PUEBLA: MEXICO'S COTTON TEXTILE CENTER

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ABSTRACT

PUEBLA: MEXICO'S COTTON TEXTILE CENTER

By

Paul M. Lamb

Puebla is the cotton textile center of Mexico. Yet there seems to be no outstanding rationale for Puebla's continued dominant position. Identified negative factors seem to outweigh positive ones, but for almost four and one-half centuries, Puebla has remained Mexico's primary cotton textile center.

Three wars, plus numerous factional struggles, almost destroyed the cotton textile industry of Puebla. Each time it emerged from the ruins stronger and more viable than before. In brief, Puebla's cotton textile industry was ignored by Spanish mercantilists, nearly destroyed by the emerging Mexican nationalists, put out of production by agressors from the United States, devastated by French invaders, and finally ruined by Mexican revolutionaries. Despite these setbacks, and despite challenges from other areas, Puebla remained the primary cotton textile center.

Unquestionably the area is physically well suited for spinning cotton fibers into cloth. Rainfall is relatively abundant, averaging a little more than thirty-two inches annually. Humidity is comfortably

consistent, but above 30 percent, which is important for spinning cotton thread. Temperatures, too, although diurnal variations may be as great as 30°F, are pleasant at an annual average near 63°F. The panorama is little short of spectacular. But none of these are adequate to overcome Puebla's apparent lack of other positive factors.

The focus of this thesis was to determine why Puebla became the cotton textile center of Mexico, to determine whether or not Puebla is still the cotton textile center of Mexico, and to gain insight relative to potential future trends of the Mexican cotton textile industry.

Findings of the study clearly demonstrate that Puebla is the cotton textile center. Some contributing factors are:

1. An adequate water supply
2. Location near a traditional indigenous cotton textile center
3. Strong cultural ties that pre-date conquest

In addition, some changes are suggested to promote Puebla's leadership. Among these are:

1. An aggressive merchandising policy
2. Integration of cotton textile industries producing at less than an optimum capacity
3. Industry-wide planning for the area
4. The retraining of personnel displaced by automatic machinery

A positive statement that Puebla will remain the cotton textile center of Mexico is unwarranted. Nevertheless, the persistence of Puebla as the major producing area for all of Mexico's cotton textile industry, plus the strong attachment by Puebla's population to the area, implies the likelihood that it will not be easily displaced within the forseeable future.

PUEBLA: MEXICO'S COTTON TEXTILE CENTER

By

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A THESIS

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My debt to numerous individuals who aided in the completion of this thesis is great. Merely to enumerate those most recently helpful would require many pages of names. But, among them all a few stand out for their efforts on my behalf.

Without the aid of Sr. Gabino Islas González, industrial investigator for the Bank of Mexico, field work would have been much more difficult. On more than one occasion his advice and assistance proved invaluable.

Dra. Silvana Levi de López and her husband Lic. Alberto López Santoyo welcomed me into their home, introduced me to numerous helpful people, furnished many hours of beneficial criticism, and untiringly drove me about central Mexico. I am doubly indebted to these wonderful people for they proved to be friends as well as advisors.

Many institutions also provided help. Among these are the University of Mexico, University of the Americas, University of Puebla, Pan American Institute of Geography and History, and the Bank of Mexico.

A unique relationship develops between a student and his advisor. For both of us the experience was trying, and at times frustrating. A less patient man than Dr. C. W. Minkel would long since have turned to more productive pursuits.

Beyond these, however, I am especially grateful to the mule, an animal both intractable and intransigent, without whose example this thesis would never have been finished.

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CHAPTER I

INTRODUCTION

Political turmoil, economic instability, and social upheaval marked Mexico's early development. Extractive industry was relied upon almost exclusively to support the economy until the twentieth century. Yet, cotton textile fabrication, present at the time of the Conquest, survived and grew despite initial neglect by the Spaniards and misdirection by the Mexicans. The historical center of the cotton textile industry was Puebla.

