. With the demographic decline that occurred in the post-Hispanic Period, the most distant terraces were abandoned and used for pasture. Today nearly all houselots have been converted to nopal cultivation, surely a response to the growth of Mexico City and the expanding urban market. Possibly nopal orchard cultivation always existed side by side with calmil cultivation. The rapid development of the urban market for tuna since 1940, however, has certainly acted as a factor in stabilizing the Scattered Village as a community type.

The essential characteristic of the Toltec occupation of the Valley is that of a period of temporary demographic depression between two periods of maximum population and intensive land use. The situation was comparable to the Colonial-Early Republican occupation of the Valley. The Toltec settlement pattern in the Early Phase represents a retention of many of the characteristics of Early Classic patterns; the Late Toltec foreshadows the later Aztec. The agricultural systems were probably comparable as well. As the population decreased it probably retreated to the most productive segments of the Valley and abandoned much of the marginal land. The system of agriculture probably involved intensive agriculture in the areas under cultivation and marginal use of peripheral lands. This essentially is the modern pattern of land use as well. In the Colonial-Republican Period peripheral lands became grazing lands; in Toltec times they were possibly used for hunting and gathering. The Early Toltec settlement pattern strikingly supports this picture, with near abandonment of the northern flank and Upper Valley, and concentration of population at the city and along the edge of the Lower Valley plain. A major cycle of erosion must have resulted in the abandoned areas and generally on the piedmont as terrace systems fell into disuse. It was probably not as disastrous as the sixteenth-seventeenth century cycle, since grazing animals were not involved. The Late Toltec or Mazapan occupation of the Valley was broader and less selective. In the newly claimed areas the tendency for occupation to occur in widely spaced clusters suggests that the pattern of population growth involved expansion from small foci of intensively cultivated areas. The Aztec Period witnessed the coalescence of such foci and restoration of eroded areas. The Mazapan and Aztec reclamation projects were probably very similar, on a much larger scale, to the process of slope rebuilding going on at Maquixco Alto today.

PART VII

SUMMARY AND CONCLUSIONS

Summary

The Valley, the Basin, and the Region.

The Teotihuacan Valley Project has produced a considerable body of new data on the culture history of Central Mexico. These data cover a great range of subject matter, from such orthodox archaeological themes as chronology and technology, to nonmaterial aspects of culture such as religious, social, and economic patterns. Throughout this preliminary report we have attempted to interpret archaeological data as far as controlled imagination and inference permit. In this portion of the report the data and interpretations presented previously will be summarized and compared to what is known about the larger areas, the Basin of Mexico and the Central Mexican Symbiotic Region, of which the Teotihuacan Valley is a part. A major problem in making comparisons is the absence of a published survey on the level of intensity of the Teotihuacan Valley Project. A surprisingly high percentage of the region is very poorly known archaeologically or ethnographically; even in the Basin of Mexico the data are unevenly distributed in space and time. The following discussion will be organized by chronological periods and phases.

Early and Middle Formative. Piña Chan (1955) dates these two divisions of the Formative Period between 1500-500 B.C. (Early, 1500-900; Middle, 900-500). In the Teotihuacan Valley the same phases are being called Altica and Chiconautla respectively.

The Altica Phase will undoubtedly be divided into two shorter phases as the laboratory work progresses. As previously stated, the ceramic complex is very close to Piña Chan's Early pre-Classic, but the initial phase of Altica probably starts somewhat earlier. Some of the samples are dominated by a cream-slipped ware which never exceeds more than 6-7 percent of the sample from levels at El Arbolillo, Zacatenco or Tlatilco, the only three other Early Formative sites known in the Basin prior to the Teotihuacan Valley Project. At El Arbolillo and Zacatenco the most distinctive time marker of the earliest levels is an incised polished black, a type not noted in our sample from Altica sites. All of our Altica Phase site samples are severely eroded so that the apparent absence of the type may not be significant. On the other hand, the high percentage of cream-slipped pottery on Altica sites is undoubtedly significant, since the slip is flaky and easily weathered. The cream-slipped ware is very distinctive and is almost identical to that of the Dili or Chiapa II Phase at Chiapa de Corzo in the state of Chiapas. Shared traits between the two types in both areas are as follows: flaky cream slip; flanged, thickened, bevelled and

grooved lips; incised interior walls; and composite silhouette bowls. In both complexes, Altica and Dili, the cream-slipped type dominates the service ware. Some of the Altica vessels had incised bases like the "molcajetes" found by MacNeish (1954) in his Huastec I excavations at Panuco. In all three areas (Chiapas, Basin of Mexico, and Huasteca) this phase of cream-slipped pottery is succeeded by a variety of polished black and red wares. In the Basin the cream-slipped type persists as a minor type throughout the Early Formative and Middle Formative Phases and then disappears in Late Formative times.

In conclusion, it is probable that the Altica Phase covers a long span of time and began several centuries prior to the first settlement at El Arbolillo. The earliest part of the phase seems to pertain to an old stratum of Mesoamerican ceramic history that had extraordinary unity and spatial distribution. Whether the various local complexes were contemporary in time is a debatable point. The C 14 dates from the Basin strongly suggest that it is earlier there than anywhere else and that this area was the center of its distribution.

The final phase of Altica, that part contemporary with Vaillant's Lower Middle Culture, Early Phase and Pina Chan's Early pre-Classic, seems to have had a much more restricted spatial distribution. It appears that the specific Central Mexican Formative styles were differentiating during this phase. It is probable that sites of this phase with closely similar ceramics are distributed over much of Central Mexico, but the only known sites are in the Basin. Not a single site has been reported in Puebla (except in the Tehuacan area where the ceramics are quite different and have ties toward Oaxaca), Morelos, and Tlaxcala.

The Chiconautla Phase in the Teotihuacan Valley is identical to Pina Chan's Middle pre-Classic and Vaillant's Lower Middle Culture, Late Phase, excluding the Tlatilco funerary complex. No sites comparable to the Tlatilco cemetery are known in the Teotihuacan Valley. The Chiconautla Phase includes only the ceramic types characteristic of the village site at Tlatilco. This ceramic complex is found all over the Basin of Mexico (El Arbolillo, Tlatilco, Zacatenco, Atoto, Coatepec, Xaloztoc, Lomas de Becerras, Copilco, Azcapotzalco, Tetelpan and Tlapacoyan). A related but somewhat distinctive complex (with more Olmec influence in the service wares) is reported by Pina Chan (1952, 1956), Mueller (1948), and Vaillant (1939) at Chimalacatlan, Atlihuayan, Chalcatzingo, and Gualupita in Morelos. A ceramic complex apparently closer to that of the Basin was reported by Noguera (1959) at Cholula in Puebla.

All of the previously reported Early and Middle Formative sites in the Basin of Mexico except Tlapacoyan occur in a zone near Mexico City that measures approximately 800 km.² (see figure 1). The Teotihuacan Valley is an area somewhat smaller in size (600 km.²), and 18 sites (of which perhaps 12 have substantial occupational debris, and the remainder are trace indications) were located that pertained to Middle Formative Phase and five (of which three have substantial occupation) to the Early Formative. The density of remains in the two areas are therefore comparable. These are the only two areas for which survey has been intensive enough to provide at least a subjective indication of population density. The impression is that both areas were lightly populated.

If tlacolol cultivation was the primary system of agriculture during the Early and Middle Formative Phases of the history of the Basin, then the

most favorable area for settlement would have been the southern part of the Basin, the distrito of Chalco and delegacion of Xochimilco. The rainfall is heaviest there, thus reducing the problem of droughts, and the area has a higher percentage of low ridge and foothill terrain in the 2400-2700 m. contour band than anywhere else. Erosion is a less severe problem in that area compared to the rest of the Basin because of the heavier rainfall and consequent more rapid growth of vegetation. We predict that more Early and Middle Formative sites will be found there than anywhere else in the Basin, including cemeteries and ceremonial foci similar in importance to Tlatilco. The principal reason why so few sites are known is undoubtedly inadequate survey. Most researchers have been convinced of the lacustrine orientation of the Formative population of the Basin, guided by the obvious preferential location of Aztec towns in 1519 and location of known Formative sites. On the contrary, even excluding the new data from the Teotihuacan Valley, the location of known sites in the area around Mexico City suggests another interpretation. Five of the 10 Middle Formative and two of the three Early Formative sites are located on the lower flanks of a small range of hills (Sierra de Guadalupe) that is comparable in size and elevation to the Patlachique Range. With the exception of Copilco and Azcapotzalco the remaining sites occur on the piedmont rather than lake shore plain at approximately the 2260 m. contour. This distribution is in fundamental agreement with the data from the Teotihuacan Valley, supports our conclusion of an ecological preference for high terrain, and to a great extent explains the rarity of known sites in the Basin. Lake shore positions would provide some advantage because of the presence of aquatic foodstuffs, but a more significant prerequisite for Formative settlement was the combination of heavier rainfall and relative freedom from frosts. In the case of the Guadalupe Range cluster, both advantages were present since the range approaches the old lake shore very closely. Best settlement locations for living, therefore, would seem to be those near both the hilly slopes and lake shore--precisely the ecological setting of such sites as Zacatenco and El Arbolillo. Again, the southern Basin, especially the delegacion of Xochimilco, offers the ecological optimum for Formative settlement because of the juxtaposition of hilly terrain and, in this case, a fresh water lake with an even richer aquatic life than Lake Texcoco.

All known Early and Middle Formative sites in the Basin except the Tlatilco cemetery fit into our classification of hamlet. Sites like Zacatenco and El Arbolillo are comparable in size and density of remains to those in the Teotihuacan Valley. The specific settlement pattern is not known. Some sites were apparently quite dispersed, others rather tightly nucleated.

The size of the group residing in the typical settlement was certainly greater than the extended family and approximated in size a territorial, land holding, unilineal descent group that Murdock (1949) calls a lineage. The emphasis on females in the figurines might mean, as Pina Chan (1955) suggests, that the group was a matrilineage, but we doubt that inferences on this level can be made from archaeological data. In the Teotihuacan Valley survey disclosed no evidence of supracommunity social, religious, or political organization, and no remains of specialized religious structures were found. The sociopolitical organization seems to have been one of small, autonomous, land holding social groups integrated by kin ties.

In the Mexico City zone the presence of the cemetery of Tlatilco, dating from the Middle Formative Phase, demonstrates that a more complex socioreligious system was present in that area. The site includes status burials with figurines and pottery vessels of a style quite divergent from that characteristic of habitation sites of the phase--a complex that looks and probably is intrusive. The striking differences in the characteristics of burials and their offerings from Tlatilco and contemporary hamlets suggests the following interpretations:

1. Society was highly stratified with a class of priest-shamans, who directed a formally organized religious cult focused on a feline rain god (but the pantheon apparently did include a variety of other deities) linked in some way with children. Possibly the children were sacrificial victims for the rain god, since they were the preferred offering to the Aztec rain god Tlaloc 2000 years later (Sahagun, 1951).

Some of the burials at Tlatilco contained an adult female as a central figure with lavish offerings and accompanied in death by sacrificial victims. The later included men, women, or children. Possibly the priest-shamans were women.

2. The Tlatilco site apparently included, along with the cemetery, a large village (approximately 30 hectares of substantial occupation--see Pina Chan, 1952) and was considerably larger than any other known Early or Middle Formative site in the Basin. Furthermore, Porter (1953) reports remains of terraced earth platforms possibly indicating the presence of the pyramid temple. The site, therefore, might be classifiable as a small town with cemetery, ceremonial precincts and residential zone and with some indication of social differentiation of a simple type. More precise definition of the character of Tlatilco will require more extensive excavation of the occupational area. Tlatilco may have been a capital of a small state that included much of the lake shore plain and piedmont west of Lake Texcoco. Such complex social systems were absent at this time in the Teotihuacan Valley. Recent data indicate the probable presence of a comparable center at Tlapacoyan.

3. The Basin of Mexico in Middle Formative times was clearly marginal to developments in Morelos, which was situated immediately across the Ajusco Range. Tlatilco is archaeologically a much less impressive site than Chalcatzingo with its relief carving in stone. Pina Chan does not present data on settlement patterns for Chalcatzingo so that it is not clear whether it was a town or ceremonial center. Whereas at Tlatilco the ceramic tradition represented in the burial offerings is absent in the habitation sites, it is hierarchially more pervasive in Morelos; even the service wares apparently have traits that were limited to the funerary offerings at Tlatilco. The implication is that the upper status individuals at Tlatilco were migrants, possibly from Morelos. All of this suggests, therefore, that the evolution of complex social systems in the Central Mexican Symbiotic area occurred in the tierra templada strip south of the Basin first and that the population was denser in Morelos. Within the Basin during Middle Formative times, there was probably a gradation of population density and social evolution from south to north with the Teotihuacan Valley in a marginal position.

Moving further afield, it is possible that the Central Mexican Symbiotic Region was a marginal area within Mesoamerica during the Middle Formative Phase. By marginal we mean simply that events there did not

stimulate historical processes in other parts of the greater area. No sites of comparable size and historical significance to such Olmec centers on the southern Gulf Coast as La Venta, San Lorenzo Tenochtitlan or Tres Zapotes are known in the region. This marginality during the Middle Formative Phase is one of the most puzzling problems in Mesoamerican culture history. The area was apparently one of the earliest centers of plant domestication, the scene of one of the earliest ceramic traditions, a major population center in Late and Terminal Formative times, the setting of the most vigorous and stimulating of all the Classic civilizations, and in post-Classic and post-Hispanic times was the geocultural heartland. Why then was there this temporary lapse to marginality in Middle Formative times? I believe the explanation may be primarily ecological. At least a minimal level of population density is a prerequisite for the maintenance of social systems of the Mesoamerican type. If the basic system of agriculture in Mesoamerica was slash and burn during the Early and Middle Formative Phases, then the more productive and favorable areas for settlement would have been the tropical lowlands. If the overall population of Mesoamerica was small, such areas would be selected for settlement and the demographic filling in process would be faster. The demographic potential of the central plateau with its great expanse of elevated flat terrain would not be achieved until intensive techniques of cultivation were developed. The area would even be ecologically marginal to Highland Guatemala, for example, with its lower elevation, heavier rainfall, and greater dominance of hilly terrain. Of course, this conclusion may be the product of insufficient research. It is possible that the Olmec style, the first, complex, religious symbolic system and vehicle of the first developed Mesoamerican civilization, may have originated in the tierra templada section of the central plateau. It is also possible that intensive agriculture involving irrigation is much older in Morelos and southwestern Puebla (where large complex irrigation systems existed in 1519) than in the Basin. The archaeology of this area is very poorly known. At least one researcher, Piña Chan, feels that the Olmec style in Morelos is older than on the Gulf Coast and even Covarrubias felt that it originated in the semiarid uplands of Guerrero. Recent evidence from the Tehuacan Valley in southeastern Puebla indicates well-developed irrigation as early as Late Formative times.

Late Formative. Three ceramic complexes were defined for this phase in the Teotihuacan Valley: Cuanalan, Patlachique, and Tezoyuca. Cuanalan is earlier and almost identical to Vaillant's Upper Middle Culture ceramic complex from Ticoman and Zacatenco (1931, 1935). Further analysis of the samples will undoubtedly permit a division into two subphases paralleling Vaillant's Early and Late Ticoman. A few minor differences are distinguishable between the ceramics of the Cuanalan and Ticoman Phases. The incidence of negative painted pottery and H4 figurines is much higher in Cuanalan; in the case of negative painting this is important since it is one of the distinctive traits of the succeeding Tezoyuca and Tzacualli ceramic complexes. These differences are trivial, however, when contrasted to the extraordinary uniformity of pottery of the phase all over the Basin of Mexico. Surface samples from Ticoman, Cuanalan, Coatlichan (a new site accidentally discovered by the project), Cuicuilco, and Tlapacoyan are almost indistinguishable. Moving further afield, the ceramics from Gualupita in Morelos and Amelucan near Puebla are very similar. Apparently the Central Mexican Symbiotic Region had a relatively uniform ceramic complex during this phase.

The Patlachique and Tezoyuca complexes succeed Cuanalan in the Valley of Teotihuacan and are probably contemporary. They were products of either ethnic or hierarchical differentiation. In this and the succeeding Terminal Formative Phases a fair amount of regional differentiation occurred in the Basin of Mexico. The Tezoyuca complex may have been limited to the Patlachique Range. The Patlachique complex appears to be closely related to Noguera's Chimalhuacan ceramic complex, and is probably widespread in the area east of Lake Texcoco. In all probability a terminal phase of Ticoman is its counterpart west of the lake. No ceramics of this phase are reported in Morelos, Puebla, or Tlaxcala.

In the Teotihuacan Valley, 29 localities with Cuanalan Phase occupation were located, of which 18 also had occupation of either the Tezoyuca or Patlachique complexes. The total number of sites with Patlachique ceramics was 67, of which five also had Tezoyuca components. Counting as sites only localities where at least one of the three complexes were reported, and not counting multiple phase occupations as separate sites, there were at least 73 sites in the Teotihuacan Valley of which at least 50 have substantial occupations. The impression of the overall phase we are calling Late Formative is that of a striking increase of population. In contrast, previous research in the Basin of Mexico as a whole reported only 17 sites of which 11 are located in the intensively surveyed strip near Mexico City.

Nevertheless, during the Cuanalan Phase, the impression remains one of sparse population. All but three of the sites are classifiable as hamlets; the others are small villages; even the largest had a population of less than 500. None of the sites are known to have ceremonial architecture. The excavated samples from TF 38 give the impression of a simple folk society. The hamlets were similar in size, population, and ecological setting to the Early and Middle Formative sites in the same area. All of the villages, on the other hand, were located near the alluvial plain where the first attempts at irrigation may have occurred at this time. The larger settlements undoubtedly had populations exceeding those of the lineage-type groups postulated as residing in the hamlets.

The picture of the socioeconomic and religious patterns summarized above contrasts strikingly with that found in the southwestern part of the Basin of Mexico. Most of the sites located near Mexico City are comparable in size and ecological setting to earlier sites in the same area and to sites in the Teotihuacan Valley. One of the most extensive lake shore plains in the Basin of Mexico was located west of Lake Xochimilco. Today this plain is covered by the Xitli lava flow and is a rocky wasteland. The enormous site of Cuicuilco, dating in part from this phase, is located in this plain. The site included at least three temple platforms of monumental size. Recent blasting by construction companies has uncovered other smaller civic buildings. A considerable number of smaller structures is probably under the lava. Two of the large pyramids are situated three kilometers apart. In an unpublished paper prepared for the American Anthropological Association meeting in 1956, Palerm and Wolf postulated the existence of a densely settled occupation zone of at least 20-25 hectares, located between these two structures. In all probability the occupation zone is considerably larger. In a later paper Palerm (1961) asserts that the urbanized zone extends for a linear distance of four to five kilometers. The impression one has is that of a large town site comparable perhaps to the later Tzacualli town at Teotihuacan.

The location and size of Cuicuilco implies furthermore that intensive agriculture was older there than in the Teotihuacan Valley. In the same paper the authors described a system of ditches that departs from hill slopes on the edges of the lava flow and runs underneath the lava--clearly predating the eruption. The authors believed that they were irrigation ditches of Late Formative Age.

In summary, our suggestion that the southern part of the Basin was the focus of population in the overall Formative Period seems to be supported by the archaeological evidence. Presumably in Middle Formative times the population in this area reached a level that stimulated experimentation with more productive systems of agriculture several centuries earlier than in the Teotihuacan Valley. Bennyhoff (personal communication) believes that Cuicuilco continued to function during the equivalent of the Patlachique-Tezoyuca Phase in the Teotihuacan Valley. In the test area around Mexico City, survey has disclosed a surprisingly small number of sites of the overall Late Formative Phase compared to the Teotihuacan Valley (11 as compared to 50). It should be noted that the density of Early and Middle Formative sites was similar in the two areas. We have argued that the Teotihuacan Valley was demographically and culturally marginal at this time. The evidence therefore indicates that a process of nucleation of population into a few centers occurred in the southwestern part of the Basin during Late Formative times, comparable to but on a much smaller scale than the process in Early Classic times in the Teotihuacan Valley.

Tlapacoyan, across Lake Chalco-Xochimilco from Cuicuilco, was apparently a smaller town site contemporary with Cuicuilco. The immediate domain of Cuicuilco, therefore, was probably limited to the modern Distrito Federal. Small states and towns of the type of Cuicuilco and Tlapacoyan were sprinkled all over the Central Mexican Symbiotic Region. In 1951, Alex Krieger, David Kelley, and the author surveyed a site predominately of the Late Formative Phase, that is, somewhat smaller than Cuicuilco, but of impressive size and located near Puebla at Amelucan. The site consisted of three formally planned civic centers distributed over an area two kilometers square. Each of the precincts included a large pyramid temple mound and smaller structures. In one of the precincts was a large rectangular mound that may have been an elite residence. The pyramids ranged in height from nine to 15 m. Occupational debris around the three civic precincts was heavy.

In the Tezoyuca-Patlachique Phase, ceremonial architecture appeared for the first time in the Teotihuacan Valley. This may also have been the first period in which community stratification appeared, providing that our interpretation of the interrelations of Tezoyuca and Patlachique complex sites as hierarchial rather than ethnic or chronological, is correct. If our interpretation is correct, the Valley was apparently divided into a number of small competing states, each including a small hilltop town or village with its constellation of dependent hamlets. The pattern is rather similar to that in Mazapan times except that no large central community crowned the hierarchial structure as in the later period. The suggestion of a competitive atmosphere is based upon two facts: the location of all Tezoyuca complex sites on the tops of small hills (all these hills are located at the edge of the Patlachique Range) and the frequent occurrence of projectile points in the excavated sample from TF 101. That this frequent occurrence is

not the product of hunting is indicated by the rarity of points in the preceding Cuanalan Phase. The population was considerably larger in the Tezoyuca Phase so it is extremely unlikely that hunting increased in importance. At least six such small states may be defined, and we suspect the presence of others. All of the known sites are located on hilltops overlooking the Lower Valley. Most of the hamlets were located in the Patlachique Range, so that the agricultural pattern was probably similar to that in the Cuanalan Phase, minor use of the alluvial plain but with a focus in the hilly flank areas.

Terminal Formative. We are using the term Terminal Formative for the final phase of the Formative Period. It is both the poorest known and perhaps the most important period of time in the culture history of Central Mexico. Very little is known about this phase outside the Teotihuacan Valley. The ceramic complex that characterizes the phase in the Teotihuacan Valley is variously called Teotihuacan I and Tzacualli. It has not been reported as a dominant chronological component outside the Teotihuacan Valley Project survey area with the possible exception of Huapalcalco in southern Hidalgo. The only excavated site reported in depth for this time phase outside the Valley is Tlapacoyan. Tlapacoyan was occupied for a long period to time coeval with the Chiconautla, Cuanalan, Tezoyuca-Patlachique, Tzacualli and Miccaotli Phases in the Teotihuacan Valley. Barba de Piña Chan (1956) divides the history of the site into three phases: Middle pre-Classic, Late pre-Classic, and Transitional pre-Classic Classic. It apparently reached its apogee in the final phase. Ceramically, the Late pre-Classic Period is similar to Cuanalan, but the succeeding transitional phase is one of rapid transition from a Cuanalan-like ceramic complex directly to Miccaotli. She also claims that influences from Monte Alban were present.

A series of striking changes in population, agricultural patterns, settlement patterns, and socioeconomic organization occurred in the Teotihuacan Valley that may aptly be called revolutionary and paved the way for the extraordinary florescence of Classic civilization. The characteristics of the Tzacualli occupation of the Teotihuacan Valley are such that the term Terminal Formative is somewhat misleading; the phase is really Initial Classic. The shift of settlement to the Valley floor, concentration of a sizable percentage of the population of the Valley into a single physical community, appearance of monumental architecture, urbanism, and the smooth transition of the ceramics to those of the Classic Period all support the idea that this phase really should be considered as part of the Classic Period. We are tentatively retaining the term Terminal Formative, however, until the results of Millon's project can be evaluated.

Although much of the data from the Teotihuacan Valley Project is inferential and indirect, we believe the following conclusions will withstand the test of future research:

1. We find no evidence of a massive population movement from outside the Teotihuacan Valley, and no need to invoke migration as a factor to explain the growth of population of Classic Teotihuacan. On the contrary, the evidence favors continuity among the Cuanalan, Tezoyuca-Patlachique, Tzacualli and Miccaotli Phases. The curve of population growth through the various phases and our reconstruction of agricultural history suggest a growth that is the product of local adaptive evolutionary processes. I am not arguing that specific technological traits and such elements of the

regional Mesoamerican civilization as pyramid temples, Tlaloc the rain god, and Huehueteotl the god of fire were not introduced externally. Some of these traits probably came immediately from Cuicuilco in the southern Basin. What I am arguing is that the most distinctive feature of Classic civilization, urbanism, was essentially a local process that occurred as an adaptive measure to the problem of living in the Teotihuacan Valley. This theoretical point will be elaborated in the final section.

2. Between Patlachique and Tzacualli times, a striking and dramatic population growth and spatial dislocation of population occurred. This shift from hillside and hilltop locations to piedmont and plain clearly indicates a shift of exploitative patterns in the use of the Valley. Although the evidence is not conclusive, we believe this change is correlated with a rapid expansion of irrigation agriculture and the integration of the land of the Lower Valley into a single irrigation system.

3. Perhaps half the population of the Valley resided in a single large town that was located, in part, within the borders of the Classic city. The balance was distributed along the piedmont in positions similar to those of post-Classic settlements. Furthermore, the locations of these rural settlements were highly selective, and tended to occur in precisely the same areas where Early Classic rural settlement was concentrated.

4. The enormous size of the town compared to other contemporary sites and the huge size of the monumental architecture in the town contrasted to the absence of such structures in the rural sites argue for at least valley-wide sociopolitical integration. This state may have been limited to the Teotihuacan Valley, since the Tzacualli ceramic complex is apparently limited to that area. This is a somewhat ambitious assertion since the possibility exists that a sizable area outside the Valley was tributary in a religious and economic, possibly even political, sense. The Tzacualli state could have included a small core (the Teotihuacan Valley) in which the population was culturally integrated but with a larger, less well-integrated hinterland.

5. During this phase, for the first time in its history, the Teotihuacan Valley became a major demographic and cultural center. Correlatively, starting with this phase, the southern part of the Basin of Mexico lost its demographic and cultural dominance in the culture history of the Basin and never regained it. At no time during the Classic and post-Classic Periods did a center in the southern area have more than local significance. This fact strongly supports our contention that a major revolution in agriculture took place in the Teotihuacan Valley during Tzacualli times since the southern Basin generally would seem to offer the greatest advantage for extensive agriculture with its lesser susceptibility to erosion, heavier rainfall, and higher percentage of elevated terrain. The extensive lake shore plain around Cuicuilco is a unique topographical feature in the southern Basin. Palerm points out in his paper that the plain seems also to be noticeably drier than the nearby slopes. The inception of irrigation in Cuanalan times there undoubtedly has had historical significance; the idea may have been brought from Cuicuilco to the Teotihuacan Valley by stimulus diffusion. The Xitli eruption, however, permanently destroyed the ecological power of this area.

The marginality of the southern Basin was not even compensated by the extraordinary development of chinampa agriculture, the most intensive system of farming in Mesoamerica. In view of the extraordinary productivity

and demographic capacity of the system it is of considerable theoretical interest that evolution of chinampa cultivation did not promote power systems. We will return to this point later.

Teotihuacan Period. The Early Classic Period in the Teotihuacan Valley essentially involved an intensification of those patterns of ecological adaptation initiated in Tzacualli times: rapid population growth, increasing intensity of land use and focus of agriculture in the alluvial plain, gradual nucleation of population into a few centers, and intensification of urbanization.

All generalizations about the Early Classic occupation of the Valley must be made in reference to the history of the growth of the city. Any reconstruction of the Valley's cultural history must therefore be highly tentative until Millon's Teotihuacan Mapping Project is completed. The reader is forewarned that much of the following reconstruction will undoubtedly require revision as the results of the project become available. The evidence derived from published studies and based primarily on Armillas' 1950 study and Millon's preliminary report may be summarized as follows:

1. The site consists of three, sociologically differentiated, concentric zones. Zone A--a formally planned core. This covers approximately eight square kilometers and the residential portion is ordered on a 60 m. grid. Within it is located the civic center. Zone B--an unplanned but densely settled periphery physically attached to Zone A on all four sides and measuring four square kilometers. Nearly all of this area is residential. The precise settlement pattern is not known but it was probably similar to that uncovered by Linne's Tlamimilolpa excavation. Zone C--a ring of large suburbs and small settlements, in some cases physically attached to the city, in other cases separated from it, but all occurring within a four kilometer radius of the Ciudadela. Many of these settlements were strung along highways leading out of the city. The situation is apparently similar to that around Tenochtitlan with its satellite communities in 1519. The pattern of many of these settlements is not known but in the few cases where it is apparent, it seems to consist of a series of large, separated, but closely-spaced, multifamily houses, possibly ordered on a grid.

2. The total area of dense settlement of the main site and its dependent suburbs was 15-16 km.².

3. The major problem in estimating the population of this dense settlement is chronological control. The maximal population was probably achieved in Xolalpan times. The grid, following Millon, seems to have been established then. Nearly all of the suburbs have their dominant chronological component in this phase. Excluding the civic center and secondary civic precincts and including the suburbs, the Xolalpan Phase residential area covered at least 650 hectares. We previously estimated a minimal figure of 60,000 people. The major problem is the degree to which Zone B was occupied in Xolalpan times. If it was all continuously occupied, the population estimate would have to be revised upward to 100,000. In the earlier phases the city proper seems to have been spatially as large as in Xolalpan times but with much lighter occupation of the suburbs. The main city itself (i.e., Zones A-B) was probably not as tightly nucleated as in Xolalpan times, or possibly there was a core of comparably dense settlement in Zone A, and Zone B may have had a more dispersed pattern with numerous open areas. If this is true, the assertion of progressive nucleation of the population of

the Valley as a whole was mirrored in microcosm by events within the city. Zone B may have appeared somewhat like Zone C in Miccaotli and Tlamimilolpa times.

4. The archaeological evidence for social differentiation and economic specialization is convincing, and at least one, possibly two markets have been located. The planning of the grid, presence of an organized street and drainage system, and extraordinary scale of monumental architecture all argue for a very tightly organized and integrated social system. Grid units like Yayahuala and Xolalpan were probably occupied by corporate kin groups living in large communal houses. Such groups were probably units of craft and mercantile specialization. Their size is comparable to the Formative hamlet-lineage.

So much confusion exists in the literature with respect to archaeological identification of cities that I will digress somewhat here to discuss this point. In several papers (1956 and 1962) I have asserted that most lowland Mesoamerican centers were not cities in the sense that Teotihuacan was. I have always felt that Maya centers especially were better characterized as ceremonial centers rather than cities. One of the most vital parts to our definition of a city is nucleation. The University of Pennsylvania has recently completed a survey of the site of Tikal--the largest of all Maya centers (Carr and Hazard, 1961). An area of 16 km.² was surveyed by dividing it into 500 m. squares and mapping all house structures. The residences were composed of relatively small, separate, stone and earth platforms, with surface rooms of perishable materials. They occur frequently in little plaza groups of 2-3-4, and occasionally occur alone. Each mound was presumably occupied by a nuclear family and the cluster by an extended family. The density of these house structures varied from four to 131 per grid square.

The total number of house mounds over the 16 km.² is approximately 2200 or an average of 138 per km.². This means a population density of only 552 per km.². Even if the individual mounds were occupied by an extended family as in the case of Aztec houses, the density would still be only 1380, similar to Low-Density Compact villages in the Teotihuacan Valley today. This is arguing, of course, contemporaneity of all house mounds, an assumption that becomes increasingly more dangerous in cases of a dispersed settlement pattern. The lower density, if used, compares to rancherías in the Teotihuacan Valley today. By contrast the density at Teotihuacan is approximately 10,000-12,000 per km.². Furthermore, and arguing strongly against the assumption of contemporaneity of houses at Tikal, the density of house mounds within the survey area at Tikal is no higher than elsewhere in the rural hinterland (see Bullard, 1960). On the contrary, the edges of urban settlement at Teotihuacan are sharply and clearly defined.

Outside the city the central fact about the zonal settlement seems to be its selectivity. Heavy rural settlement occurs only in areas peripheral to the main valley and the two great alluvial plains. A major population focus was located on the hilly northern flank of the Valley and a lighter concentration on the piedmont of the Upper Valley. Elsewhere rural settlements were few in number and tended to be small in size. Some of those that do occur elsewhere seem to have had specialized functions, i.e., quarrying, salt-making and maguey cultivation. Furthermore, in the areas of heavy settlement the population history is peculiar and apparently effected by nonecological processes. For example, in the Cerro Gordo, North

slope area survey disclosed a long history of nucleation of hamlets into large villages and small towns that correlated with a population history of lightly dispersed Miccaotli settlement, population climax in Tlamimilolpa times, a rapid reduction of population and concentration in a few centers in the Early Xolalpan Phase, followed by near abandonment of the area during Late Xolalpan and Metepec Phases. The data for this area are also quite provocative on the theme of urban-rural acculturation. In the Miccaotli Phase we found so many absences in the ceramic complex that a new set of criteria is being designed to detect the occupation of this phase. By Tlamimilolpa times the ceramics are nearly identical to those in the city. This same process is reflected in community settlement patterns and residential architecture. The shift from hamlets to large nucleated communities, in several cases with a grid plan of large multifamily houses, and civic centers imitating the plan of the city are other indications of this increasing integration of the rural population into a single great society.

Nearly all rural Teotihuacan settlements except those of the earliest (Miccaotli) phase are compact and tightly nucleated. They vary considerably in size, several perhaps consisting of a single multifamily house, others possibly with populations in the thousands.

The clustering of rural population into a few, frequently planned, settlements gives one the impression of a state-controlled process and is a striking parallel to the Spanish Congregacion policy of the sixteenth and seventeenth centuries. If such were the case it would imply an equally close supervision of rural life. Toward the end of the Teotihuacan Period (Metepec Phase), this socioeconomic integration reached the point where at least 90 percent of the population of the survey area resided in a single nucleated settlement. This nucleation affected even the suburban ring. Nearly all of the suburbs were abandoned by the end of the Xolalpan Phase. Possibly Zone B in the city was continuously and densely occupied for the first time during Metepec times and this filling in may have been the product of rural migration to the city.

Direct proof as to the use of such intensive agricultural techniques as terracing, floodwater and spring irrigation is admittedly deficient for the Teotihuacan Period, but the indirect evidence from the settlement pattern seems conclusive to use. The total population residing in the Teotihuacan Valley in the Xolalpan Phase must have approximated the Aztec and have been at least double the modern. Even taking into account the post-Conquest loss of productive lands through erosion, the system would have had to have been at least as intensive as today. No evidence was found of the degree of climatic change that would have made such techniques unnecessary. The large nucleated settlements, especially the city, also argue for intensive land use. This is particularly the case when we consider that the land directly used by the urban population was apparently restricted to the main valley. The proven cases of Early Classic canalization of streams flowing through the city, abundance of general evidence of alteration of stream beds, and frequent occurrences of canalized streams in the vicinity of rural Teotihuacan settlements all point in the same direction.

One definite fact about land use is the obvious focus of activity in the alluvial plain and direct control of these areas by the urban population. The zonal settlement pattern seems to indicate a similar relationship between cities and agricultural activity pointed out by Adams in his study of Early Dynastic Mesopotamia (Adams, 1960). Apparently, even large population

centers in pre-Iron Age civilizations may be characterized to a certain degree as oversized agricultural communities; a sizable percentage of the population were farmers as well as specialized craftsmen. Primarily for this reason we have slightly modified my definition of urban from the position presented in my 1961 paper. The key element in the definition should be the emphasis on social differentiation and economic specialization within a community rather than absolute absence of food production. The important characteristic of an urban community is the high degree of differentiation of the population in social and economic activities, not that the population did not produce any of their own food. Of course, as the city of Teotihuacan increased in size to reach its maximal figure of around 100,000, more and more of the population must have become increasingly dependent on tribute, trade and nonagricultural activities for support; our impression of a semiagricultural, semicommercial community is perhaps most applicable for early phases of its history.

Outside the Basin of Mexico the specific Teotihuacan culture is widely distributed over the Central Mexican Symbiotic Region, especially the Nuclear Area (the Basin of Mexico, Western Puebla, Tlaxcala and Morelos). The number of reported sites, however, is surprisingly low. Linne described and excavated sites in Tlaxcala at Las Colinas, Zoquiapa, and San Nicolás El Grande, all near Calpulalpan (Linne, 1942); the Instituto Nacional de Anthropología y Historia has excavated part of a huge civic precinct at Cholula inside the great pyramid (Marquina, 1936), a relatively large pyramid near Tepeapulco in Hidalgo 30 km. northeast of the Sun Pyramid, and a small pyramid at Huapalcalco near Tulancingo in southern Hidalgo (Mueller and Lizardi Ramos, 1959; Mueller, 1960). In Morelos, Teotihuacan occupation has been reported at Chalcatzingo and near Xochicalco by Mexican archaeologists (Piña Chan, 1956; Saenz, 1962).

For the Basin of Mexico, excluding the Teotihuacan Valley, reported sites are equally sparse. At the time Tolstoy did his surface survey of the central part of the Basin, Teotihuacan occupation was known only at Azcapotzalco (El Corral), Coyotlatelco, El Arbolillo, Xico and Chalco. Tolstoy's sample of 111 sites yielded only five new sites of this period (site numbers 35, 52, 86, 104, 106) of which only 106 had substantial occupation. Later (1959) Mayer-Oakes published an account of an excavation of what was apparently a salt-making tlátel at El Risco with occupation of the Teotihuacan Period. In 1960 he excavated a similar tlátel at Tulpetlac and another small site at Tecolapan near Tlalnepantla. Brainerd, Hicks, and Nicholson report Teotihuacan occupation in four additional sites in southern Acolhuacan at Portesuelo, El Resumidero, Coatlichan and Los Reyes (Nicholson and Hicks, 1964). Brief surveys outside the survey area by personnel of the Teotihuacan Valley Project have located three additional sites: one at the Rancho de San Antonio near Papalotla, one near San Francisco Olalpa and one at La Presa del Rey near Temascalapa.

This provides us with a grand total of 19 sites for the rest of the Basin of Mexico in contrast with approximately 100 sites reported in the Teotihuacan Valley. Conceivably, a much denser concentration occurred there than elsewhere in the Basin, but this is dubious. One might argue that since the major center was located there, this might have attracted rural population to the immediate vicinity of the city. In fact, however, the distribution of Teotihuacan Period sites in the Valley strongly suggests that most of the land was held by the city. This landholding pattern

would result rather in a reduction of small settlements, not an increase. We believe the low number of known Teotihuacan sites outside the Valley is, surely the product of insufficient survey. In the case of the Teotihuacan Valley, nearly all of the area was at least cursorily examined. No area of the Basin has been surveyed with comparable intensity.

Tolstoy, Hicks and Nicholson have all explicitly asserted and Mayer-Oakes and Lorenzo implied that Teotihuacan sites are rare in the Basin of Mexico as a whole; but we believe they err in the same way previous researchers have erred about the density of Formative settlements. We feel sure that there are probably hundreds of undiscovered sites of this period including perhaps scores of sites comparable in size and complexity of religious architecture to TC 73, 83 and 40. The error lies in not taking into account possible variations in ecological preference. By utilizing the ecological approach one might evaluate the known data that refers to the area around Texcoco as follows:

1. This area could be described as consisting of three, parallel, ecological zones with respect to human occupation. These are:
 - a. Alluvial Plain. The most extensive of all the alluvial plains of the Basin (varying from three to 10 km. in width) is located here. It lies between 2240-2250 m. above sea level, is an area of deep fertile soil, but presents certain difficulties to primitive agriculture due to its greater susceptibility to frosts (frosts at the Chapingo station are even more severe than at San Juan Teotihuacan), lower rainfall and distance from permanent water resources for irrigation. It is densely settled today and was a population center in Aztec times.
 - b. Piedmont. A very badly eroded, gently sloping area located between 2250-2500 m. A string of small villages parallels the alluvial plain and is located in the middle of the piedmont strip today; it had an extraordinarily dense population in Aztec times.
 - c. Mountain Slope. The mountain slope area is located between 2250-2600 m. and is an area of steep forested slopes, and heavier rainfall. It has suffered less from erosion than the piedmont. The springs that provide water for modern and ancient irrigation systems are located there. Today a string of small villages is located at the lower end of the contour strip. The Aztec density of population in this area is not known.

2. In each of these ecological strips the communities vary in agricultural practices and settlement pattern and have differing economic specializations. For example, the mountain slope villages produce pulque and charcoal; the piedmont villages, fruits and flowers; those in the plain provide milk, maize and certain craft products; and several communities on the lake shore gather aquatic products. The market at Texcoco is the focus of an intensive regional trade based in part on these local specializations.

3. Even assuming inadequate survey, it seems certain that the Aztec population of the area exceeded by a considerable margin the Early Classic, and this generalization probably applies to the Basin as a whole. Even in the Teotihuacan Valley, an area marginal in Aztec times to such population centers as the Texcoco plain and the chinampa area, the Aztec population was approximately as large as the Early Classic. Both archaeological and documentary evidence indicate an extraordinarily dense population in the Texcoco area in both plain and piedmont. All of the city state cabeceras were located in the plain, including the huge center of Texcoco.

4. If we accept this picture of a much heavier Aztec population than in earlier periods, then the rarity of discovered Early Classic and Formative sites makes sense. Most survey has been carried out in the plain where good roads are available. Nearly all of Tolstoy's sites were found near highways. If the population was only a fraction of that of the Aztec Period, it would have been more selective in its use of land. We have previously postulated that the piedmont and mountain areas would be ideal for extensive cultivation in Formative times and suggested that the population in that period was concentrated there. As the population increased in Classic times, there would have been a need either for intensification of cultivation in this same area or expansion into the alluvial plain. My guess is that the former occurred first and that the relatively flat piedmont (which at that time had good substantial soil cover and was situated close to the springs usable for irrigation) would have been the preferred area for settlement. The expansion into the plain may well have been delayed until the demographic pressure of the Aztec Period forced the population into the development of big irrigation systems. The piedmont has another advantage in that it is close to the high mountain wall with its heavier rainfall and therefore abundant runoff would have been available for floodwater irrigation.

If this reconstruction is correct, then the Teotihuacan settlement should be concentrated along the piedmont strip. The possibility exists, however, that in much of the Basin (outside the Teotihuacan Valley) the population was small enough so that extensive agriculture was the basic system until post-Classic times. In view of the enormous size of the city, which in its late phases of growth undoubtedly outgrew the immediate agricultural productivity of the Valley, this would seem improbable.