The Problem

One aspect of the problem proposed for this thesis was to determine why Puebla became the cotton textile center of Mexico. Preston E. James, in the third edition of Latin America, wrote: "It [Puebla] is the chief center of the Mexican cotton textile industries . . . ."[1] However, consideration of the following factors fails to indicate why the industry located in Puebla:

1. The area is not a major cotton producer. Although cotton was grown by the Indians in Puebla prior to arrival of the Spaniards, locally-grown cotton has been relatively insignificant as a raw material for the textile industry.

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[1]Preston E. James, Latin America, third edition. (New York: The Odyssey Press, 1959), p. 642.

2. Puebla is not a major market area. The Valley of Mexico, in which Mexico City is located, has been the historical population center. In addition, Guadalajara, Monterrey and Ciudad Juárez all have larger populations than Puebla.

3. Major transportation systems do not converge on Puebla. The primary highway, railroad and air networks focus on Mexico City, which is also the historical focus of trade routes.

4. Puebla is not a major political center. Often, especially in Latin America, industrialists tend to locate where they may have some influence in the political process. This is generally the capital city. Mexico City was the political center at the time of conquest and remains so today.

5. Puebla is not the major labor center. Mexico City, Guadaljara, Monterrey and Ciudad Juárez all have a larger labor resource base. Mexicali, Tijuana and León have a labor base almost as large as that of Puebla.

6. The major center of investment capital is not located in Puebla. Foreign and domestic capital, although available throughout the country, is concentrated in Mexico City.

In summary, Puebla does not seem to be a logical primary location for Mexico's cotton textile industry.

Some modifying factors must also be considered. First, Cholula, less than twelve miles from Puebla, was a native textile center when conquered by the Spaniards.[2] There was a long tradition of spinning and weaving in the area, and skills developed by the Indians may have been utilized by the conquerors. A skilled labor pool, if recognized, was available and might have affected the choice of Puebla as a site for the production of cotton textiles.

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[2]Ing. Francisco Quintanar A. La historia del algodón mexicano, (México, D. F.: 1962), p. 44. See also Hernán Cortés, Cartas de relación de la conquista de México, (México, D. F.: Colección Austral No. 547, Espasa-Calpe Mexicano, 1961), p. 31.

Second, climate may have been a factor. Puebla is located in the highlands away from the unhealthful coastal region. Humidity is a definite factor in the process of spinning and weaving. Although not specifically recognized by the native population, it may well have been intuitively understood as important.

Third, water power was abundant along the Atoyac River and tributary streams. Although water power was not generally applied to cotton textiles until the eighteenth and nineteenth centuries, its potential was known. It was a factor for other industries that located in the area.

The negative factors seem to outweigh the positive ones. One objective of this research is to analyze what appears to be a problem of illogical industrial location.

A second aspect of the research is to determine whether or not Puebla remains the cotton textile center of Mexico. James does not mention the cotton textile industry in association with Puebla in the fourth edition of Latin America, published in 1969. Two other geographers, Robert C. West and John P. Augelli, in writing about textiles in Mexico, simply state that ". . . the main cloth centers are in Puebla and Mexico City where 40% of the textile workers are concentrated."[3] It is not clear whether the 40 percent refers to Mexico City alone or to both Mexico City and Puebla.

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[3]Robert C. West and John P. Augelli. Middle America, Its Lands and Peoples, (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1966), p. 347.

A survey of published data supported the hypothesis that Puebla has been displaced by Mexico City in total production of cotton textiles. In 1935, there were 113 workers' associations, with 12,588 members employed, in the textile industry of Puebla. During the same year there were 108 associations, with 11,945 members employed, in the textile industry of Mexico City.[4] During the decades of the 1940's and 1950's, Puebla's dominant position in the textile industry was challenged. Mexico City appeared to be the center of the country's cotton textile fabrication, supplanting Puebla. By 1961, Mexico City was the location of both the largest number of associations and greatest number of workers in this industry (Table 1).