In connection with these arguments Coe (1964) has recently asserted that chinampa cultivation was practiced in the southern Basin during Early Classic times. The evidence presented is, to say the least, unconvincing. It is based on the scattered finds of figurines of this period in the soil of the chinampas near Xochimilco. Figurines are a very insecure basis for associational dating. In numerous sites in the Teotihuacan Valley figurines of the Teotihuacan Period were found on Aztec sites with no associated Teotihuacan pottery or other indication of occupation. Numerous villagers today, especially children, collect ancient figurines. What is needed are house sites and refuse deposits in situ. Coe also errs in his assumption that chinampa construction must be correlated with mass, organized, state-directed projects. There are eyewitness accounts of chinampa construction and most of the chinampas were apparently built by small work gangs. In 1954, while conducting a study of the economic aspects of chinampa cultivation, I surveyed the old lake bed between Tlahuac and Xico. This area, formerly occupied by chinampas, was appropriated by a local hacendado during Diaz's administration. He drained off the area by means of a grid of deep ditches to convert it to plow land. I examined the banks of several ditches and found abundant pottery, but it was restricted to the Aztec Period. Coe's argument that the chinampas were probably the economic base of Teotihuacan seems rather peculiar. Why build a city 30 km. away from its principal rural hinterland?

Outside the Teotihuacan Valley very little data exist on community settlement patterns for the Early Classic Period. Many of the sites discussed previously were probably provincial centers since they do include

substantial ceremonial architecture. Such sites as Las Colinas, San Nicolás El Grande, Tepeapulco, Rancho de San Antonio, Huapalcalco, and Chalcatzingo are all approximately the same size with respect to their civic architecture and are comparable to TC 73 and TC 40 in the Teotihuacan Valley. Azcapotzalco and possibly Portesuelo may also be ranked with these sites although the former does not have preserved civic architecture. These sites are comparable in the size of their civic architecture to small Aztec city states. Presumably they are local provincial centers. The community settlement pattern of these local centers outside the Teotihuacan Valley is unknown. They could have been ceremonial centers of the Maya type, but the known evidence indicates that they were towns similar to TC 73 and TC 40.

Speaking of San Nicolás El Grande, for example, Linne states: "About two kilometers southeast of San Nicolás el Grande there are some considerable remains of an ancient city. The site is on the lowest part of the northern slope of Cerro San Nicolás, and covers an extensive area, cf. the sketch map, fig. 98. The ruins consist of three larger and forty odd smaller mounds, some of which were pyramids and other foundations of buildings." (1942, p. 75).

There is an enormous gap in size between Teotihuacan and these small centers; this picture is in startling contrast to that in Aztec times when there was a continuum of size of political centers ranging from Tenochtitlan, comparable in size to Teotihuacan, down to small centers like Acolman and Tepexpan. The only possible exception to this apparent lack of intermediate size centers in Classic Cholula. The data imply that perhaps the dominance of the city was more complete than in Aztec times.

Apparently, Azcapotzalco also included a large, densely settled, residential zone (see Vaillant, 1941).

At least three of the sites, Chalcatzingo, San Nicolás El Grande, and Las Colinas, seem to have civic centers that include two large pyramids along the end and one side of an elongated plaza, possibly again in imitation of the Sun Pyramid-Moon Pyramid arrangement at Teotihuacan.

The ceramics from excavated sites in the central plateau are almost entirely of the general Tlamimilolpa-Xolalpan Phase and show some local divergences from the ceramic complex in the Teotihuacan Valley. (For example, Linne found no tripod vases at Las Colinas). The data seem to support our suggested parallel between the rise of Teotihuacan Period nucleated villages and towns in the Tlamimilolpa-Xolalpan Period and the Spanish Congregation policy. In all probability the local populations, perhaps residing in hamlet-like settlements as in the Teotihuacan Valley, were collected into villages and towns to facilitate taxation. The fact that ceramics and artifacts are not identical with those of the city would argue that the new towns were composed of local people. Of course, all of this reconstruction is hypothetical until more settlement data can be assembled from outside our survey area.

If the sites discussed above were provincial centers or small towns, we are still left with the problem of rural settlement pattern. Was the spread of Teotihuacan influence in such traits as pottery, figurines, and other artifacts accompanied by changes in domestic architecture and rural settlement pattern or is the picture in the Teotihuacan Valley unique?

The only good data available on rural settlement patterns are from Mayer-Oakes' El Risco study, and this site or complex of sites is clearly a special case. The pattern there is apparently similar to that of Aztec salt-making sites, a great arc of well-spaced, large, earth mounds running along the lake shore. Each mound is apparently an earth dump derived from the leaching of salt out of saline earth mixed with occupational debris.

The specific Teotihuacan culture in at least its technological aspect was apparently limited to Central Mexico. Its trading contacts with and influences on contemporary regional Classic civilizations, however, was extraordinary but highly selective. In southern Vera Cruz its influence is felt in ceramics and figurines; in the Valley of Oaxaca in architecture, mural painting and ceramics; in Guerrero in portable stone sculpture. In most cases the pattern is one of "influence" rather than imitation or duplication, i.e., Teotihuacan ideas are blended with regional traditions. An exception to this rule is Kamimaljuyu where high status individuals were buried in pyramids constructed in the Teotihuacan style and accompanied by imported Teotihuacan and locally made copies of Teotihuacan pottery. Here the evidence seems to be in favor of the actual residence of people from Teotihuacan rather than periodic commercial contacts. The nature of this Teotihuacan influence on Mesoamerica as a whole has been debated about over the past 30 years. Most authors seem to feel it is the product of peaceful trading contacts or perhaps pilgrimages to Teotihuacan as a religious center of supraregional significance, like present-day Indian pilgrimages to Guadalupe or sixteenth-century pilgrimages to Cholula. The evidence from the Teotihuacan Valley Project and Kamimaljuyu, however, suggests a more militaristically, politically oriented culture than has been supposed. The presence of numerous obsidian projectile points, trophies made from human skulls, and cannibalism at TC 8, the Congregacion-like manipulation of population in the Teotihuacan Valley, plus the evidence from Kamimaljuyu points toward a more imperialistic society. There is also evidence of human sacrifice and cannibalism at both Azcapotzalco and Teotihuacan itself (see Vaillant, 1941). Recently excavated murals at the city indicate a more militaristic spirit than previously supposed. In all of the foreign areas, the Teotihuacan influence dates from the Tlamimilolpa-Xolalpan Phases. The parallel with the Aztec Period is rather close in that Aztec conquests also were selective. Tlaxcala, for example, in the heart of the plateau was unconquered, as were the Chiapas highlands, yet Oaxaca and the Chiapas Coast were controlled.

In Aztec times the grain tribute was drawn primarily from the Central Mexican Symbiotic Region; the periphery was taxed in more exotic, less basic foodstuffs and goods. Perhaps this was true in Teotihuacan times as well. The growth of the city of Teotihuacan seems to correlate rather well with this picture. We have postulated that its early growth depended on local evolution of intensive agriculture and that it was primarily an agrarian center. Its final spurt of growth may be correlated with the assumption of control of the Central Mexican area and its surplus production of staple foods.

Toltec Period (Late Classic and Early post-Classic Phases). Of all the periods we have discussed thus far, the Toltec is probably the most complex and most difficult to elucidate adequately for several reasons. First, our survey area, the Teotihuacan Valley, is distinctly a demographic and sociopolitical backwater in a highly sophisticated state whose center

was elsewhere. This fact limits the generalizations concerning Toltec culture generally that are possible from the data which we have amassed. Rather, in order to understand this period fully, we must take into consideration events at sites as distant from our survey area as Tula and Hidalgo to the north, Cholula and Puebla to the east, and Xochicalco and Morelos to the south. Unfortunately, data comparable in scope to our Teotihuacan Valley materials are scanty or lacking from precisely those areas which were nuclear in Toltec times.

A second set of problems lies in the existence, for the first time, of documentary data relating to this horizon. That the existence of such additional evidence should be regarded as a dubious blessing may perhaps seem paradoxical. Yet as many questions at least are raised as are answered. Serious methodological problems arise in interpreting and applying the evidence so obtained. The dates of composition of most of this material are unknown; is any of it contemporary with the events recorded, and if so, how much? While much of the material is clearly legendary, there is no independent evidence extant that would enable us to separate the legendary from the historical. Similar problems arise in dealing with similar materials from, say, Western Europe; but there more corroborative evidence is available to provide control. Even those controls present for Aztec documents--sixteenth-century Spanish observations--are lacking for the earlier period. A final warning: If it is impossible, in effect, to sort out legend from true history, it is often equally difficult to control for conventions of historiography or for political propagandizing. Both of these last-named situations have clearly documented Western European parallels; but in the Toltec case even mere recognition can be a serious methodological problem. Later in this section we shall consider these questions in more detail.

We have previously defined the two basic ceramic complexes of the Toltec Period in the Teotihuacan Valley. We also noted the presence of a third complex which we are calling Oxtotipac, probably largely contemporary with Xometla but possessing more Metepec traits than does the latter. In this section, we shall first summarize the data on Toltec settlement patterns from the Teotihuacan Valley. Subsequently, we shall discuss the historical accounts of the Toltec, and, finally, attempt to reconstruct the events occurring from the fall of Teotihuacan to the rise of Texcoco-Tenochtitlan.

The Xometla complex sites are classifiable as small towns, villages, and hamlets. All tend to be compact and tightly nucleated, thus resembling Early Classic rural settlements. The location of all but three of the sites in the Lower Valley and Delta areas on the edge of the alluvial plain marks the inception of a pattern that remains dominant up to the present day. The total population residing in the Lower Valley-Delta settlements, although quite small, was substantially higher than that of Early Classic times. At least two settlements were located among the small hills bordering the Valley between Cerros Gordo and Malinalco. The major focus of population, however, remained at the site of the older city, where many of the Metepec Phase residences apparently continued in use.

Oxtotipac complex sites are very rare; only one definite site other than the city has been identified. In the Upper Valley a possible terminal Metepec, i.e., a complex transitional between Metepec and Oxtotipac, seems

to occur on a few sites and may be contemporary with Oxtotipac. More probably, however, these sites were abandoned before the Oxtotipac complex was fully evolved.

In Mazapan times the post-Hispanic pattern became firmly established. This was a period of pronounced ruralization (even the city disintegrated into a complex of rural and semiurban communities), of decline of civic construction, and of broader and more even distribution of population in the Valley as a whole. Sites are usually small, and houses within them widely spaced. The old Classic city probably functioned as a small provincial center. The balance of the sites seems to cluster in tiny districts focused on small towns or villages in the Lower Valley-Delta, and villages and hamlets in the Upper Valley.

The preceding summary of settlement patterns of Toltec Period in Teotihuacan lends strong support to our conclusions of the marginal nature of this area during the Toltec Period. In this respect, it is significant that the marked ruralization is a progressive one. If we are to understand the events of this period, therefore, it is necessary to examine other areas of the Meseta Central, and to consider more general evidence bearing on Toltec culture. We therefore turn to more detailed examination and criticism of such evidence.

One of the major problems of Central Mexican archaeology is that of the fall of Teotihuacan. Documentary sources make no reference to this event, and seem all to refer to a period subsequent to it--even those lists which go back earliest in time and mention dates approximating those when such a major event may well have occurred. This fact in itself is significant, and has considerable bearing on the chronology of the sources, which may themselves have been committed to writing only when this period had been forgotten. If those portions of the dynastic lists which refer to such early dates were indeed contemporaneous with those dates, it seems unlikely--assuming that the documents are indeed historical rather than mythological--that an event of such major importance would not be mentioned.

The archaeological literature has emphasized the suddenness of the collapse of Teotihuacan and ascribed it to military conquest. Proof of this assertion includes evidence of intentional destruction of civic buildings and burning of residences. In the debris of the collapsed walls and roofs of destroyed and partially destroyed buildings, frequently found mixed with Metepec Phase ceramics, occur sherds belonging to what we are calling the Xometla complex. Since this complex includes the red-on-buff decorated type called in the literature Coyotlatelco, and since this ware is thought to be the product of the Early Toltecs, the destruction of the city is usually ascribed to these people. The data from the Teotihuacan Valley Project seem to substantiate this general argument, but also point to a much more complex succession of events than previously supposed.

The first sixteenth-century accounts that seem to be genuinely historical--with reservations--refer to a people called the Toltec, the people of Tula or Tollan. The most detailed accounts are found in the "Anales de Cuauhtitlan" (1945) and the "Historia Tolteca-Chichimeca" of Fernando de Alva Ixtlilxochitl (1952). Each source provides a migration legend explaining the origin of the Toltec, a dynastic list with dates, a brief outline of significant events in the history of the expansion of the Toltec state, and an account of the destruction of Tula. The lists of kings do not agree in date and only partially in names. The two lists are presented on the following page (the dates and lists are from Vaillant, 1941):

Ixtlilxochitl List

Huemac-Migrant priest leader
 Chalchiuhtlanetzin 510-562
 Ixtlilcuechahauac 562-614
 Huetzin 614-666
 Totepeuh 666-718
 Nacoxoc 718-770
 Mitl Tlacomihua 770-829
 Xihuiquenitzin(Queen)829-833

Iztaccaltzin 883-885

Topiltzin 885-959

Anales of Cuauhtitlan

Mixcoamazatzin-Migrant military leader
 Huetzin 869- ?
 Totepeuh ? - 887
 Ihuitimal 887- 923
 Topiltzin 923- 947
 Matlaxochitl 947- 983
 Nauhyotzin I 983- 997
 Matlaccoatzin 997-1025
 Tlilcoatzin 1025-1046
 Huemac 1047-1122

Vaillant had identified the archaeological site of Teotihuacan with the Tula of the chronicles. He had worked out the ceramic chronology of Teotihuacan and of the large site of Azcaputzalco or El Corral on the other side of the lake, and, on this basis, established four phases of Teotihuacan history. The city itself was thought to have been abandoned at the end of phase 3 (Tlamimilolpa-Xolalpan), and the evidence from Azcaputzalco was that of a sudden expansion in phase 4 from a previously much smaller settlement. Vaillant therefore considered the two lists as separate, and assigned the Ixtlilxochitl list to Teotihuacan. According to his reconstruction, Teotihuacan was destroyed, the population fled to Azcaputzalco and established a new dynasty, to which the Cuauhtitlan list refers.

We believe that Vaillant's assumption of two distinct lists is correct, except that the Topiltzin in both seems to have been the same personage. It may, however, be that this is a title (the etymology supports this interpretation), and not a personal name at all. Again, there is no independent basis for distinguishing myth from history anywhere in either lists, and without such corroboration, any use of these documents may, of course, be questioned on methodological grounds.

In the Anales de Cuauhtitlan, Topiltzin is also identified as Ce Acatl Quetzalcoatl (the Feathered Serpent), who was later deified, or identified with a pre-existing deity. Accounts of his life are extraordinary blends of mythology and history, and the caveats stated above apply with equal vigor at this point. Ixtlilxochitl's history includes a migration from the north under an astrologer-priest, Huemac, who founded Tula in 510 A.D.; a succession of rulers, most of whom reigned exactly 52 years (the Calendar Round, and further occasion for suspicion on this basis); gradual expansion of the Toltec state, followed by disaster under the reign of Topiltzin. This disaster was a combination of droughts, local revolts, and foreign invasions.

The Anales de Cuauhtitlan also begins with a migration, but under a military chieftain called Mixcoamazatzin; the migrants arrived at Tula where Huetzin was enthroned as king of Tula. Three reigns later a

fratricidal conflict occurred between rival religious sects, in which Topiltzin, identified as the priest-ruler Quetzalcoatl, was driven out of Tula. He then fled to the Gulf of Mexico, embarked on a raft, and sailed to the east. The story is picked up in Yucatan by local Maya traditions describing the arrival on the west coast of Yucatan of a foreign group speaking a strange language under a leader named Kukulcan (the Feathered Serpent in Yucatec Maya). This group ultimately established a state in Yucatan, centered at Chichen-Itza. At Tula meanwhile, the Toltec dynasty continued through four reigns of military expansion. In the fifth reign, that of Huemac, Tula was finally destroyed after a series of disasters similar to those recounted in the Ixtlilxochitl version.

One of the major recent achievements of Mexican archaeologists has been the identification of the archaeological site of the Toltec capital. On the basis of a careful re-examination of the documentary sources, Jimenez Moreno (1941) collected a list of place names of hills, streams, and communities, and was able to correlate them with modern toponyms in the vicinity of Tula in southern Hidalgo.

Acosta's later excavations at Tula confirmed this identification (Acosta, 1956-1957, 1957). Prior to Acosta's work, Vaillant had identified the two ceramic complexes we call Xometla and Mazapan, but assigned them to the Chichimec, one of the invading groups that destroyed Tula. We have already noted the association of the Xometla complex with the destruction of Teotihuacan. The Mazapan complex occurs either on the tops of the ruined mounds of the Early Classic city or as intrusive burials in the debris. At Tula, Acosta demonstrated that the Mazapan complex was associated with the major building construction at the archaeological zone, and that the Xometla complex was found only on the lower levels of his stratigraphic test pits. The obvious conclusion from the work of Acosta and Jimenez Moreno was that Teotihuacan was destroyed by the Toltecs rather than built by them, and that Tula ultimately replaced Teotihuacan as the major center in Central Mexico.

The site of Tula is of considerable size, and is distributed along the summit of a low narrow ridge approximately three kilometers long. The legally defined modern archaeological zone consists of a complex of civic buildings centered on a great plaza, located at one end of the ridge. At the opposite end of the ridge is a second unexcavated civic center comparable in size to that of the archaeological zone. The area between has heavy occupation. We previously noted the fact that all the construction at the archaeological zone dates from the Mazapan Phase; at the unexcavated precinct the Coyotlatelco or Xometla complex seems to be dominant.

Previously noted but not discussed in detail was the close similarity between Early Toltec ceramics as a whole and those of the terminal phase of Teotihuacan. It is probable that detailed laboratory analysis will demonstrate that the former is directly derived from the latter. There are actually as many or perhaps more changes between Mazapan and Xometla than between Xometla and Metepec. On the basis of the data presented here on the Toltec and Early Classic Periods we believe that a reasonable reconstruction of events between the fall of Teotihuacan and the rise of Texcoco-Tenochtitlan is as follows:

1. In view of the new C 14 dates from Teotihuacan, Tula may well have been founded as early as 510 A.D., as Ixtlilxochitl asserts, perhaps as a provincial center dependent on Teotihuacan. We are extremely distrustful,

however, of the documentary sources with respect to migrations. At times the documentary history resembles a gigantic chess game in which entire peoples are involved, a historical process greatly at variance with what we know about peasant and folk societies. The ceramic record does not give one the impression of any mass population movement. It is more probable that the population living around Tula was tributary to Teotihuacan during the Tlamimilolpa-Xolalpan Phase. They probably were not, however, as tightly integrated into Teotihuacan society as were people living in such sites as TC 40 and 73 on the northern periphery of the Teotihuacan Valley. As a frontier area there was probably some stylistic divergence in the direction of later Xometla complex even at this time. We suggest that Ixtlilxochitl's history refers to a point in the evolution of local culture in which they became politically independent (probably in Metepec times) and set up a new state centered at Tula.

2. The Metepec Phase at Teotihuacan witnessed in all probability a rapid decline of the political power of Teotihuacan over its extensive rural hinterland. We noted previously the evidence of growing military symbolism in the art of Teotihuacan. None of the dependent centers outside the Teotihuacan Valley seem to have Metepec Phase occupation. Across the lake, Azcapotzalco reached its maximum size during this phase and the ceramics are divergent enough from those in the city to suggest political independence. The tributary domain of the city may well have been restricted to the Teotihuacan Valley. Accompanying this shrinkage of tributary domain was a process of nucleation of the local population into a single center. In view of subsequent events this may have been a defensive measure. In this connection the emigration of population from the northern periphery is significant since this area would be most vulnerable to attacks from the northern frontier. In the long run, of course, this defensive response was unsuccessful; it must have put enormous stress on the agricultural system, a fact which would make such a response still more maladaptive. It would be almost impossible to maintain terrace systems as far away as the North Slope-Cerro Gordo area.

3. Ultimately, the northern frontier peoples under the leadership of Tula successfully attacked Teotihuacan. That it was an indecisive war is suggested by the existence of two contemporary ceramic complexes for perhaps a century in the Early Toltec Period. We suggest that the Oxtotipac complex pottery was made by the older Teotihuacan population who apparently continued to reside in the city. The appearance of Xometla complex sites in the Lower Valley-Delta contemporary with the Oxtotipac settlement in the archaeological zone, we believe, supports this reconstruction of events. The Lower Valley-Delta would have been the prize agricultural land in the Valley--especially during climatic phases of lower rainfall.

In accounts of Aztec history the lands of conquered people were frequently expropriated and granted as rewards for military service to individuals and kin groups (see Duran, 1951). The Early Classic settlement pattern with its concentration of population in one center would have facilitated land appropriation and the formation of squatter settlements. It is probable therefore that the Xometla sites in the Lower Valley-Delta represent occupation by migrants from Tula. The older population residing in the city presumably retained the holdings in the Middle and Upper Valley.

4. As Tula expanded its domain and prestige, several processes must have occurred at Teotihuacan: a rapid decline of population as lands were

lost, consequent migration of craft guilds to the new center, and rapid Toltecization of the remaining population. The statement about craft guild migration is in keeping with what we know about historical processes in the better documented Aztec Period. Mass population movements such as the sources described were probably very rare events. Migrations of small groups with special skills in response to shifting centers of political control and trade and perhaps as a result of state policy, at least in part, however, was probably one of the major mechanisms of sociocultural change in Mesoamerica. Ixtlilxochitl, for example, records an immigration to Texcoco of two Mixtec craft guilds in the reign of Quinatzin (Ixtlilxochitl, 1952). Ultimately, the process of Toltecization was completed at Teotihuacan itself as the presence of the Xometla complex there demonstrates. We believe that many of the apparent changes in the ceramic and artistic styles in Central Mexico were primarily the product of the processes outlined above, i.e., basic population stability over long periods of time, shifting socioeconomic dominance of specific communities over extensive areas for shorter cycles of time, zones of acculturation radiating out from such centers with some stylistic independence along the frontiers, rapid evolution of new styles as frontier areas became politically independent, and migration of small groups with special skills in response to shifting markets. We see no need to invoke periodic mass migrations as an explanation for sociocultural change.

5. Contemporary with these events in the northern part of the Basin of Mexico and southern Hidalgo, two major rural powers were evolving in the south, following the disintegration of Teotihuacan civilization, at Cholula and Xochicalco. In both sites the chronology is rather confused. Noguera (1947) considered the florescence of building at Xochicalco to be contemporary with Teotihuacan, and that the former site was the center of a distinct regional civilization. The basis of his conclusion is the occurrence at Xochicalco of the basal-flange vessel form, which he related to similar vessels of the Tzakol Phase in the Peten. Evidence today is strongly against this interpretation. Basal-flange vessels are equally diagnostic of our Oxtotipac-Xometla complexes, which the Xochicalco examples resemble in fact far more closely than they do the Uaxactun Tzakol material. There are sites of the Tlamimilolpa-Xolalpan Phases in Morelos at Chalcatzingo and Gualupita and several only a few kilometers from Xochicalco. Furthermore, the ceramics from Xochicalco have obvious and definitive relationships to our Oxtotipac and Xometla complexes and to the middle phase at Portesuelo. Most of the construction at Xochicalco probably equates in time (but the ceramic style is distinctive, however) with the Early Toltec and both are Late Classic in terms of Maya chronology.

The case of Cholula is less clear, but we shall tentatively suggest that the Cholulteca ceramic tradition starts at this time, that it originated in Cholula rather than the Mixteca and that the great pyramid was probably built during this Late Classic Phase. (See Nicholson's 19?? discussion of this theme).

There were probably other smaller centers in Central Mexico at this time. One has a picture of political fragmentation and conflict. The domain of Tula may well have been limited to the northern part of the Basin of Mexico.

6. Direct or indirect archaeological evidence for irrigation is lacking, but all three of these Late Classic-Early post-Classic centers are

located in areas with large, sixteenth-century irrigation systems. The one at Cholula may have been one of the largest such systems in Mesoamerica. It is probable that all three systems were functioning at least as early as Late Classic times.

In the history of Tula there seems to have emerged a growing focus of ritualization of warfare that was to remain in vogue until the Spanish Conquest. This tendency is reflected in the art styles. Unlike many specialists on Central Mexican art, we see strong stylistic and thematic continuities between Teotihuacan and Toltec art which seem to demonstrate a process of refocusing and reintegrating older concepts into a unique configuration. There are, of course, methodological problems in the treatment of art styles. Negative evidence here is worthless; lack of militaristic scenes reflected in art cannot be taken to indicate a corresponding unimportance of the military within the society as a whole. In European art from the period of the late nineteenth and early twentieth centuries, for example, very little specifically militaristic art was produced; yet during this same period Europe was torn by nearly constant wars. Art, too, is governed by cultural patterns, standards of appropriate subject matter and treatment, and therefore must be used with caution in attempts to infer other aspects of culture.

The economic and political bias of the Toltec Empire seems to have been northward. Toltec expansion to the south seems to have been effectively blocked by Xochimilco and Cholula, at least until the final century of its history. Toltec influence is much stronger westward and northward. There is considerable Late Toltec influence in the Valley of Toluca, Michoacan and as far northwest as Sinaloa. In a recent publication, Armillas (1964) relates this to broader regional changes that occurred in response to a shift northward of precipitation belts. In pre-Toltec times the frontier of Mesoamerica was very restricted. In the Toltec Period the frontier expanded rapidly to the north and in Aztec times retracted again. The entire area today has less rainfall than the central plateau, and is what may be called an ecologically unstable area where a slight increase in rainfall produces a favorable situation for agriculture and a slight decrease produces disaster. If our climatic reconstruction of the Valley of Teotihuacan is correct, the northward shift of rain may have resulted in a dry phase in the central plateau. The sharp decline and contraction of population in Xometla times and its restriction to the more favorable parts of the Valley suggest this, as does the relatively small Mazapan population. The decline may have started as early as Metepec times and the collapse of Teotihuacan therefore correlated with ecological problems caused by declining rainfall. These problems in turn were probably the primary factor in the political unrest in the Hidalgo area.

One of the graduate students working with the project, John McCullough, is working out the details of Toltec chronology. He feels that he will be able to divide the Mazapan Phase into two shorter phases, an earlier one for which the term Mazapan is being reserved and a later phase called Atlatongo. In the Atlatongo Phase a new complex of ceramic types appears including an orange ware that could have been the prototype of the Aztec orange ware. It also includes forms similar to those in X Fine Orange and Plumbate. The maximal expansion of the political power of Tula and its most extensive trade networks seem to date from this phase. Possibly parts of southern Mesoamerica may have been controlled politically at this time.

A major problem in analysis of the Toltec occupation of the Central Plateau as a whole is the lack of settlement data outside the Teotihuacan Valley. We know practically nothing about rural and urban settlement patterns or the density of sites outside the survey areas. The Valley was clearly marginal, demographically and culturally, at this time and the low population and feeble development of civic architecture and urbanism may not be characteristic of Toltec occupation elsewhere in the Basin. There is reason to believe that the Valley was unusually backward at this time. In two brief surveys personnel of the project located two Late Toltec centers with impressive ceremonial architecture, one near the Teotihuacan Period site of Rancho de San Antonio, the other a place called Cuecillos north of Temascalapa. Cuecillos is an enormous site with at least a dozen major structures. One of the best samples of the Atlatongo Phase was collected there. The site of Portesuelo also seems to have been of considerable size during the Toltec Period. It seems improbable, however, that the Toltec population was as large as the Aztec anywhere in the Basin of Mexico.

The documentary sources ascribe the fall of Tula to a series of droughts, internal troubles and invasions by barbarous tribes from the north. The historical traditions that refer to this period and the century following characterizes it as a period of turmoil, population displacements and migrations from the north. The invading groups are consistently described as barbarous, some, the Chichimec, are supposed to have been hunters and gatherers ignorant of agriculture.

In the mentioned publication Armillas essentially accepts this reconstruction of events but with reservations. He visualizes it as a movement of population from the northwest frontier in which the rapidly deteriorating meteorological conditions for agriculture forced sedentary but nonurban peoples to the south. In the Basin the succeeding Aztec Period seems to have been one of ecological conditions favorable for agriculture. He feels that there was therefore a substantial population movement back to the traditional heartland. With this brief statement of his views we will now pass on to a discussion of the succeeding period.

Aztec Period. One of the most difficult problems in Mesoamerican archaeology is evaluating the validity of the vast literature on the mass population movements that are supposed to have occurred subsequent to the fall of Tula. A number of different migrations are recorded each explaining the origin of one of the linguistic dialects found in the central plateau in 1519. The Aztecs or Mexica were the last to arrive. The impression is one of whole tribes on the march, all described as barbarous in comparison to the Toltec. As indicated previously, we are suspicious on general principle of such migration traditions. Practically all organized human groups record migration legends; they apparently satisfy a basic need of all men to explain their origins. Most Mesoamerican specialists do accept the accounts of population movements following the fall of Tula, and some have accepted those that refer to the origin of the Toltec. They have ascribed the collapse of Classic civilization and postulated subsequent major changes in culture in post-Classic times as a product of this population movement. Traits of post-Classic culture that are supposed to be innovations include: growing secularism and loss of the thorough religiosity of the Classic Period; increasing militarism with such new features as a militaristic ruling class, war symbolism in religion

and art; human sacrifices; imperialistic states and urbanism. The Classic, on the other hand, has been characterized as peaceful, theocratic, religiously oriented or focused and lacking urbanism. Most of this characterization was exaggerated anyway, but was based primarily on a comparison of Classic Maya with post-Classic Aztec culture.

There seems good reason to challenge this picture of Classic versus post-Classic cultural patterns, at least in Central Mexico. Some of the differences are simply those of emphasis and are the product of gradual evolutionary processes that developed over thousands of years. Some are regional traits, for example, urbanism began as early as the Late Formative Phase in the Basin of Mexico and never became entrenched in Yucatan even in post-Classic times. Finally, the collapse of Classic civilizations occurred in different areas in different times. The collapse was as early as the seventh-eighth century in the Basin of Mexico, did not occur until the tenth century in the Peten and at Tajin did not happen until the twelfth-thirteenth centuries.

We are especially dubious about the possibilities of empires being destroyed by hunters and gatherers. It is extremely improbable that this is demographically possible, and of course, there is the enormous logistic problem of feeding thousands of hunters and gatherers marching over great distances. Most of the sources bring them from northwestern Mexico. One would have to assume that nearly all of the hunting and gathering population of northern Mexico somehow were able to gather together and traverse 500-1000 miles of territory to provide the enormous manpower needed to challenge a territorial state like that of Tula.

Of course, arguments against or for mass population movements must in the long run depend on substantial archaeological evidence. We have argued strong continuities in local population, based on ceramics throughout the archaeological sequence. Aztec ceramics can be derived easily out of the Mazapan or Cholulteca traditions with no need to involve mass population movements to explain the changes. In fact, Aztec ceramics generally seem to have ties southeastward to Chalco and Cholula rather than with the northwest! Needless to say, there is no evidence of campsites of hunting and gathering Chichimecs that date from this horizon.

We do not insist, however, that migrations did not occur in Mesoamerican history. We are simply arguing that when they did occur, they must have been the product of an unusual set of circumstances and that they were rare events. Therefore, methodologically, the archaeologist would utilize this explanation of culture change as a last resort. Armillas' arguments do sound convincing, and it is probable that a serious deterioration of climate in northwestern Mexico did result in a dislocation of population southeastward that resulted in local movement, not of hunters and gatherers, however, but of frontier cultivators into the Basin of Mexico. We doubt that the specific source of the invaders was further afield than, say, Queretaro or Guanajuato, possibly they came no further than from Hidalgo. The area of the modern state of Hidalgo would seem to be the most likely candidate. It is today and probably always has been an ecological pressure area. Topographically, it is characterized by tiny valleys and large areas of agriculturally marginal hilly terrain. The rainfall ranges from 300-600 mms. and is generally insufficient for maize cultivation. Yet the state had a relatively dense population in the sixteenth century and

does today (approximately half a million). The population then and now consists of a great number of small semi-isolated population clusters practicing intensive agriculture in the valley bottoms.

The combination of relatively unfavorable climatic conditions, intensive agriculture, and critical historical variations in rainfall would tend to produce a highly unstable ecological system. Its proximity to the richer and more stable areas and relatively dense population must have produced a most unstable and dangerous political frontier for the ecologically more entrenched population on the central plateau. In the post-Conquest ecclesiastic documents there is even mention of bands of Chichimec hunters and gatherers in the hilly areas apparently living in economically symbiotic relationship to the valley villages. The greatly exaggerated role given the Chichimecs by the documentary sources in the destruction of Tula would therefore be explained if bands of Chichimec accompanied the sedentary barbarians.

The striking increase of population in the Teotihuacan Valley between Mazapan and Aztec times may have been the product in part of incursions of these foreigners. On the other hand, the close correlation in location between Mazapan and Aztec sites argues in favor of local growth.

We have divided the Aztec Period in the Teotihuacan Valley into three definite phases called Zocango, Chimalpa and Teacalco. They correspond very closely to Vaillant's II-III-IV divisions and the Tenayuca-Tenochtitlan-Tlatelolco of Griffin and Espejo (1947, 1950). No definite Culhuacan or Aztec I occupation has been reported anywhere in the Teotihuacan Valley. In view of the fact that over 100 sites were intensively surveyed and sampled and another 100 revisited, this absence is certainly significant. It is probable that the Culhuacan complex was limited to the southern part of the Basin of Mexico.

One of the major contributions of the Teotihuacan Valley Project has been the collection of a great body of data on Aztec settlement patterns. The data show an extraordinary correspondence between modern and Aztec patterns on both zonal and community levels. With respect to zonal patterns, we see a close correlation of Aztec and modern population distribution of land forms, of variations in rural community density to variations in productivity of the various segments of the Valley, locations of political and economic centers and apparent distribution of population. There are also differences. The Aztec population distribution was more balanced with much more population in marginal areas such as the Upper Valley and northern flank. Presumably this relates to the Colonial and Republican Period deterioration of hillside and piedmont lands and the consequent retraction to and increasing reliance on the alluvial plain for cultivation. Secondly, in Aztec times there was a stronger tendency for centers to be located downvalley. Three towns were located in the Delta (Chiconautla, Tepexpan, and Tezoyuca), one in the Lower Valley (Acolman), one at the springs (Teotihuacan), and only one in the Upper Valley (Otumba). Today only one of the municipal centers is located in the Delta, one in the Lower Valley, one at the springs, one in the Middle Valley and two in the Upper Valley.

With respect to community patterns there are both similarities and differences between Aztec and modern patterns. The range of population density found in modern rural communities can be duplicated in the Aztec site sample. In both cases compact nucleated settlements occur in the Lower Valley-Delta area within and on the edge of the alluvial plain. Piedmont and

hillside communities both today and in Aztec times have much lighter densities with large houselots. True dispersed or rancheria patterns are very rare in both time periods. Somewhat of a methodological problem, however, exists in identifying an archaeological rancheria. The densities cited in the section on modern settlement patterns occur in areas of severely eroded land so that the population density of a rancheria in such a setting would be very low. If a productive system of irrigated terrace agriculture were present in Aztec times then archaeological site densities for rancherias might well exceed the modern several times. It is conceivable, under optimum conditions, that a piedmont rancheria achieved a density of 1000 people per km.². If we use modern densities it would be classified as a Scattered Village. Some of the piedmont sites southeast of Otumba may be classifiable as rancherias.

The form of Aztec rural settlements in the piedmont, of course, differs strikingly from the modern. Typical of Aztec rural settlement pattern is its extraordinarily subtle relationship to topographical variations. Almost every small hill, as well as continuous ranges like the Patlachique or large hills like Malinalco and Gordo have strip settlements paralleling or encircling them. Such linear settlements occur invariably in gently sloping land and wherever possible the settlement strip parallels deep soil plains on one side and steep slopes on the other. Such a pattern is, of course, one in close harmony with agricultural practices. Also apparent from the data is a sorting of houses along such strips into relatively discrete communities ranging from perhaps 10-60 houses. Many of these settlements are comparable in size to the Mazapan and Formative hamlets and were probably occupied by kin groups. We have suggested a correlation between these units and a unit called a *barrio pequeño* or *tequitano* in the sixteenth-century documentary sources.

The survey has also revealed data on Aztec urban communities. In the Teotihuacan Valley such communities were small, varying in size from 1000-8000 people and all probably had a settlement density comparable to the modern compound town of San Juan Teotihuacan with wards of varying levels of urbanization and nucleation of settlement. Each had a large civic center, a densely settled, highly urbanized core and attached settlement with a lighter, more dispersed settlement pattern. Evidence was found of social differentiation in the form of variation of house types and of economic specialization. Each was the center of a small state that had an average population of perhaps 20,000 people. All paid tribute to Texcoco. Evidence from both documentary and archaeological sources demonstrates that the population in the Valley in 1519 was extraordinarily dense. All indications are that the Aztec population was as heavy as the Early Classic. This is surprising since the Valley was politically marginal to other areas of the Basin at this time, whereas it was the center in Early Classic times. Land use was extraordinarily intensive and such techniques as floodwater and spring irrigation and terracing were highly developed.

Along with evidence of specialization in the towns, there is good archaeological evidence of rural community specialization similar to that found in Highland Guatemala and Mexico today including at least salt-making, obsidian quarrying, and obsidian processing.

The abundance of civic architecture, even in small sites, contrasts strikingly with the poverty of the preceding Mazapan Phase. Several hundred civic buildings, including pyramid temples and multiroom house-like

structures were found, and the survey undoubtedly missed some sites, especially hilltop ceremonial complexes. It should be noted also that destruction, especially of town sites has been heavy and numerous civic buildings have been destroyed by zealous priests as the product of recent urbanization.

The Teotihuacan Valley was politically marginal to other areas of the Basin of Mexico during this period. Although detailed settlement pattern data are lacking, published studies, sixteenth-century documentary data, and our brief surveys demonstrate that the Basin of Mexico was everywhere at least as densely populated as the Teotihuacan Valley. The maximal population of the Basin as a whole was certainly achieved at this time. If our reconstruction of climatic cycling is correct, it was a period of optimum conditions for intensive agriculture. It was also the period of optimum use of geographical resources. Probably for the first time intensive agriculture was practiced in the entire Basin. There were at least two, possibly three major foci of population. The two definite centers were located on opposite sides of Lake Texcoco, each focused on a large city. The dual community of Tenochtitlan-Tlatelolco was situated within the lake and was surrounded by chinampas. Causeways connected it to a cluster of large lake shore towns, Tepeyacac, Tlacopan, Azcapotzalco, Coyoacan, Mexicaltzingo, Huitzilopochco and Ixtapalapan. In a study made by the author the various documentary sources that provide population figures for this cluster show a probable population of 100,000-150,000. A literal use of the estimate of some of the Spanish Conquistadores would provide a figure closer to 500,000. The arguments against this higher figure will be presented in the final report.

Texcoco on the other side of the lake was surrounded by a similar cluster of satellite communities, towns like Coatlichan, Huexotla, Atenco, and Chiautla plus dependent rural settlements. Some sources state that the Texcoco plain was so thickly settled that it looked like one large settlement. Including all of the dependent rural settlements, the cluster here may have been as large as that of Tenochtitlan-Tlatelolco. The third would be the complex of settlements in the chinampa area centered on Xochimilco. In contrast, there is evidence of only one comparable demographic concentration for the Early Classic Period.

To a great extent the extraordinary population growth around Xochimilco and Tenochtitlan was the product of the evolution of chinampa agriculture. Based upon archaeological data and colonial maps and documents, it is probable that 15,000 hectares of lake bottom were converted to the most productive agricultural land in Mesoamerica (Sanders, 1956). The demographic capacity of this area was enormous. It could have provided sufficient surplus food for the entire population cluster near the Aztec capital. The ultimate dominance of Tenochtitlan over Texcoco in part was probably derived from the control of this valuable economic resource. It is conceivable, as Coe argues, that chinampa agriculture began in the Early Classic Period, but we think it more probable that it developed in post-Classic times. If the rather scanty data on the size of the Early Classic population can be relied on, there would seem to have been insufficient demographic pressure to have stimulated the enormous outlay of time and labor that chinampa agriculture demands. The expansion of this type of agriculture plus more extensive application of terracing probably made the extraordinary population and urban growth of the Aztec Period possible.

Urbanization was a distinctive trait of Aztec culture. Tenochtitlan itself may have been more urban, in the sense of a lesser dependence of its population on agriculture, than Teotihuacan. Its agricultural hinterland, to judge from Spanish statements and the distribution of nearby settlements, was limited to the chinampas within and around the city. The famous Maguey Map (see Toussaint, et. al., 1938) shows a settlement pattern on the northern periphery of houses distributed on chinampas, but each holding is so small that it could not have provided more than one-fourth of the food supply of a family. The Teotihuacan Valley during the Aztec Period seems especially marginal in this trait of urbanism. Even small urban communities elsewhere in the Basin such as Coatlichan and Huexotla near Texcoco are much more impressive than Acolman or Chiconautla.

Conclusions

The Ecological Approach.

In the introduction we briefly discussed the ecological approach which in this concluding section we will attempt to apply to the body of data derived from the Teotihuacan Valley Project. The basic ideas presented in the introduction may be briefly summarized:

1. The culture of a given people can be considered essentially as a complex of adaptive techniques to the problems of survival in a particular geographical region. Human cultural evolution generally is a superorganic process that grew out of organic evolution. The culture of man is, in a sense, a means by which humans successfully compete with other animals and with plants. The product of most plant and animal evolution is more effective utilization of the landscape in competition with other plants and animals. This effectivity is usually expressed in population growth, and population density is a measure of such success in a given area at any given point in time.

2. There are varying but limited numbers of possibilities in the way in which a people may adapt to a given environment. It is in part for this reason that groups with quite distinctive cultures may occupy the same or similar environments.

3. The adaptation of a group to its environment is achieved primarily by technological and subsistence techniques, but may involve economic, social, or even ideational processes. Social organization as a whole is really an adaptive system since organized humans can always exploit their landscape more efficiently than isolated ones can.

Other aspects of culture such as religious beliefs and practices have as a primary function the integration of the social group. If this argument is correct, then all aspects of a culture have adaptive significance.

4. The level of technology and the degree of productivity of the subsistence pattern of a group affects the degree to which variation in response in the other aspects of culture is possible. Some geographical environments with a given level of technology are inherently less productive than others. This factor limits population growth, which in turn restricts the variability of response in other aspects of culture.