The greatest change in the textile industry took place in the post-World War II period. One example of the dramatic difference in cotton textile fabrication is the number of automatic looms installed. In 1961, 10,000 were in operation, most of them in Mexico City. By 1963 there were more than 30,000 (Table 2). During these same three years, the number of non-automatic looms was reduced by one-half, yet the total number of spindles remained the same. "Puebla . . . ranks second to the Federal District in the number of spindles . . . ."[5]

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[4]Estados Unidos de México, Secretaría de la Economía Nacional, Dirección General de Estadística, Anuario estadístico 1938 (México, D. F.: Talleres Gráficos de la Nación, 1939), Table 76, pp. 143-145.

[5]United States, Department of Commerce, Bureau of Foreign Commerce. Investment in Mexico (Washington, D. C.: Government Printing Office, 1955), p. 133.

TABLE 1

MEXICO: TEXTILE ASSOCIATIONS AND MEMBERS, 1961

States	Associations	Members
Baja California	16	1,406
Campeche	7	301
Coahuila	26	2,646
Chihuahua	8	726
Colima	2	182
Distrito Federal	154	84,805
Durango	9	504
Hidalgo	20	2,525
Jalisco	8	521
México	33	5,845
Michoacán	8	1,893
Morelos	1	32
Nayarit	2	598
Nuevo León	19	2,615
Oaxaca	1	108
Puebla	137	16,657
Querétaro	8	1,411
San Luis Potosí	10	2,609
Sinaloa	9	433
Sonora	12	596
Tamaulipas	28	5,994
Tlaxcala	20	3,389
Veracruz	17	6,705
Yucatán	67	7,653
Total	622	150,154

Source: México, Secretaría de Industria y Comercio, Dirección General de Estadística. Anuario estadístico de los estados unidos mexicanos, 1960-1961. (México, D. F.: Talleres Gráficos de la Nación, 1963). Table 8.3, pp. 316-325.

TABLE 2

MEXICO: NUMBER OF SPINDLES AND LOOMS, 1961-1963

Equipment	1961	1962	1963
Spindles	1,300,000	1,300,000	1,300,000
Looms			
Automatic	10,000	11,000	30,652
Non-Automatic	30,000	28,500	14,396

Source: Unión Panamericano, Departamento de Estadística, Instituto Interamericano de Estadística. América en cifras, 1965, Part 2, Industria (Washington, D. C.: Secretaría General de la Organización de los Estados Americanos, 1966), p. 71.

The third aspect of the research is to gain insight relative to potential future trends of the Mexican cotton textile industry. If a flight of Puebla's cotton textile industry is taking place, it should be possible to identify new locations and to project construction, power facilities, marketing, capital, labor and other needs. Also, the effect of the loss should be identifiable in the Puebla area. If Puebla, in 1959, was the cotton textile center, and was displaced by 1969, there should be some evidence of abandoned factories or limited production and a reduction in the number of machines in operation. Housing construction, new services, and purchases of non-essential items should be on the decline. Labor should be in surplus or in flight to other areas, unless new industries were being developed to absorb it.

Factors analogous to the move from New England to the Piedmont region by United States textile companies may be useful to consider.

Early cotton textile manufacturers in the United States located in an area with adequate power and a climate with near optimum humidity. Although relatively distant from the source of raw materials, a pool of skilled labor soon grew up near the New England mills. Strong unions subsequently developed, and wages were high. Many mills were the primary tax and salary base for the communities in which they were located. Machinery became obsolete and new machines often demanded extensive and costly reconstruction. It was literally cheaper to build new mills with modern equipment than to rebuild existing facilities.

Electricity made power more mobile, and climatic control within buildings was refined through air conditioning. Since labor in the Appalachian Piedmont was cheaper, and tax inducements and new buildings were offered, it was no longer economically sound for the industry to remain in New England.

Many of these same conditions are present in Puebla. The city is relatively distant from raw materials, labor unions are strong, wages are high, and in some factories the machinery is more than fifty years old. Power, an early inducement, no longer ties the mills to source locations because in the form of electricity it permits location almost anywhere.

Restated, the research problem consists of three parts. These are (1) to determine why Puebla developed as Mexico's cotton textile center, despite many seemingly negative factors, (2) to determine whether or not Puebla remains the center, especially in view of data

indicating a change to Mexico City, and (3) to gain insight into potential future trends of the Mexican cotton textile industry.