5. The physical environment therefore plays a restrictive, permissive, and, in the sense that it limits choice, a directive role in the evolution of a cultural system. The physical environment itself can, of course, be modified by the cultural system. The model presented in the introduction

of an ecological system composed of three semiautonomous subsystems--culture, biota, and physical environment--was designed to facilitate and clarify this interactive process. Each of these subsystems functions on the basis of discrete and separate processes; hence it is perhaps more convenient to conceive of them as systems in interaction rather than as subsystems.

6. The interaction between these three systems is one of the dominant stimuli that produces changes in the cultural system.

We believe that this approach will resolve one of the most difficult problems approached by cultural historians--the origin and growth of the type of cultural system we are calling civilization. In the definition of civilization given in the introduction, attention was focused on social and economic characteristics. Civilization was defined as a large social system with intense socioeconomic differentiation of statuses. In analysis of the evolution of such systems we began with a number of premises about their nature. First, they are expensive in term of the restriction of the social and economic behavior of individuals and small local groups. Perhaps this fact explains the relative rarity of the historic development of individual civilizations. We might argue that civilizations evolve under a special set of circumstances that not only permit but also select for their appearance. In primitive societies lateral kinship extensions integrate community and supracommunity aggregations into relatively small social systems. In civilizations the integrative processes are hierarchial rather than lateral, based on a well-defined pattern of differentiation of individual, subcommunity, community, and supracommunity statuses and roles. The local community is no longer an economically and socially autonomous unit but rather a socially defined division of a large complex system involving other communities of equal, superior, or inferior status. Such large systems are characterized by formal techniques of social control and formally defined authority positions. In other words, there is a state, the size and degree of integration of the state depending to a great extent upon the efficiency of transportation and communication. The simpler the transportation and communication system the greater the limitation on the size of the physical territory controlled. This means that there was a premium on intensive agriculture in culture areas like Mesoamerica, since the large population required for the evolution of a civilization must be distributed within a relatively small area for effective socioeconomic integration. Theoretically, the more technically advanced the communication and transportation system, the larger the territory may be. This point should be qualified somewhat, however, since there are cases where an extraordinarily effective political organization made the integration of a huge territory possible by using very simple techniques. An excellent example of this exceptional situation is that of the Inca Empire with its chasqui messenger system based on human runners and paved highway systems.

The essential task of the culture historian with respect to the problem of the growth of civilizations is to define the processes that resulted in the transformation of a small, homogenous social system into a large heterogenous one. In the case of Mesoamerica we are emphasizing the ecological approach because the process does seem to have been a local one evolving out of local needs and responses. To clarify further, large social systems are integrated by a set of specific techniques of organization and social control (the state) and once evolved and perfected seem to have considerable advantage and impressive vitality in a competitive

situation to small social systems. These techniques may be introduced into new areas by forcibly incorporating the local population into these big societies. Of course, even in such cases the process of incorporation of the local population can still be analyzed as a local process--in a sense, this is what acculturation studies attempt to do. It is conceivable that a migrant group with a social system of the civilization type settles in an area with geographical characteristics so alien that new adaptive adjustments are necessary. These adaptive adjustments may require an entirely new configuration of the original social system. Finally, a group living in the frontier of a highly developed civilization may, for defensive reasons, be stimulated into adapting a few of the basic techniques necessary in organizing large groups of people (for example, the hierarchial principle), but the evolution of their particular system may be almost entirely a local process and the result, a unique form of civilization.

The process in the Teotihuacan Valley seems to have been essentially of the latter type. Therefore, it was to a great degree a local process growing out of local needs and adaptive responses to the peculiar physical environment of the Valley. Furthermore, the stimulus of the particular environment was met with a response so vigorous and unique that it had repercussions all over Mesoamerica.

Some areas of Mesoamerica, therefore, became civilized as the product of local processes alone, others by means of local and extra-local processes together. In a sense we are simply restating Toynbee's Challenge and Response theory in which he makes the distinction between physical environmental and social environmental challenges. The culture history of the Teotihuacan Valley is a case of both types of challenges operating interdependently--that of a peculiar environment and that of established older civilizations to the south.

Hydraulic Agriculture.

We believe two primary characteristics of the ecological system of the Central Mexican area in 1519 were the primary stimuli toward the evolution of civilization in that area, hydraulic agriculture and economic symbiosis.

The hydraulic agriculture hypothesis involves several basic points. They are stated as follows:

1. We stated that the nonmaterial characteristics of a civilized population are the presence of large numbers of food producing specialists, economic, political and religious, and organization on a large scale. Since these specialists must be supported by the surplus productions of others, a productive agricultural economy is a requirement. The fact that agricultural and transportation technologies of Mesoamerica were primitive placed a premium on intensive patterns of land use. A very dense population concentrated into a relatively small area would be ideal. The less dense the population, the larger the territory and the greater the strain on socioeconomic integration. Irrigation, terracing, and chinampa agriculture provided precisely that type of subsistence base.

2. In irrigation agriculture, primary and secondary canals must be excavated and cleaned annually by cooperative labor; the larger the system, the greater the size of the organized labor force must be. This cooperative labor must be planned and organized. Theoretically, this can be done by decentralized and relatively informal arrangements among groups of politically autonomous or at least nonhierarchial units; but it is much more

effective when there is a state-like social structure. The larger the system, the greater the necessity that formal patterns of authority be established.

Some irrigation cooperatives are based on local water sources so small that they are of subcommunity or community size. Since they are small, the same informal patterns of control and group organizations that are effective in small nonhydraulic societies work well. When a large number of social and physically discrete settlements are involved, especially when the pattern is one of intensive agriculture in areas of severely limited land and water resources, conflicts arise which require or stimulate more formal patterns of delegation of authority. There is, therefore, considerable variation in the social aspects of irrigation agriculture. The crucial variable seems to be the size of the land dependent on a single integrated system and the proportion and economic significance of irrigated to nonirrigated land used by the cooperative.

3. Aside from the organizational requirement of cooperative labor and maintenance, cooperation is also necessary in the regulation of water distribution. Some arrangement is necessary whereby each farmer and each community receives water. Again, this may or may not be accomplished by centralization of authority, but such centralization is undoubtedly the most efficient solution. One of the most common sources of conflict among modern communities in the Valley of Teotihuacan is over the water allotment. In the Valley, it should be emphasized, the supply of water is less than that of land. When a system of centralized authority for water allocation is established, then hydraulic agriculture provides that authority with an extraordinarily effective weapon against recalcitrant peasants or communities--the withholding of water. The result can be a very despotic political system.

We have previously stated that agriculture may play both an economic role (essentially a permissive role, i.e., that of productivity) or a social role (in the sense that cooperation on a supracommunity scale is required) in the evolution of civilization. Chinampa and terrace cultivation involve only the economic role. Neither normally requires large cooperative undertakings for success. They may involve such cooperation (examples are state-organized terrace construction in Peru, state-constructed dikes in the Lake Xochimilco-Chalco to control chinampa flooding), but such high levels of cooperation are usually undertaken when the development both of the agricultural technique and state has already achieved a high level of maturity. Irrigation is the only agricultural technique of the three that has even in its formative development in an area both economic and social effects in the development of civilization.

The most elaborate presentation of the above theoretical construct is undoubtedly that of Wittfogel in his book *Oriental Despotism* (1957). His ideas are summarized more compactly in his 1955 paper and the following is a distillation of this paper.

1. Wittfogel uses the term "hydraulic agriculture" for a system of agriculture that is based on large scale, government-directed water control and construction of water works. He calls societies that possess such works whose social evolution is functionally correlated with their construction, and who have "inordinately strong governments" "hydraulic societies". Such societies are centered around the state; there are no other institutions capable of competing with the state.

2. The basic institutional features of hydraulic societies were control of private property, monolithic bureaucracy, incorporation of church with state, and the extraordinary role of the state as an entrepreneur of public works, especially hydraulic.

3. Not all hydraulic societies were equally evolved in the characteristics listed above. As Wittfogel puts it, they vary in "hydraulic and managerial density." He correlates these variations with the degree of significance of irrigated versus nonirrigated land in the economy of the particular group. The term "Compact Hydraulic Society" refers to situations when all cultivated land is irrigated and all land holders are therefore under the control of the state. "Loose Hydraulic Societies" are those where there is a sizable amount of nonirrigated land. He also uses the term "Marginal Hydraulic Society" for cases in which irrigation is lacking but where the societal characteristics are present as the product of introduction of such techniques from a hydraulic society.

4. With respect to the evolution of hydraulic society, he postulated several basic stages. The first stage involves a large number of separate community irrigation systems. The pueblos of the American southwest are cited as an example of this developmental stage.

The second stage involves the evolution of a "hydraulic region". This is a relatively large area with a single, integrated, irrigation system controlled by a dominant community. If such a stage occurs in a desert area, then a Compact Hydraulic Society evolves; if there is rainfall and a considerable amount of nonirrigated land, a Loose Hydraulic Society evolves. He also suggests that in areas like the Near East Loose Hydraulic Societies may have preceded Compact Hydraulic Societies in the nearby mountain areas and that irrigation was introduced into Mesopotamia by a Loose Hydraulic Society. Its managerial density, he suggests, increased as it adapted to the desert conditions. He postulated a final stage when the Compact Hydraulic State establishes hegemony over nonhydraulic or Loose Hydraulic Societies in supraregional empires. In this stage there is a decline in the density of the hydraulic bureaucracy and the overall society becomes a Loose Hydraulic Society. This is the product of two processes: the incorporation of land not served by the hydraulic system and therefore not subject to the same controls, property holding becomes more complex with private land holding as well as community and state; increasing importance of craft specialization and trade as the limits of the potential of wealth based on irrigation agriculture is reached. This type of society he calls "Semi-Complex Hydraulic Society," not Complex, because the state is still the supreme economic power and is involved in the new sources of wealth.

Few attempts were made to discuss the role of irrigation in the evolution of Mesoamerican civilization until Armillas published his 1947 paper "Notas Sobre los Sistemas de Cultivo en Mesoamerica." Prior to this, Spinden, in 1928, suggested but did not elaborate on the probability of the role of irrigation in the beginning of Mesoamerican civilization.

As a result of stimulus from Armillas, a theoretical school has developed in recent years and several people have written extensively on the subject. Aside from Armillas and West and Armillas (1950), Palerm (1961), Millon (1954, 1957), Wolf (1959), Schilling (1939), and the present author (1956) have all stressed the importance of hydraulic agriculture in the evolution of the civilization of the Central Mexican area. Most of this research has involved analyses of documentary references to Aztec Period

irrigation and archaeological identification of Aztec systems. These studies have demonstrated conclusively the economic and integrative role of irrigation in the central plateau for that period and have focused attention on the role of the Aztec Period states as entrepreneurs of hydraulic works. Based on the relative amounts of irrigated versus nonirrigated land, a Loose Hydraulic Society certainly existed in the area in 1519.

The major problem has been archaeological, that of establishing the antiquity of irrigation and of hydraulic society and their role in the genesis and growth of Mesoamerican civilization as a whole. It is theoretically possible that hydraulic agriculture began in Aztec times and that the civilizations of Teotihuacan, Tula, Xochicalco, and pre-Aztec Cholula were not based on hydraulic agriculture. We feel, however, that this is highly improbable. Of course, even if it could be demonstrated that irrigation agriculture developed contemporaneously with the earliest civilization in the area, there still remains the difficult problem of evaluating in an archaeological setting the cause-effect relationship between hydraulic agriculture and civilization.

Millon has recently (1962 and 1962) published two papers in an attempt to qualify the absoluteness of theoretical assumptions of the interaction between irrigation and centralized political systems. In one of his papers "Variations in Response to the Practice of Irrigation Agriculture," he evaluates the degree of correlation between small irrigation systems and centralized authority. The method was essentially comparative and synchronic. Seven small contemporary irrigation systems from East Africa, Ceylon, Japan, Bali, Iraq, Arabia and Mexico (the Teotihuacan System) are compared and the following conclusions reached:

1. The use of irrigation by a community or group of communities clearly introduces a special factor in social interaction. This factor has potentially both integrative and disruptive functions. The operation of the system requires cooperation but may produce conflicts, especially in those situations where the water supply is less than that of irrigable land or vice versa.

2. A variety of arrangements is possible in the management of small irrigation systems.

3. No absolute relationship exists between the size of a small irrigation system and the degree of centralization of authority in the use of it.

The focus was upon small systems because Millon has been concerned in his research with the role of irrigation in Central Mexico culture history and all of the systems in that area may be classified--in his terms--as "small".

His conclusions are undoubtedly valid as far as they go, but there are a number of methodological problems and implicit assumptions in this study that, I believe, are open to serious argument and question.

Although I am sure that Millon did not intentionally convey this impression, nevertheless, there is the implicit assumption in his reasoning that ecological adaptation is static. Obviously, if one conducts a purely synchronic study such as this one, there is always the problem of time and the level of effectivity of adaptation of a people to an area. For example, the El Shabana of Iraq, one of his sample groups, were apparently recent immigrants into the area and were formerly pastoralists! The evolution of

any ecological system requires time, and as we stated previously, a particular group may not necessarily select the most effective solution to an ecological problem. Our argument is that over a long period of time the practice of irrigation presents certain problems and stimuli and that there is a strong selectivity in the same sense as biological natural selection, in favor of centralized control. The overall history of Iraq certainly justifies this assumption.

A second assumption is that a local group with an irrigation system organized along essentially traditional lines is free to work out the problems of conflict and cooperation. In all the cases cited by Millon the irrigation cooperative was a unit within a larger national political and social system. He cites cases in both Japan and the Teotihuacan Valley where federal troops intervened in conflict situations to prevent physical combat between communities. As we shall argue later, conflict is probably one of the major stimuli to the evolution of centralized control in the history of irrigation systems.

Several of the examples used--the Sonjo of East Africa, Pil Eliya in Ceylon, and the Nahid in Arabia involve social groups so small (in the case of the first two, single communities) that traditional kin ties would be sufficient to integrate the society regardless of the absence or presence of irrigation. The same really applies to Bali. The individual cooperatives do crosscut village lines but do not involve more than 3,000-4,000 farmers each. In his study the only two samples that are really comparable in that they are both relatively large supracommunity systems and do have a respectable antiquity are the cases of a group of twelve villages in Japan and the Teotihuacan Valley system involving sixteen villages. The later is centralized, the former is not. It is interesting to note that in both cases the national government had to intervene to prevent warfare over water rights!

In his second paper "Conflict in the Modern Teotihuacan Irrigation System" Millon elaborates on the disruptive effects of an irrigation system with insufficient water to supply the available irrigable land. He stresses conflict between upstream and downstream cultivators (over theft of water by upstream communities); the right of Atlatongo to a permanent supply of water from the San José Canal; between ejidatarios and propietarios pequeños; and between users of the San José and San Antonio Canals (both canals derive their water from a single source).

It is our theoretical position that it is precisely conflict that stimulates the selective process for centralization of authority--the more severe the conflict, the greater the need for and probable evolution of centralized control. One of the significant facts that emerges from his discussion in the 1962 paper is that such systems do not work effectively unless there is a highly centralized authority. We are not arguing that other arrangements are not possible or workable, but simply that there is a functional relationship between centralized power and relatively large irrigation systems, that the former is an effective solution to the problem of the operation of the latter. If population growth is one of the major achievements of the evolution of ecological systems, then the development of centralized control of irrigation systems can be readily understood. It controls conflict within the cooperative, permits a more efficient use of water and land and provides the cooperative with an economic and organizational advantage in conflict with groups external to the system.

Adams, in three recent papers, "The Origin of Cities" (1960a), "Early Civilizations, Subsistence and Environment" (1960b), and "A Synopsis of the Historical Demography and Ecology of the Diyala River Basin, Central Iraq" (1962), has also challenged the functional relationships between irrigation and warfare, on one hand, and the rise of cities in Mesopotamia on the other. His major method criticism is based upon the sequence of events as reflected by archaeological data from Mesopotamia. Most writers on Mesopotamia history (see Childe, 1954 and Frankfort, 1951) have been convinced of the economic and integrative role of irrigation on the evolution of Mesopotamian states. They have also argued that the history of Mesopotamia is one of coalescence of small nucleated centers into large ones as the product of wars fought over land and water resources. The growth of large centers and of states in Mesopotamia were apparently correlative processes so that the term city state is frequently applied to the Sumerian states. Adams major criticism is based on the following considerations:

1. In Late Predynastic and Sumerian times the population of Mesopotamia consisted of a series of town or cities each with its own independent irrigation system (although all were based on the two major rivers). Each town or city was surrounded by a zone of irrigated land and each such zone was separated from others by unimproved desert.

2. The integration of these local irrigation systems into a single master system did not occur until Iron Age times.

3. Therefore, he argues, states predate large integrated irrigation systems. Furthermore, since states were present at a time when there was an abundance of land and water, competition over such resources could not have been a major factor in their growth.

We find his arguments unconvincing for several reasons. In the first place, the small independent system that characterized the Sumerian states was as large and in some cases larger than the Aztec and Modern Teotihuacan Valley irrigation system. We feel that such systems were individually large enough to have played an integrative role in the growth of the state. In his 1962 study Adams shows in detail a history of gradual nucleation of villages into towns and towns into cities linked with the development of the aforementioned local systems. In other words, we see the city state itself as the significant irrigation cooperative, not all of Mesopotamia. The evolution of supersystems involving large areas of the Mesopotamian plain is simply the end product of a process that began on a local level. The sequence of events in Mesopotamia of growth of society of village to town to city to regional state in reality is a striking demonstration of the interaction between hydraulic agriculture and large societies.

With respect to the warfare hypothesis, Adams admits the importance of the role of warfare in the social evolution of Mesopotamia. If they were not fighting over land and water, what were they fighting over? Mesopotamia tax records seem to point clearly to economic motivation in war. We feel that the error here is in assuming that war over land and water means war over unimproved desert and uncontrolled rivers. In reality an irrigation system represents an enormous investment in labor. In the setting of ancient Sumeria when the population of a city state outgrew its irrigated zone, the state was faced with two alternatives--expansion of the system or conquest of neighboring states and regularized exploitation of their established irrigation system by means of tribute. The latter is actually a more economic response. The conflict was therefore over canal systems and improved land.

Symbiosis.

We are calling the second ecological process in the evolution of Central Mexican civilization symbiosis. As visualized from the broad evolutionary picture, the primary function of the hydraulic process is to improve subsistence; the primary function of the symbiotic process is the procurement of raw materials and finished technology although subsistence is directly or indirectly involved. By symbiosis we refer to the economic interdependence of social and physical population units in a given region. In a broad sense symbiosis is characteristic of all human social interaction. The family as a social group is essentially an economic partnership with sexual and age divisions of labor. No human community has probably ever been completely self-sufficient. Economic specialization in this broad sense and a system of exchange of services and goods characterizes all human societies. What particularly characterizes civilization is the degree of intensity of such specialization and exchange. Also, there seems to be a correlation between population density and the degree of symbiosis. Darwin in 1859 noted that even in plants and infrahuman animals there is a marked increase of specialization as the density of living creatures increases in a given area. Later the sociologist Durkheim (1933) applied this principle to humans and discussed the relationship between symbiosis and population density. The denser the population the greater the competition over the prime resource, agricultural land, and the greater the stimulus toward agricultural or nonagricultural specialization. Intensive agriculture in small, artificially productive areas such as the core lands of hydraulic societies is perhaps one of the most powerful stimuli to such specialization. This process works in several ways. Some crops are basic foodstuffs (e.g., maize), others are highly prized but consumed in small quantities (e.g., chile peppers); some are demanding as to soil and water requirements (maize), others as to temperature (tomatoes); and other crops are tolerant of a greater variety of conditions. The solution is agricultural specialization and particular farmers may grow only particular crops. Intensive agriculture in contrast to extensive cultivation produces shortages even in basic raw materials for peasant technology. For example, villagers in the lower parts of the Basin of Mexico must purchase all of their wood technology, in some cases even firewood, since the natural vegetation has been completely destroyed by agricultural activities. On the Gulf Coast, on the other hand, where slash and burn cultivation with its succession of cultivated fields and forest in various stages of regrowth is practiced, each farmer has such raw materials in his holding.

In the case of the Central Mexican Symbiotic Region the stimulus is further increased by the mountainous terrain. The combination of tropical latitude and a great altitudinal range have provided an extraordinary variety of environments each with specific resources and each presenting somewhat different problems to primitive cultivation. This variability is based on the behavior of frosts, temperature, rainfall, vegetation, absence or presence of lakes, and topography. The microgeographical zoning is extraordinarily intense and must have acted as a powerful stimulus to local specialization in trade and the establishment of stable symbiotic patterns, particularly when combined with stable demographic growth and increasingly more intense methods of land use that the archaeological data suggest.

Ecological History of the Teotihuacan Valley.

Applying the broad principles discussed above, the history of the ecological system of the Teotihuacan Valley subsequent to the introduction of agriculture may be summarized in three basic stages: Marginal, Nuclear, and Sub-Nuclear. Before discussing this history, however, we will first outline the most significant ecological characteristics of human utilization of the area.

1. Agriculture without irrigation or terracing is possible in the Valley. The level of productivity without the use of such techniques is low, however, because of the irregularity of rainfall, presence of frosts, and problems of soil erosion. A relatively small population could live in the Valley with an economy based on extensive agriculture by cultivation of relatively large plots of land. By this means a surplus could be produced in good years to make up the deficiencies in poor years. In the earlier phases of agricultural evolution the practice of extensive cultivation would be more productive even than today since the wetter, relatively frost-free slopes could be utilized. Furthermore, with a small population agriculture could have been confined to the hilly flanks of the Valley, leaving the plain available for hunting and gathering. As the population increased, the combination of soil erosion and depletion of wild food resources would, however, result in an increasingly unstable subsistence pattern.

2. Irrigation and terracing result in an extraordinary increase of productivity and provide a much more stable subsistence system. The irrigated alluvial plain area is a key agricultural resource that has become increasingly significant in the history of the Valley--especially during phases of drier climatic conditions or intensive erosion.

3. The water for the permanent irrigation system derives from 80 springs, all located within a very small area (20 hectares). This was the most significant, single, ecological resource. Irrigation water in the Middle and Upper Valley, on the contrary, derives from multiple independent sources.

4. Although the supply of water from the springs has undoubtedly fluctuated in the past, it has probably always been far below the supply of irrigable land. Chronic water shortage, therefore, has been a major ecological problem. The possibility of rainfall agriculture actually aggravates the problem since it permits further population growth while, at the same time, the striking contrast in productivity between rainfall and irrigation agriculture stimulates continuous conflicts over the use of the water from the springs.

5. Even when taking the small size of the Valley into consideration, such factors as the location of specific resources and variations of topography and hydrography have produced significant microgeographical variations that have had a striking effect on the socioeconomic evolution of the population. Contrasts may be pointed out among the upper, middle, and lower sectors of the Valley and among the plain, piedmont, and hillside segments of each sector.

6. The Valley is part of a larger natural unit, the Basin of Mexico. This larger area is a topographical and hydrographical unit within which movement of people and goods was intensive and greatly facilitated by the lakes. This larger unit is also characterized by greater extremes of microgeographical variation than the Valley.

With this brief outline of the most significant characteristics of the Valley, we will now discuss the three basic stages of its ecological evolution.

Marginal Stage. By marginal we refer to a number of characteristics of the ecological system: small population, absence of large socioeconomic groupings and little or no influence of the two dominant ecological processes, hydraulic agriculture and economic symbiosis. Archaeologically, it includes the phases from Altica through Tezoyuca-Patlachique. The data pertaining to the Altica Phase present a picture of a very small initial population, practicing tlacolol cultivation on the southern flanks. This population was distributed in small socioeconomically autonomous communities, each probably composed of a lineage. The distribution suggests only slight development of economic symbiosis since all of the communities are located in geographically similar areas. The demographic history during the succeeding Chiconautla and Cuanalan Phases is essentially one of gradual growth and multiplication of the numbers of such population units, the colonization of the northern flank of the Valley without major changes in social structure, and little development of economic symbiosis between units. Apparently, however, there was enough demographic pressure to stimulate some experimentation with agriculture in the alluvial plain during the Cuanalan Phase and there may have been an incipient development of hydraulic agriculture and plain to hillside symbiosis. The greater productivity of the plain even in this early phase is evident when one compares the size of the village site at TF 38 with contemporary hamlets in the hilly flank areas.

In view of this experimentation the ecological system of the succeeding Tezoyuca-Patlachique Phase remains a puzzle. Why should the population have abandoned occupation of the plain and reverted completely to a hillside preference? Assuming that our interpretation of the interrelationships between Tezoyuca and Patlachique is correct, the data might be interpreted in two different ways:

1. The string of Tezoyuca complex sites along the edge of the plain were occupied by cultivators using the alluvial plain below. The rather inconvenient hilltop location as opposed to location within or on the fringe of the plain might have been defensive in purpose. We have previously cited evidence of warfare. One might interpret the situation in terms of a number of small warring states competing for the control of the plain. Following this interpretation, the Tezoyuca sites were the centers of such states and were tiny towns with populations of rulers, part-time farmers, and craftsmen. The rest of the population (Patlachique Phase sites) resided in dependent hamlets and practiced tlacolol cultivation in the hilly flank.

2. The plain was temporarily abandoned for cultivation and the Tezoyuca sites were ceremonial centers, possibly small towns that drew their economic support entirely from hillside cultivation.

In either case the pattern could be interpreted as an experimental reaction to the increasingly drier conditions that reached a climax in the succeeding phase. As the drier conditions prevailed the crisis could have been met by extension of hydraulic agriculture in the plain or a retreat to hillside cultivation. At any rate, religious architecture first appeared in the Valley at this time and some type of supracommunity religious institution was certainly present. If our reconstruction of geographical history

and agricultural patterns is correct, the phase must have been one of considerable ecological stress. The population was of respectable size; hillside erosion must have accelerated enormously, and with the increasingly drier conditions, all of these factors must have presented serious problems of adaptation. Either of the two suggested responses was possible; the first in terms of subsequent events would have been a more creative one, the second in the light of later developments would have to be considered an ecological detour.

Nuclear Stage. We are calling the second stage of ecological adjustment Nuclear. By this we refer to the fact that the Valley was the setting of a regional demographic and sociocultural center during this phase. In the Teotihuacan Valley the initiation of this stage (Tzacualli Phase) was correlated within striking changes in the relationship of people to their agricultural resources. There was a population explosion, a shift of agricultural activity to the piedmont and alluvial plain, and by the end of Tzacualli a shift of the majority of the population to a single physical community. We feel that these events are linked to the increasingly drier climatic conditions that stimulated a rapid expansion of hydraulic agriculture in the Lower Valley. During the succeeding Miccaotli Phase, this process of nucleation at a single center continued. There is even the possibility (definite conclusion must await the final analysis of the ceramic chronology) that the entire population resided at the city during the Miccaotli Phase. We relate the early growth of the city to the expansion of permanent irrigation. If our estimates of population growth are reasonable, perhaps 20,000-30,000 people resided at the city by the end of the Miccaotli Phase. The irrigated Lower Valley-Delta could have supported a population of that size. If the Middle Valley plain and piedmont were cultivated using terracing and floodwater irrigation, a considerable agricultural surplus could have been created for trade. Our picture of Teotihuacan society at this time is that of a socially stratified but primarily agricultural community, possibly ruled by a priesthood, with the land and water under the control of temple corporations. There undoubtedly were craftsmen, but we suspect that most of them were part-time and that everyone, excluding the top of the social pyramid, were farmers. The size of the city, degree of nucleation, relationship to land, and general social characteristics as we have understood them provide a picture of Teotihuacan society extraordinarily similar to the towns of Late Predynastic Mesopotamia. It is probable that the political and economic hegemony of Teotihuacan had not yet expanded beyond the Teotihuacan Valley. In the case of Teotihuacan the evolution of a large society with complex internal differentiation, like that of Sumeria, is distinctive in that physical nucleation accompanied the process of societal growth. It is perhaps this characteristic more than any other that has puzzled and intrigued scholars.

We believe that this process of nucleation in the early phase of Teotihuacan history can be understood in terms of the two functional aspects of irrigation agriculture--the economic and the social. The high productivity of hydraulic agriculture permits the growth of large communities even when their economic base is primarily agricultural. Many of the contemporary chinampa villages have populations in the thousands (Atlapulco has nearly 6000 people, yet it is an agricultural community and Xochmilco in 1910 when it was still almost entirely an agricultural community had a population of 15,000). The growth of Teotihuacan may then be understood as a

demographic process permitted by the productivity of hydraulic agriculture. It may also be understood as a social process, an unusually vigorous reaction to the integrative effects and needs of hydraulic agriculture. We have argued that centralized control is a more efficient way of managing a multicomunity irrigation system. Theoretically, and this is probably the most common solution, the population may reside in a great number of small physical communities subject to a single administrative center. In the history of Teotihuacan the process of social integration as in Mesopotamia was carried to extremes, and the population as well as the authority was centralized. This process of nucleation then may be considered as a social invention, an integrative technique. In Wittfogel's terms, Miccaotli Teotihuacan might be considered a Compact Hydraulic Society.

As the population of Teotihuacan continued to expand beyond the resources of both the alluvial plains and especially the permanently irrigated Lower Valley, new ecological pressures must have occurred. The response was multifaceted:

1. Increasing economic specialization and social differentiation in the center so that it became increasingly urban in character.
2. Rural population expansion in the form of planned villages and towns along the peripheries of the valleys.
3. Military conquest and systematic taxation of areas outside the Teotihuacan Valley.

The extraordinarily well-integrated Teotihuacan society plus its demographic strength would have given it obvious military advantages in competition with other states. The expansion of agriculture into areas not related to the irrigation system, development of trade and economic specialization, and increasing control over independent hydraulic systems and areas of nonhydraulic agriculture would all have a tendency to diffuse the "managerial density" and would result in a Semi-Complex Hydraulic Society, using Wittfogel's terminology. Toward the final phases of the history of Teotihuacan, the ecological system became overextended and must have become highly unstable since the ultimate population growth of the city depended on control of areas which were less well-integrated socially, located at considerable distances, and more importantly, which included states similar in character and growth processes to Teotihuacan itself.

Competition and conflict would have been an inevitable part of the socioeconomic pattern. In the final phase of the history the reactions to such external pressures seem to have been met by intensification of a well-established pattern--increasing nucleation--rather than a new solution. At the end perhaps 100,000 people were gathered together into a single center. Although this final phase of the process was probably a defensive measure, it would have put enormous strains on the ecological system and ultimately have made the city even more vulnerable to military conquest.

Sub-Nuclear Stage. The final or Sub-Nuclear stage was initiated in the Xometla Phase, reached its climatic development (as measured by population growth) in the Chimalpa-Teacalco Phases, and has continued to the present day. By Sub-Nuclear we refer to the fact that the major population centers of the region were located outside the Valley; but the fact that they were situated at relatively short distances means that the Teotihuacan Valley played vital economic and social roles in their growth and support.

The ecological system characteristic of the Valley at this time included the following primary characteristics:

1. Maximal population growth ever supported by local food resources alone, and in the Chimalpa-Teacalco Phases probable maximal population of any phase in the history of occupation of the Valley.

2. Distribution of the population in a great number of communities of varying size and status. The zonal distribution of population was characterized by a greater degree of balance with respect to the various ecological divisions of the Valley although the springs and the alluvial plain of the Lower Valley-Delta remained the foci of ecological power.

3. Organization of the population into small states each consisting of a central village or town and a great number of dependent rural settlements. Each state was politically dependent on centers of power outside the Valley but was a socioeconomic unit characterized by a high degree of economic symbiosis within the town and between towns and villages. The vehicles of such symbiosis were the taxation system and market. Within the Valley the various centers in the Aztec, Colonial, and Republican Phases, and probably of the Toltec Period as well were subject to informal and formal socioeconomic domination by those centers located in the area of the springs.

4. The towns of the Valley along with towns of similar size all over the Basin of Mexico were linked economically by a system of regional markets located in the centers of political control. The pyramid of markets coincided very closely with such centers of political control. Whether markets are causes or effects of political systems is really irrelevant; the importance lies in the functional interrelationships between them.

In both the Nuclear and Sub-Nuclear stages the population of the Valley was distributed into a great number of socially and economically differentiated units that participated in a complex web of symbiotic relationships. The major difference is that in the Nuclear stages most of these units in the Valley resided in a single physical community, whereas in the Sub-Nuclear stage they were dispersed. There are, of course, advantages to each pattern. The primary advantage of the Sub-Nuclear stage pattern was convenience to cultivation; the primary advantage of the Nuclear stage pattern was convenience of marketing. Since agriculture was a more basic activity, the Sub-Nuclear pattern might be evaluated as a more stable, qualitatively more effective adaptation.

Central Mexico in Mesoamerican Pre-History.

The Teotihuacan Valley Project, we feel, has provided a body of significant data on the factors and processes that led to civilization in Central Mexico and to the unique role that this area played in the cultural development of Mesoamerica as a whole. Distinctive traits of this area as contrasted to other cultural subareas are an unusually dense population, urbanism, and an aggressive expansionist personality (which took the form either of organized trade or conquest).

Lowland Maya civilization by contrast was nonurban, nonexpansive, inward oriented, and overly specialized in the area of religion. This is not to argue that religion was not an important focus in Central Mexico, but that it was only one of the facets of development in a multicentered culture.

All Pan Mexican states in the history of Mesoamerica were based in the central plateau, and the most extensive networks of trade were established by centers in that area. Trade and conquest were apparently the two primary vehicles by which the process of diffusion occurred within the Mesoamerican

area. The primary vehicle in the evolution of the Central Mexican variant of Mesoamerican civilization, we feel, was the highly integrated urban community, and the distribution and growth of such centers was based upon small areas of hydraulic agriculture. The advantages enjoyed by such centers in competition with other states seem to be demographic, economic, and social. No other population units of comparable size and degree of socioeconomic integration could be assembled to challenge them effectively.

Notes with Respect to the Maps

The Teotihuacan Valley maps were all drawn by Joseph Marino. A base map was prepared from a tracing of a 1:25,000 aerial mosaic (prepared by the Compañía Mexicana de Aerophotos). From this a set of maps, reduced to a scale of 1:50,000 (using a pantograph) were made and the sites plotted by phase or period. These maps were then reduced to page size and printed using a photo-offset technique. This reduction of scale was done to economize and does present problems of reading, especially with respect to the "occupational density key." This problem is particularly acute with respect to figs. 9, 10, and 11. In the 1:50,000 maps the house mounds were keyed using a large dark dot, the areas of "light occupational density" were shown as smaller and lighter dots. In the printed maps it is difficult to sort one from the other. In fig. 11 the dots in TA 9, 11, 12, 22, 88, 144, 145, 147, 156, 180, 202, and 203 all refer to occupational density, in the balance of the sites to house mounds. In fig. 2, 9, and 10 all dotted areas refer to occupational density.

In fig. 11 (Aztec Period) some of the sites have double numbers separated by dashes (eg. 170-16). the first number refers to the archaeological survey, the second to the list of communities on page 208. The list derives from the Relación de Tecciztlan and Arzobispado de Mexico. We believe we have successfully identified the archaeological remains of most of the communities in the Relación. The Cabeceras are indicated by name rather than number (eg. Acolman, Teotihuacan). In the case of the Otumba Area only a few sites were identifiable since the Arzobispado de Mexico Document lists only the saints name of each community and does not include an accompanying map. We have also plotted on the Aztec map (fig. 11) the approximate positions of roads and canals indicated on the map accompanying the Relación de Tecciztlan.

In some Aztec sites (eg. TA 56, 58) the border of the site is drawn but the interior space lacks a key. This indicates that erosion was so severe that house mounds were destroyed and it was impossible to accurately assess the occupational density.

In fig. 2 the name of the village of Atlatongo is missing. The reader is referred to fig. 10 for its location. On all maps the border of the Early Classic City is adapted from Millon (1964).

Fig. 1, A, B, and C were adapted from the maps in Gibson's 1964 study. Most of the site locations were taken from Piña Chan (1955), Vaillant (1944) and Tolstoy (1958).

Communities in the Valley of Teotihuacán 1570-1580

Data from Relacion de Tecciztlan

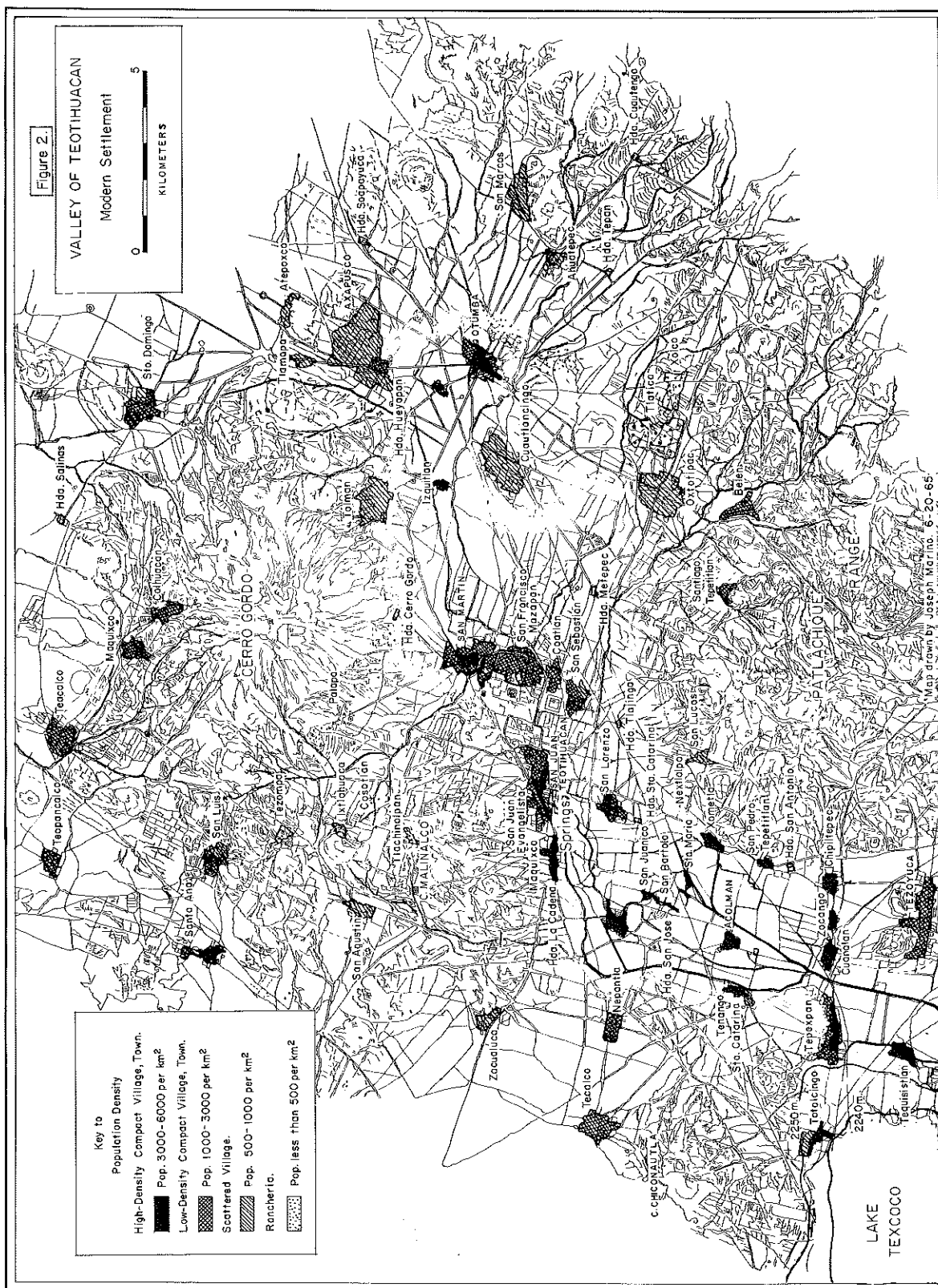
Dependent communities of Tepexpan	Archaeological Site No.
1. Santiago Zagualuca	220
2. San Miguel Atlamaxac	132
3. Santa Ana Tlachahualco	130
4. San Matheo Teopalcanco (Teopancalco)	119
5. San Francisco Temazcalapa	(Outside survey area)
6. San Pedro Tulamiguacan (Tulamihuacan)	129
7. San Xriptoual Culhuacazingo (Colhuacan)	115
8. Santa Maria Maquixco	45
9. San Jhoan Tlascalco (Teacalco)	217
10. San Bartolome Atocpan	(Outside survey area)
11. San Xeronimo Chiapa	"
12. Santa Maria Suchitepec	"
Dependent communities of Acolman	
13. San Pedro Tepetitlan	166
14. San Antonio Huiztonco	87
15. San Miguel Jometla (Xometla)	168
16. Santa Maria Tlatecpa	170
17. Santa Ana Atenpa	169
18. San Bartolome Quauhtlapeccho	171
19. San Juan Chicnahuatecapa	172
20. Santiago Atla (Atlatongo)	173
21. Tres Reyes Yzquitlan	219
22. San Augustin Aticpac	135
23. San Martin Tonalá	134
24. San Niculas Tenextlacotla	16
25. Santa Maria Ostonocazca	18
26. San Matheo Tezcacohuac	Unidentifiable or outside survey area
27. Santo Tomas Atlauhco	"
28. San Marcos Quacyocan	"
29. San Felipe Sacatepec	"
30. San Martin Huiznahuac	"
31. Santa Maria Atenpa	"
32. San Juan Tlaxinca	"
33. Santiago Nopaltepec	"
34. San Matheo Tochatlauco	"
35. San Lucas Tlamazingo	"
36. Santa Maria Zaquala	"
37. Santa Maria Chiapan	"
38. San Juan Tepehuizco	"
39. San Juan Atlatongo	"