At the first Conference of Latin Americanist Geographers, at Ball State University in Muncie, Indiana, April 30 to May 3, 1970, contact was made with Dra. Silvana Levi de López, representative of the Instituto de Geografía, Universidad Nacional Autónoma de México. Arrangements were made to visit the Instituto de Geografía, and plans were formulated to initiate a comparative study of the cotton textile industries of Puebla and Mexico City. The Mexico City study is to be done by Dra. de López.

Objective

If the center of cotton textile operations moved from Puebla to Mexico City, it should be possible to document factors responsible for such a move. Among the factors investigated were those related to:

1. Raw materials. From what area is the cotton for textile mills drawn? If grown within the national confines of Mexico, how is it transported to the processing plants? If extraterritorial, what countries furnish the cotton and how is it delivered? What changes are reflected by relocating the cotton textile center from Puebla to Mexico City?

2. Power. What are the power sources in Puebla and in Mexico City? What is the relationship of power sources to location? What changes resulted from the use of electricity?

3. Technology. How does increased mechanization affect the cotton textile industry? What is the effect of automatic looms, temperature and humidity control and increase in total number of spindles operated by one worker? How do improved strains of cotton portend changes in the industry?

4. Transportation. How is the location of mills affected by transportation? What transportation means are used to move raw materials to Puebla and to Mexico City? How does the

location of the cotton industry, in turn, affect transportation of the finished products? What changes have taken place in recent decades that may be related to a move from Puebla to Mexico City?

5. Marketing and markets. How does the choice of Puebla determine the markets for finished products? How have the markets changed? Is Mexico aggressively marketing cotton textiles throughout the world?

6. Capital. What is the source of invested funds? How is it accumulated? What factors made Puebla, and Mexico City, attractive for investors? Is there government financing? If so, to what extent and how does it affect location? In what way do government financing policies affect the marketing of cotton textile products?

7. Labor. What are the labor organizations in Puebla? Are the same organizations operative in Mexico City? Is there a labor flight to other parts of Mexico from Puebla? What is the relationship of labor available to labor use? What are the age and sex of cotton textile workers? How many employees are occupied in the textile industry?

Certain answers seemed apparent. Mexico City is the capital of the country, with approximately 16 percent of the total population. Business, finance, government and foreign representatives are located in the capital. All transportation systems converge on Mexico City. There are also negative factors, such as lack of adequate water supplies, low power potential, and high land values. It is the focus of this study to determine whether a shift has taken place, and the causal relationships of such a shift.

The Study Area

The State of Puebla is located in the east-central part of Mexico. Its relationship to surrounding political divisions within the Republic is shown on Figure 1. The state covers approximately 13,100

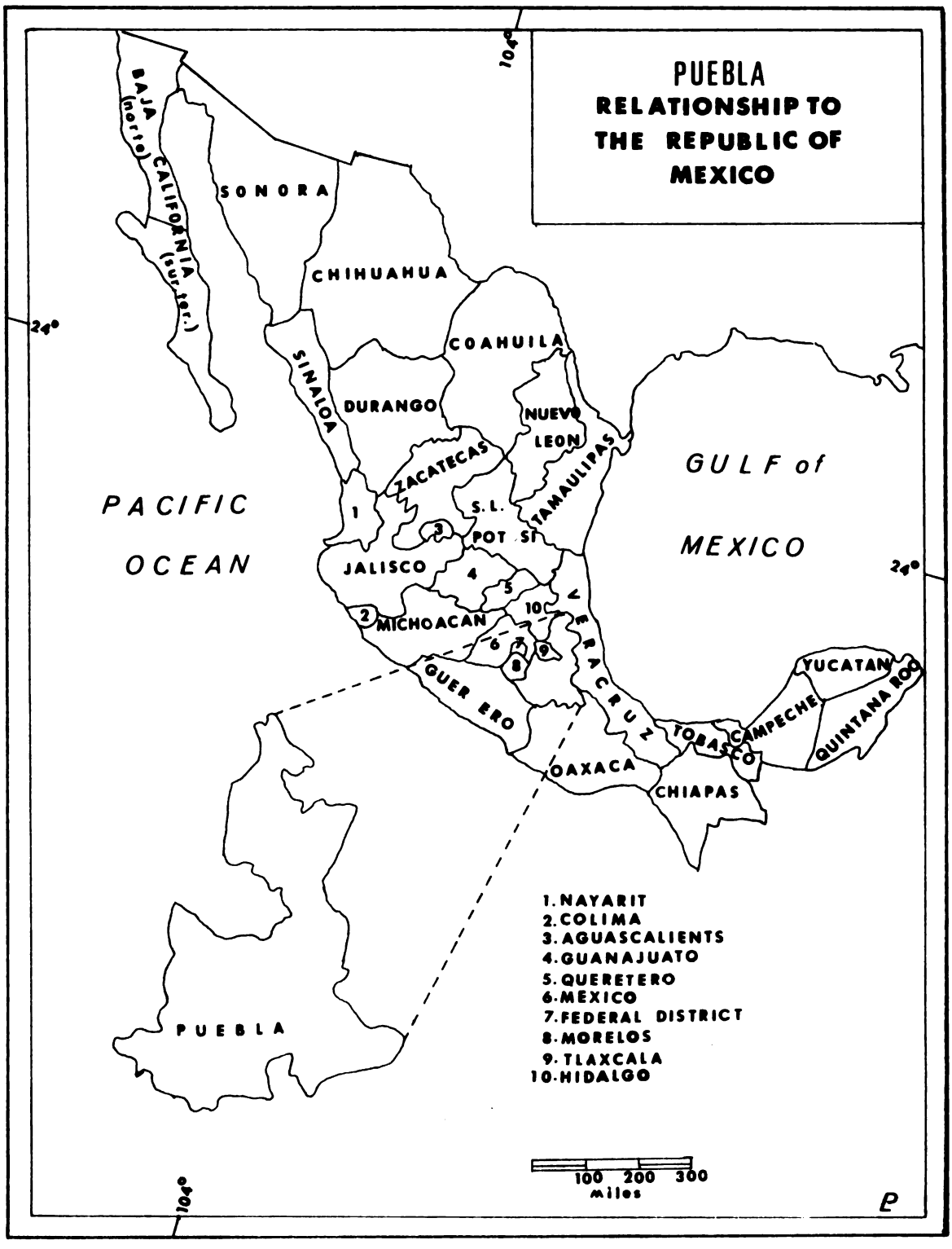
PUEBLA
RELATIONSHIP TO
THE REPUBLIC OF
MEXICO
BAJA (norte)
CALIFORNIA (sur, ter.)
SONORA
CHIHUAHUA
SINALOA
COAHUILA
DURANGO
NUEVO LEON
TAMAULIPAS
ZACATECAS
S.L. POT ST
JALISCO
MICHOACAN
GUER ERO
OAXACA
CHIAPAS
VERACRUZ
TOBASCO
CAMPECHE
YUCATAN
QUINTANA ROO
PUEBLA
PACIFIC OCEAN
GULF of MEXICO
1. NAYARIT
2. COLIMA
3. AGUASCALIENTS
4. GUANAJUATO
5. QUERETERO
6. MEXICO
7. FEDERAL DISTRICT
8. MORELOS
9. TLAXCALA
10. HIDALGO
100 200 300
miles
24°
104°

FIGURE 1

square miles, or an area about the size of Massachusetts and Connecticut combined.

The capital city, Puebla de Zaragosa, and those municipios immediately adjacent to it, form the core area where the cotton textile industry is concentrated. This area includes Cuautlancingo, San Jerónima Caleras, San Felipe Hueyotlipán, Puebla, San Pedro Cholula, and San Andrés Cholula (Figure 2). Although visits were made to some nearby areas, primary efforts were devoted to the core area.

Procedure

During the period March-May, 1970, a survey of literature relative to the cotton textile industry of Mexico was conducted at Michigan State University. Master's and doctoral theses were screened for references to growth and change of the cotton textile industry. None contradicted the original assumption that Puebla's textile industry is moving. Much of the data suggested that Mexico City has been supplanting Puebla as the cotton textile center of Mexico.