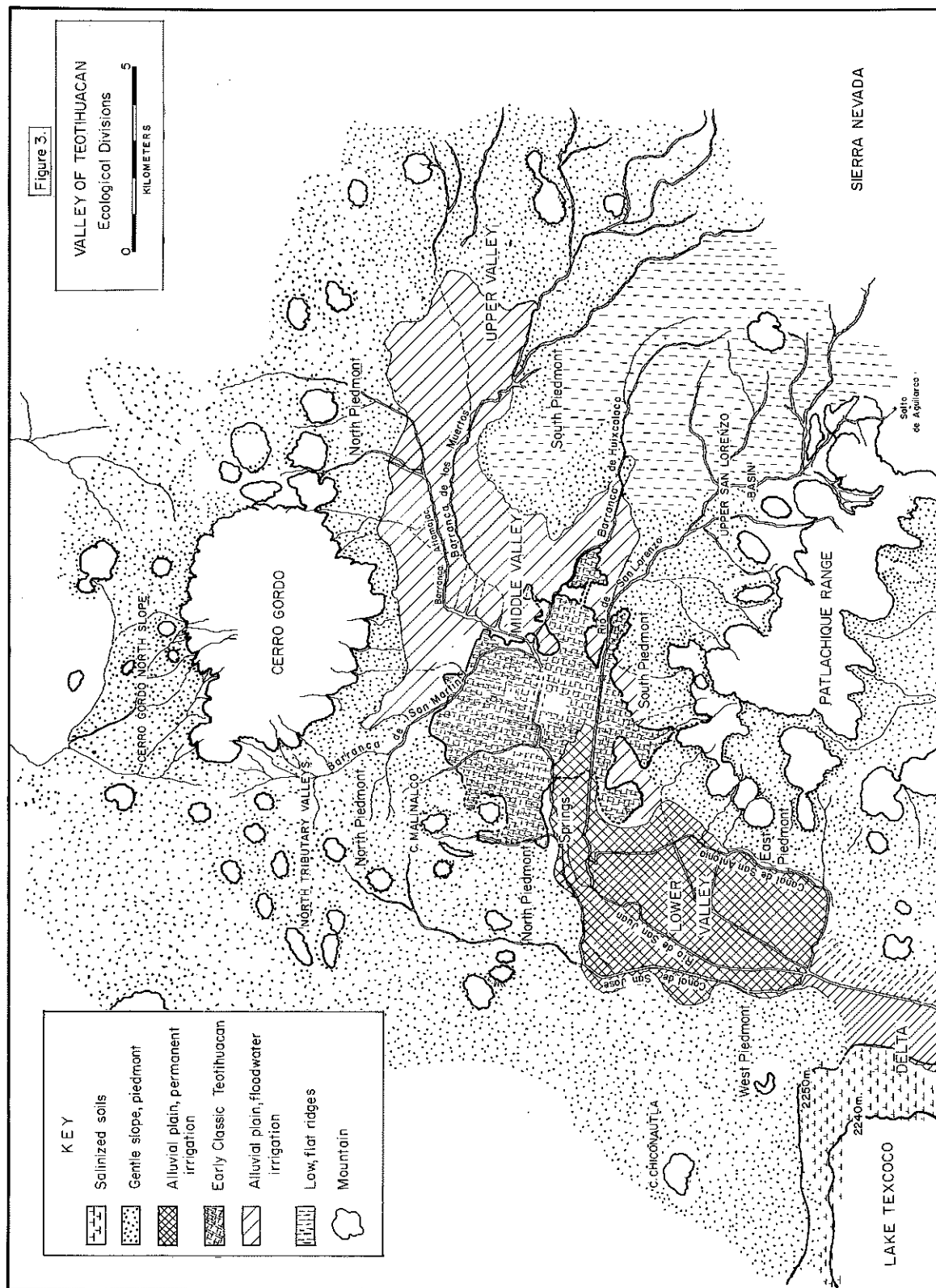
Dependent communities of San Juan Teotihuacan	Archaeological Site No.
40. San Lorenzo Atezcapa	179
41. San Miguel Tlotezcac	178
42. San Sebastian Chimalpan	153
43. Santa Maria Coatlan	152
44. San Francisco Macatlan (Mazapan)	151
45. San Pedro Tlaxican	150
46. San Martin Teacal	148
47. Santiago Tolman	65
48. San Andres Oztocpachocan	Unidentifiable but within survey area
49. Los Reyes Aticpac	142
50. San Antonio Tlaxomulco	144
51. San Augustin Coahuayocan	(Outside survey area)
52. San Pedro Ocotitlan	"
53. San Miguel Tlalguac	"
54. San Luis Xiuhquemecan	131
55. San Juan Evangelista Tlaylotlacan	156

Data from Arzobispado de Mexico

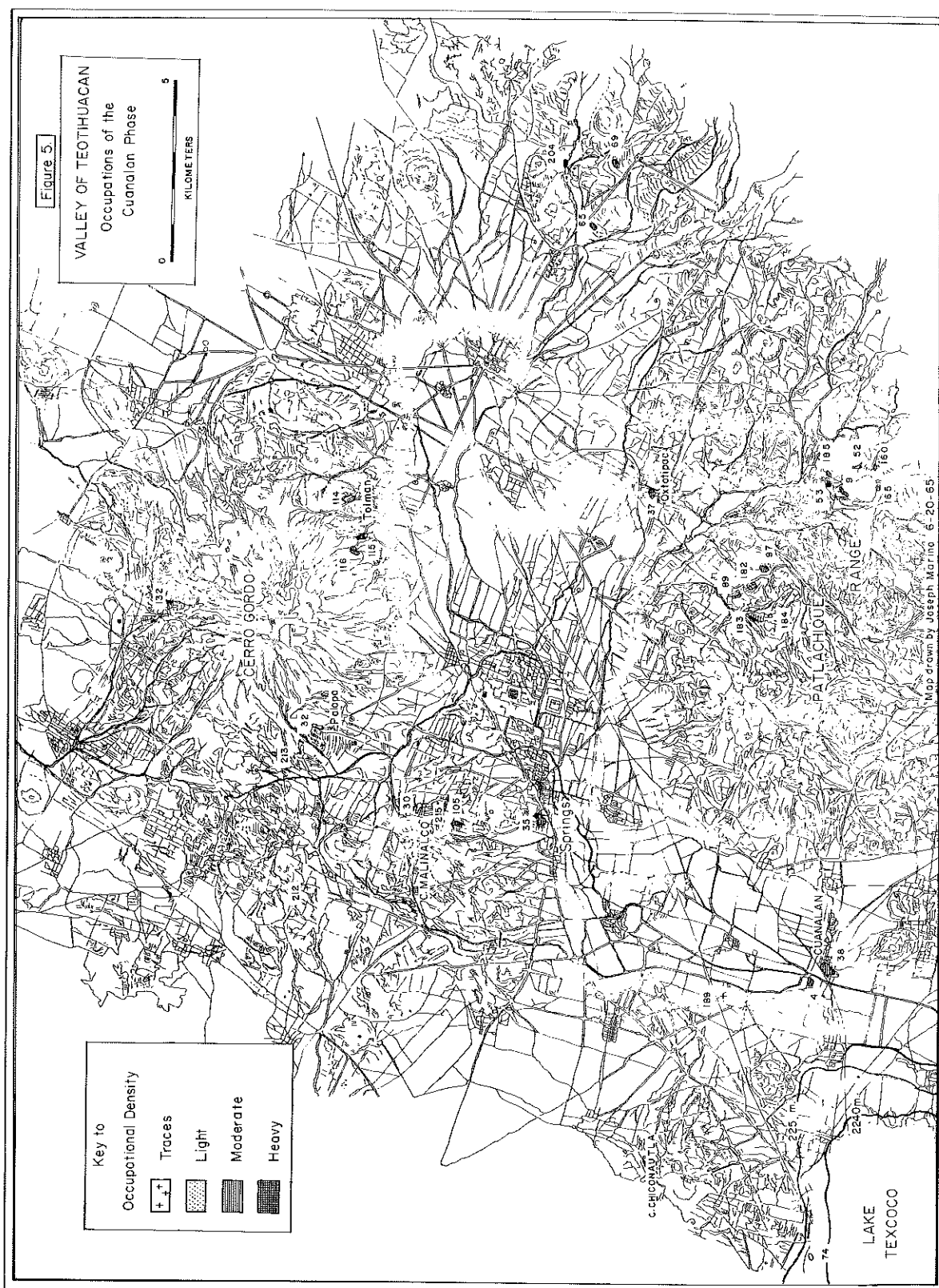
Dependent communities of Otumba

56. San Salvador (Cuautlanzingo)	90
57. San Sebastian (Tlamimilolpa)	80
58. San Pablo (Izquitlan)	207
59. San Lorenzo (Cholpa)	208
60. San Martin (Ahuatepec)	210
61. San Matheo (Tepan)	38
62. San Marcos (Ahuatepec)	77
63. San Lucas	81
64. San Esteuan (Axapusco)	139
65. Santa Cruz (Tlamalpa)	214
66. San Nicolas (Oxtotipac)	203
67. San Luis	Unidentifiable
68. San Miguel (Xolco)	58
69. San Bonifacio (Nonoalco)	71
70. San Illefonso (Tescotitla)	120
71. San Antonio (Ometusco)	North of survey area
72. San Bartolome	Unidentifiable
73. Santo Domingo (Iztacamecan)	127
74. Los Reyes	Unidentifiable
75. San Bernabe	"
76. Santa Lucia	"
77. La Asumpcion de Nuestra Senora (Tilmatlan)	190
78. Santa Catalina	Unidentifiable
79. Santa Ana	"
80. San Joan (Zoapayuca)	101
81. San Joan Evangelista	Unidentifiable
82. Santiago (Tepetitlan)	186
83. San Gregorio	Unidentifiable









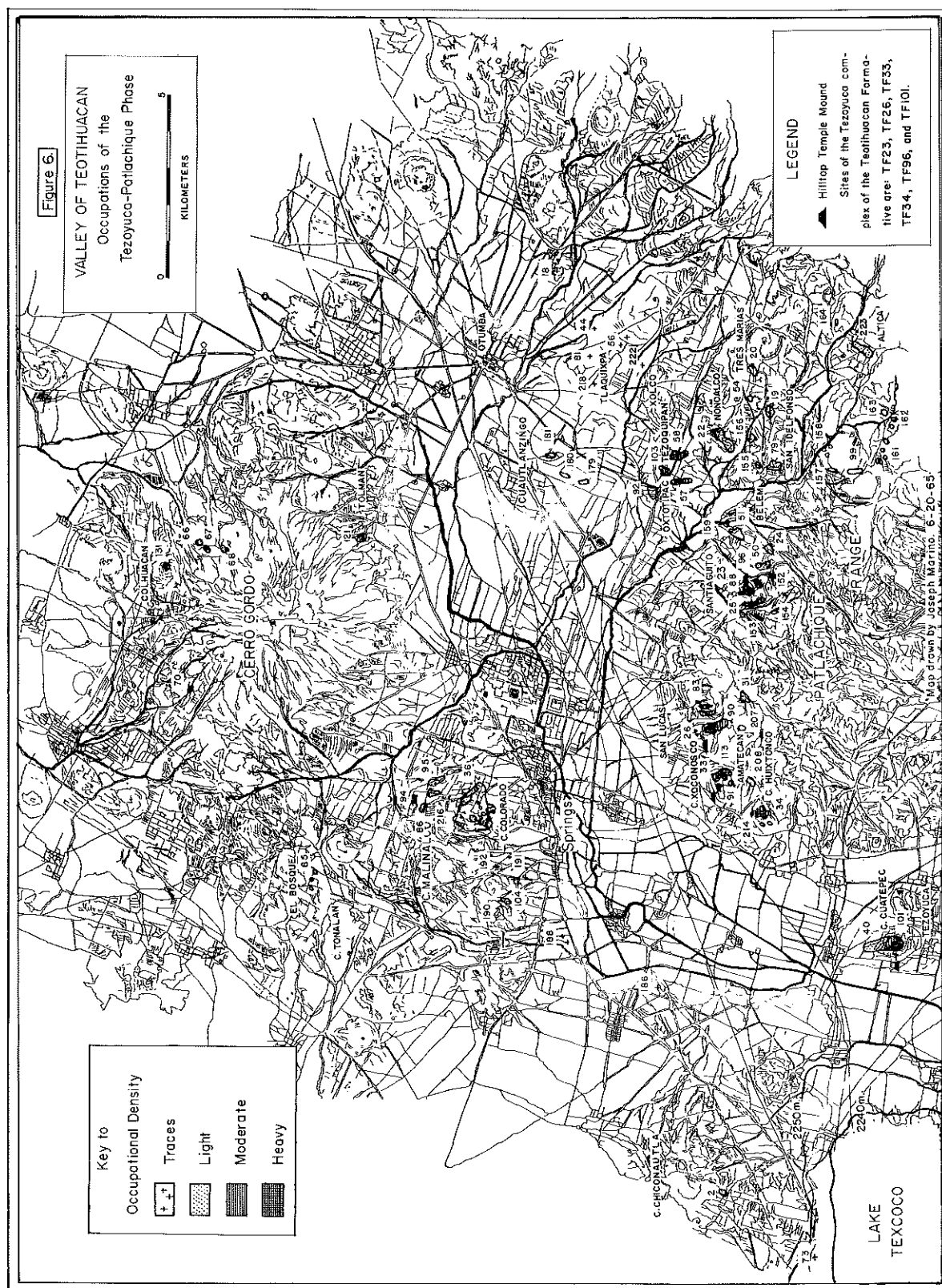


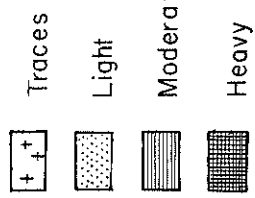
Figure 8.

VALLEY OF TEOTIHUACAN

Occupations of the
Classic Period



Key to
Occupational Density



LEGEND

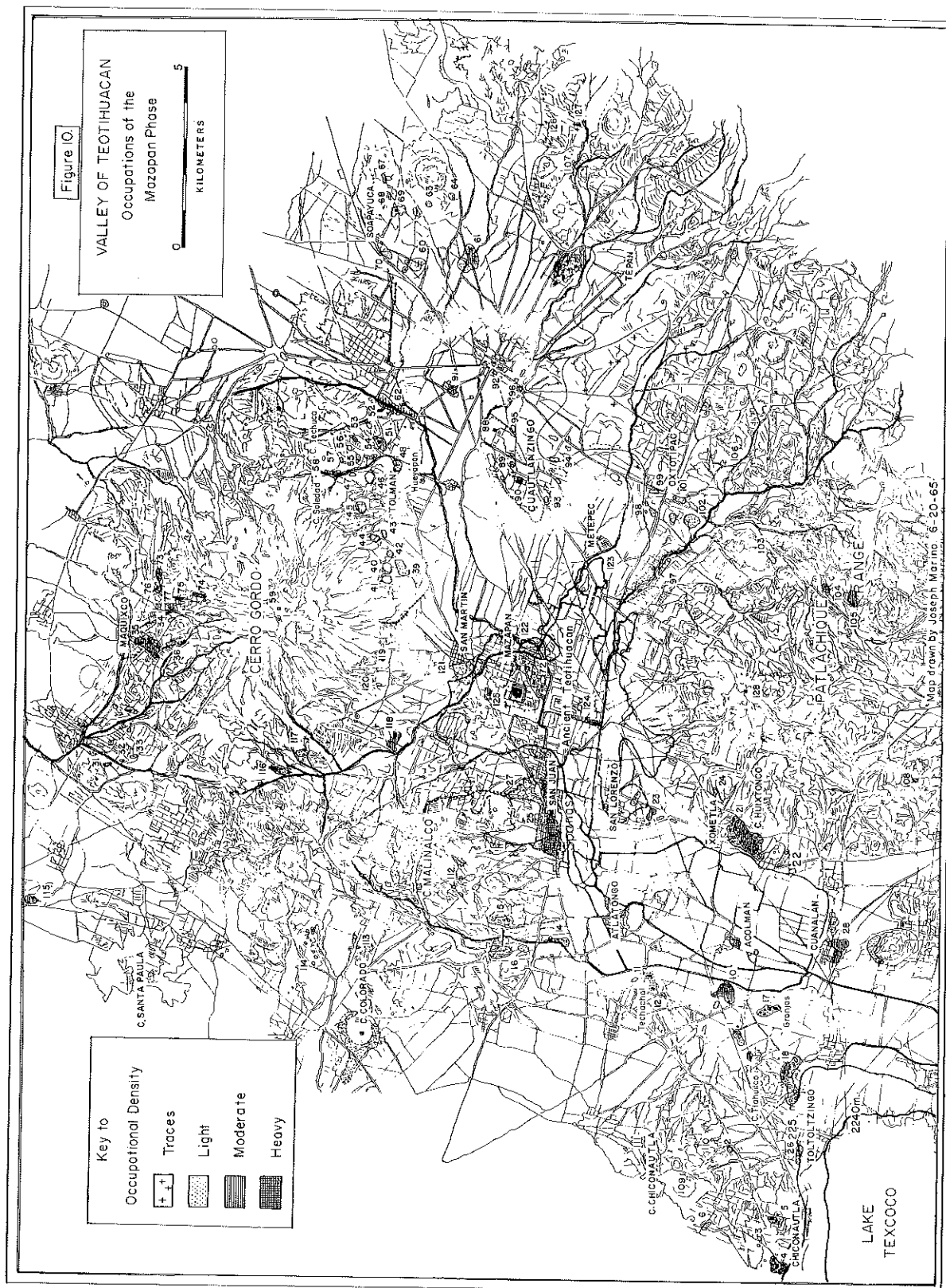
- Lands cultivated by the population of urban Teotihuacan. (Approx.)
- Abandoned canal
- Former stream bed
- ===== Axial avenues of Teotihuacan

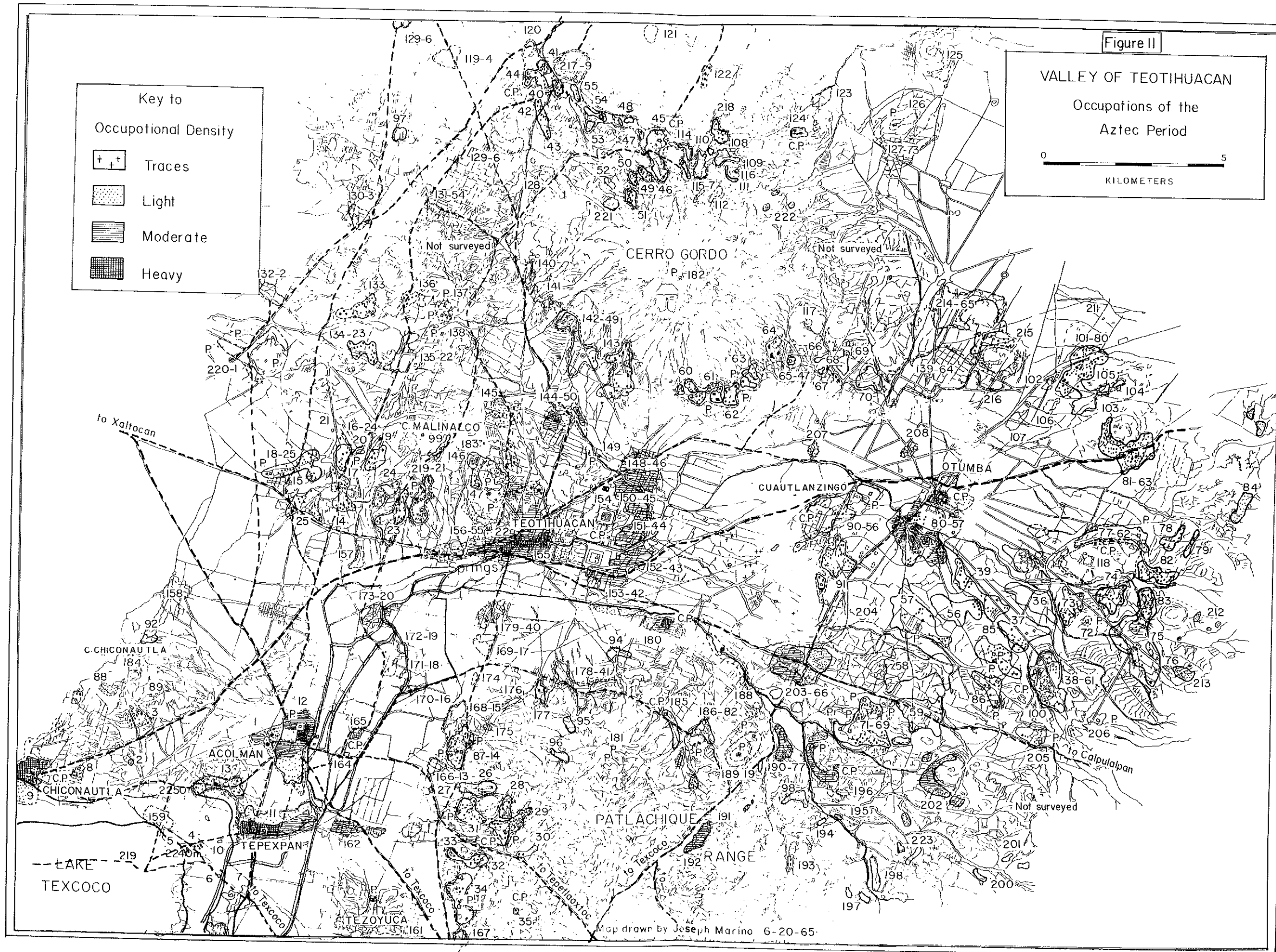
- a. Pyramid of the Moon
- b. Pyramid of the Sun
- c. Ciudadela
- d. Tlamimilopa
- e. Xolalpan
- f. Galicia of Coatlán
- g. Yoyohualá
- h. Tetitla
- i. Atetelco
- j. La Ventilla
- k. Teopanacaxco