Field research was conducted in the Puebla area from June 22 through September 12, 1970, to determine: (1) Puebla's unique position as the original center of Mexico's cotton textile industry, (2) concommitant factors related to Puebla's decline and Mexico City's growth in cotton textile manufacture, and (3) the effect of this change upon the economic development of Puebla. During the field work, numerous organizations in Mexico City and Puebla were visited. Among these were the Pan American Institute of Geography and History, the City Council of Puebla, the Research Department of the Bank of Mexico,

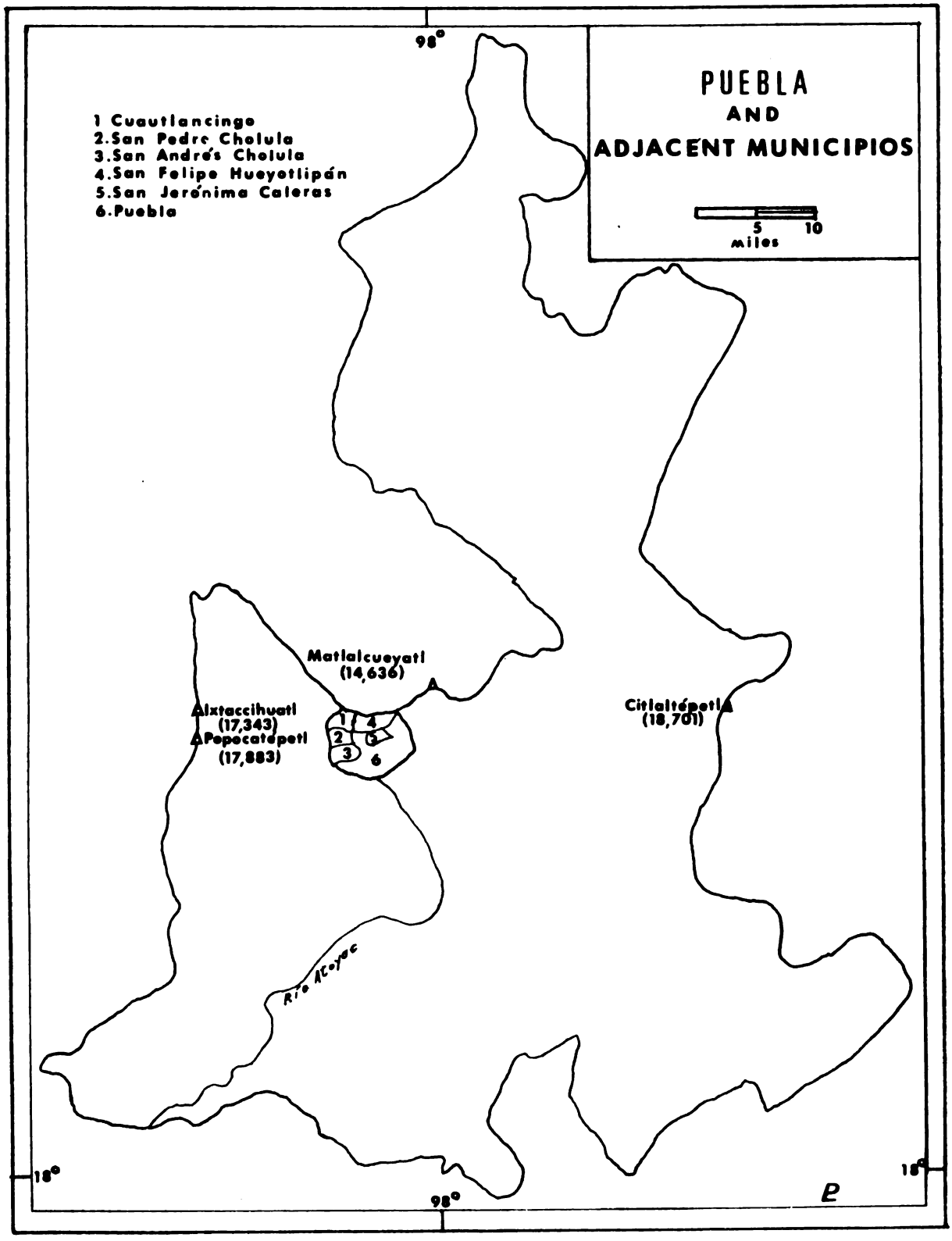
98°
PUEBLA
AND
ADJACENT MUNICIPIOS
5
10
miles
1 Cuautlancingo
2.San Pedro Cholula
3.San Andrés Cholula
4.San Felipe Hueyotlipán
5.San Jerónima Caleras
6.Puebla
Matlalcueyatl
(14,636)
Iztaccihuatl
(17,343)
Popocatépetl
(17,883)
Citlaltépetl
(18,701)
1
2
3
4
5
6
Río Atoyac
18°
98°
18°
P

FIGURE 2

and the Universities of Mexico, Puebla, and the Americas. Field trips were made to Atlixco, Cholula, Tlaxcala and other nearby textile centers. Time was spent in Mexico City using the facilities of the Bank of Mexico, University of Mexico, and the Pan American Institute of Geography and History, both at the beginning of the study and at its termination.

Early problems forced a re-evaluation of the initial research program: (1) the magnitude of the textile industry of Puebla had been underestimated; (2) initial efforts to visit industries were in some cases forstalled by refusal of permission to enter the premises; (3) the original questionnaire proved unsatisfactory because administrators did not wish to reply to direct questions, replied only to selected questions, or gave information that conflicted with other sources; and (4) labor contract negotiations were underway at the time field work began. These obstacles were overcome through the development of useful contacts with persons knowledgeable concerning the topic under study. Concentration upon a sampling of the industry, memorization of a set of questions to be introduced during the interviews with plant administrators, and settlement of the labor contracts also proved helpful. Public transportation, although adequate in most cases, was augmented by the use of a small motorcycle. The latter allowed greater mobility and permitted visits to some locations that might otherwise have proved difficult. Visits to some cotton textile factories were arranged by Sr. Benjamín Abascal and Ing. Antonio Fárias, and numerous other people facilitated data collection as the research progressed.

Findings of the Study

Based upon the research undertaken, the following conclusions have been reached:

1. Puebla's adequate water supply was an early source of power and an inducement for the location of the cotton textile industry in that city.

2. Puebla's early dominance is related to its location near a traditional indigenous cotton textile center.

3. The cotton textile industry is not moving from Puebla to other cities of Mexico. Puebla, with an adequate power and labor supply and located within one and one-half hours by automobile from the capital, offers conditions for further growth and expansion.

4. The cotton textile industry in Puebla remains the largest segment of the total textile industry in Mexico.

5. The growth evidenced by the cotton textile industry in Puebla is associated with population increase, not with an aggressive business policy.

6. There is a modernization program in progress. Each factory has its own timetable. Associated with the purchase of new machines is a training need. Some plants with the newest equipment train young men between the ages of eighteen and twenty-five because of resistance to change by employees of long standing. Since the newer equipment requires less personnel, there is a tendency not to replace all retiring employees.

7. Although production equals or exceeds that realized prior to installation of modern equipment, some of the industry with newer machinery has from 15 to 20 percent of its productive capacity unused.

CHAPTER II

PHYSICAL AND HISTORICAL BACKGROUND

The development of Puebla as Mexico's cotton textile center was based upon both physical and cultural factors. Location in an area physically well-suited for spinning and weaving of fiber was a primary factor. Also important was a long tradition of textile manufacture within the general area.

Physical Features

The basin of Puebla lies at an elevation of 7,100 feet above sea level and is drained by the Río Atoyac. High mountains rise to the west and northeast. Deep ravines are evident along the flanks of the mountains and where poor soil management can be identified. In some areas the original basin surface lies thirty to forty feet above levels presently cultivated. Very little forest remains. Reforestation preserves and water and soil management practices are encouraged to reduce erosion and land abuse.