LAKE
TEXCOCO

Map drawn by Joseph M. ... 6-20-65







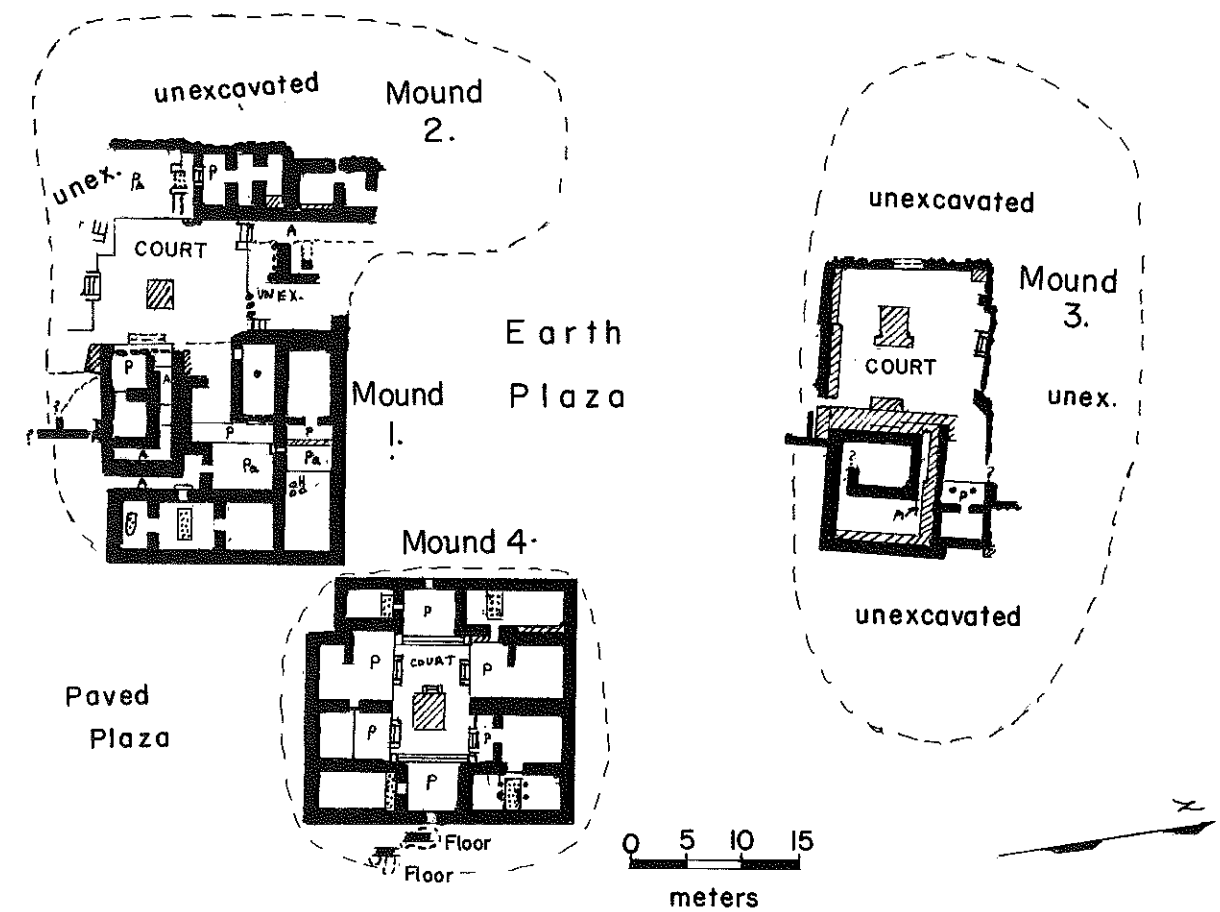


Figure I2. TC8. Excavation Ground Plan.

<p>KEY:</p> <p>Pa = Patio</p> <p>P = Porch.</p> <p>A = Alley.</p>	<p>Rock wall base.</p> <p>Original mound periphery and destroyed features.</p> <p>Hearth</p>	<p>Lightwells.</p> <p>Altars, Benches, and Buttresses.</p> <p>Postholes.</p> <p>Stairways.</p>
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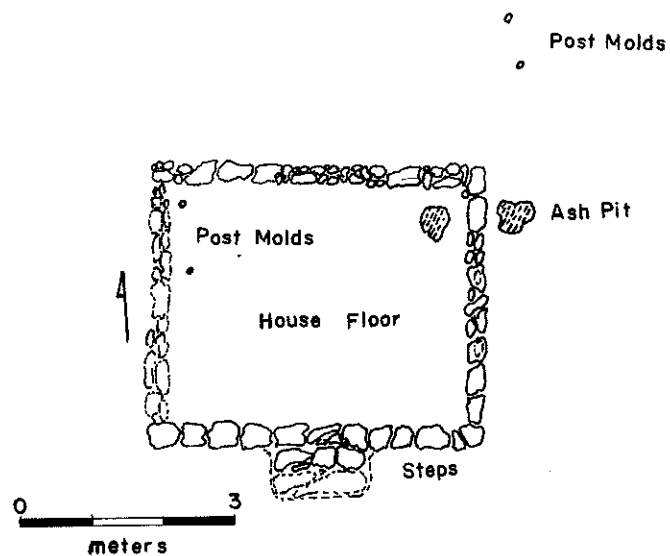


Figure 13a. TF38 Excavation Ground Plan.

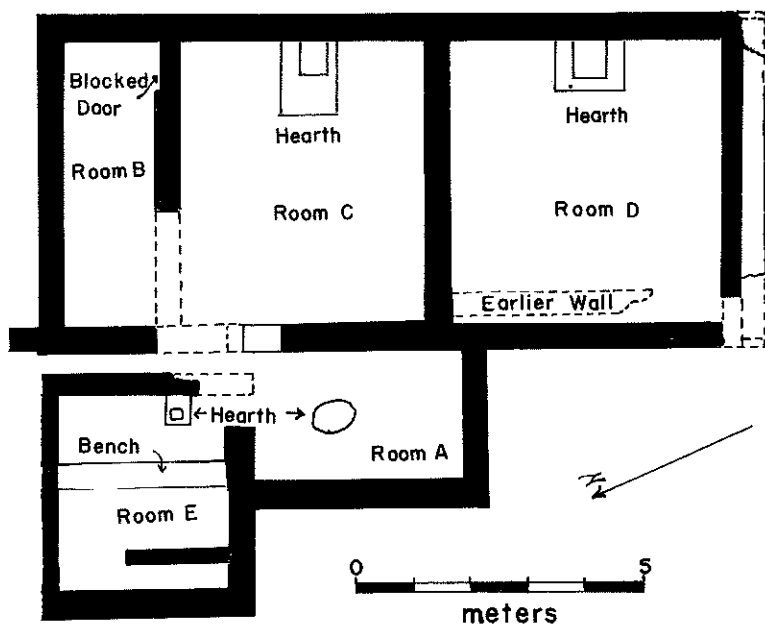


Figure 13b. TA40 Excavation Ground Plan.

(Based on drawing by Thomas Charlton)

Figure 14.

POPULATION HISTORY OF THE TEOTIHUACAN VALLEY

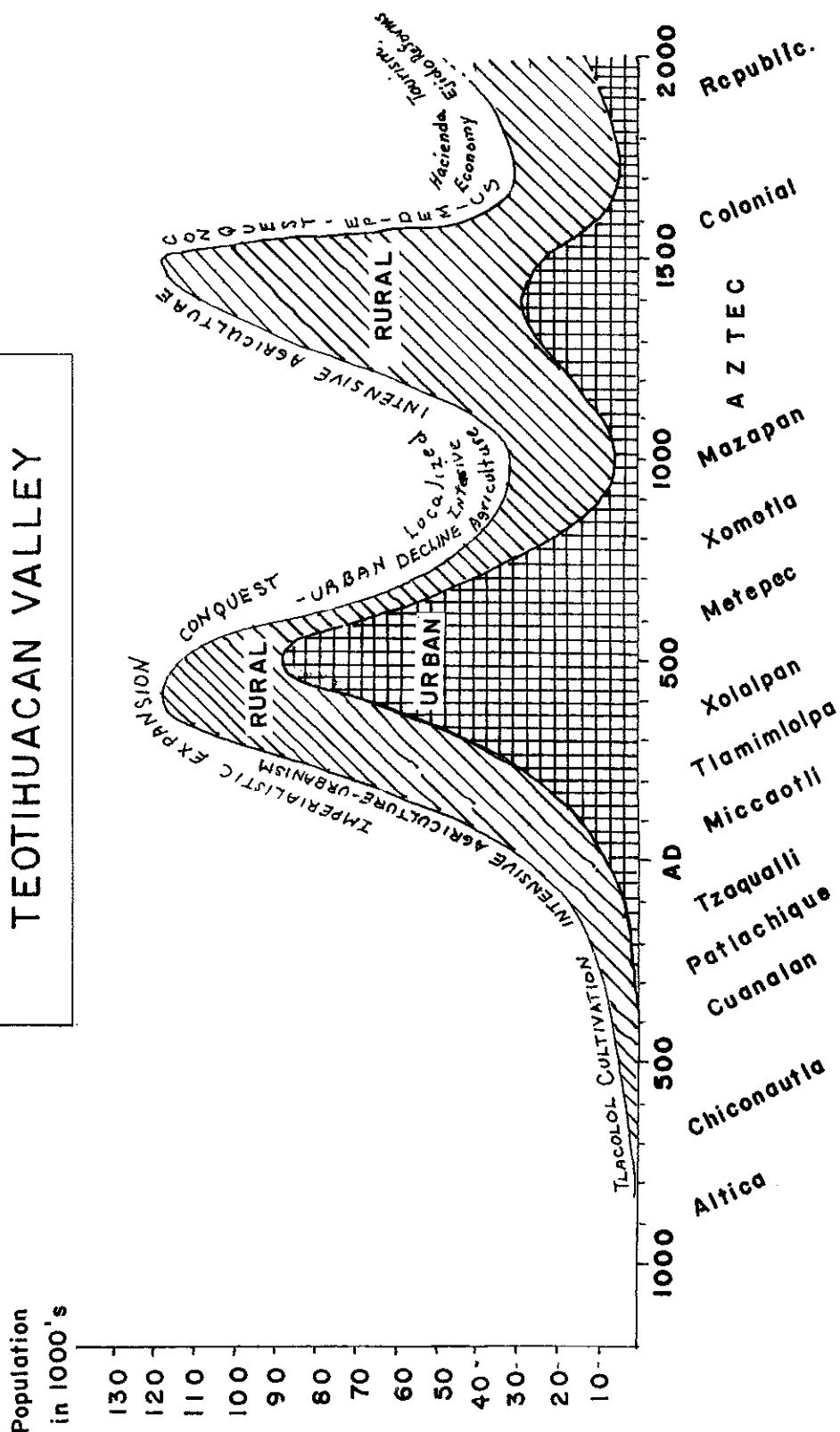
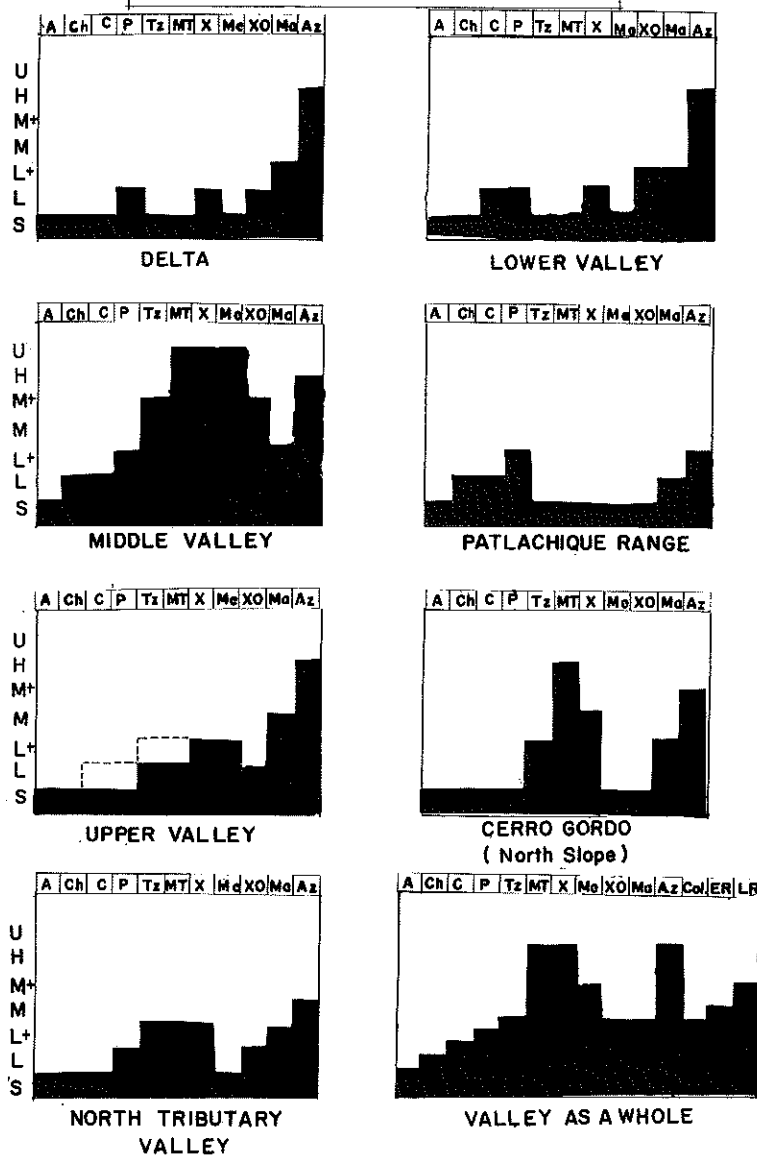
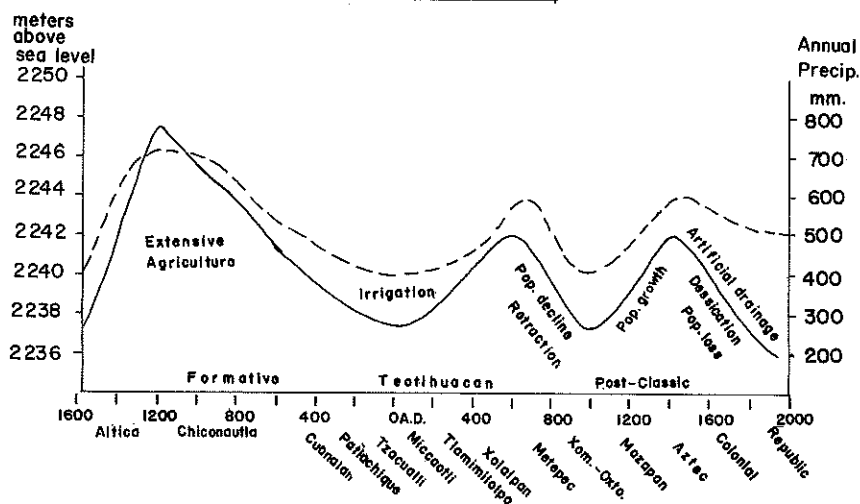
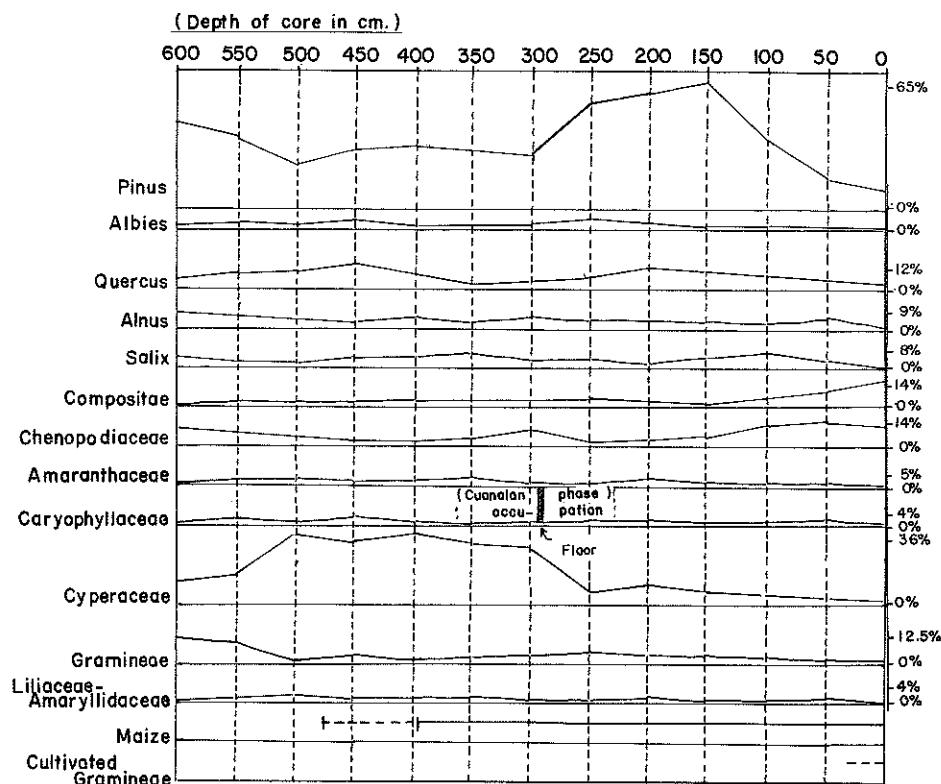


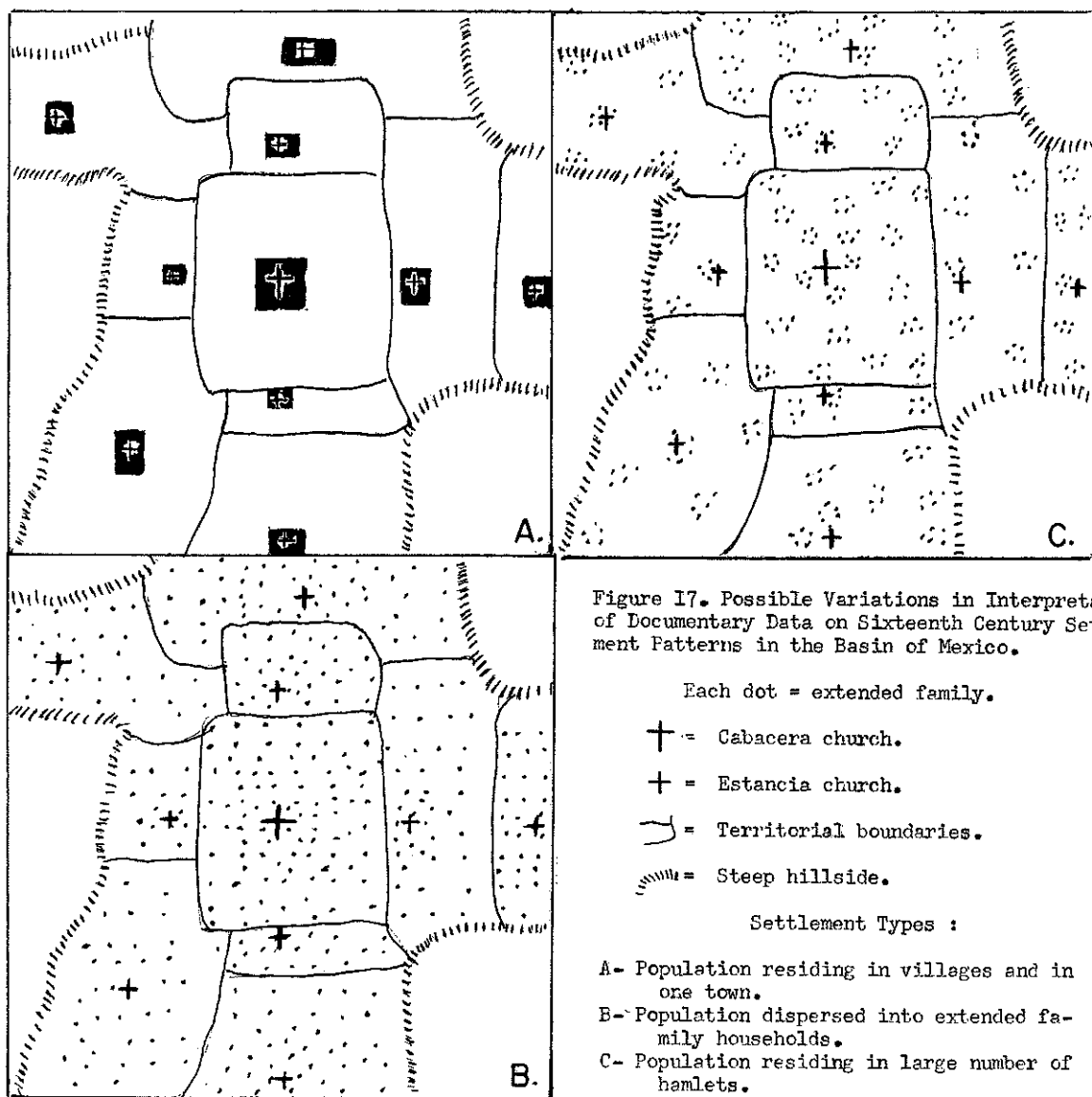
Figure 15.

Graphs of Variations in Occupation-Intensity of the Teotihuacan Valley by Phases and Areas



KEY: Phase abbreviations: A=Atitlan, Ch=Chiconautla, C=Cuanalan, P=Patlachique, Tz=Tzacualli, M-T=Miccootli-Tlamimilolpa, X=Xolalpan, M=Metepec, XO=Xometla-Oxtotipac, Ma=Mazapan, Az=Aztec. Col.=Colonial, ER=Early Republic, LR=Late Republic. Occupation-Intensity: S=Sparse, L=Light, M=Moderate, H=Heavy, U=Urban.





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