Terrain

Four of America's highest mountain peaks are visible from Puebla. The Pico de Orizaba[1] to the east (18,701 feet above sea level) and Popocatépetl and Ixtaccihuatl to the west (17,883 and 17,343 feet,

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[1]Locally known as Citlaltépetl.

respectively) are permanently snow-capped. La Malinche[2] reaches an elevation of 14,636 feet and lies to the north. These mountains are part of the east-west neo-volcanic range that terminates geologically the older basaltic north-south range traversing most of North America. Only Popocatépetl has erupted within this century.

The Río Atoyac, part of the headwaters of the Río Balsas system, provides drainage for the basin. During the rainy season, June through October, silt-laden seasonal tributaries swell the river. At Valsequillo, the Manuel Avilla Comacho dam was constructed on the Atoyac in 1946 and impounds over 400 million gallons of water.

Climate

Climatic conditions vary widely with elevation and exposure to moisture-bearing winds. These conditions are influenced by an extremely complex aerographic system, in turn modified by the terrain.

Temperature is reduced approximately one degree fahrenheit for every 330 feet of elevation, and the basin reflects a lower annual average than would be expected at sea level. Sea level temperatures for the same latitude average between 84° and 88°F. In the basin of Puebla, annual monthly averages range between 62° and 65°F, and in the city the average temperature is 63°F. Diurnal variations are greater. During April and May the average nighttime temperatures are in the low 50's, and the daytime averages in the high 80's (Figures 3 & 4).

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[2]Locally known as Matlalcueyatl.

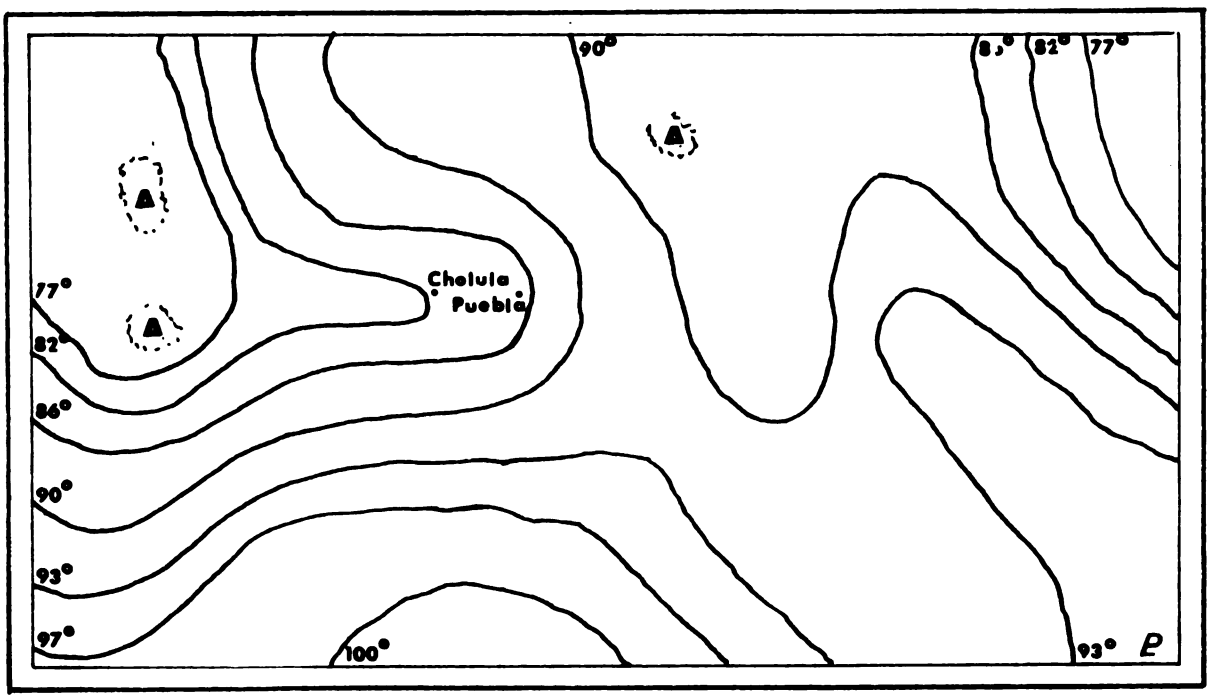

FIGURE 3

Puebla: Maximum Temperature, April

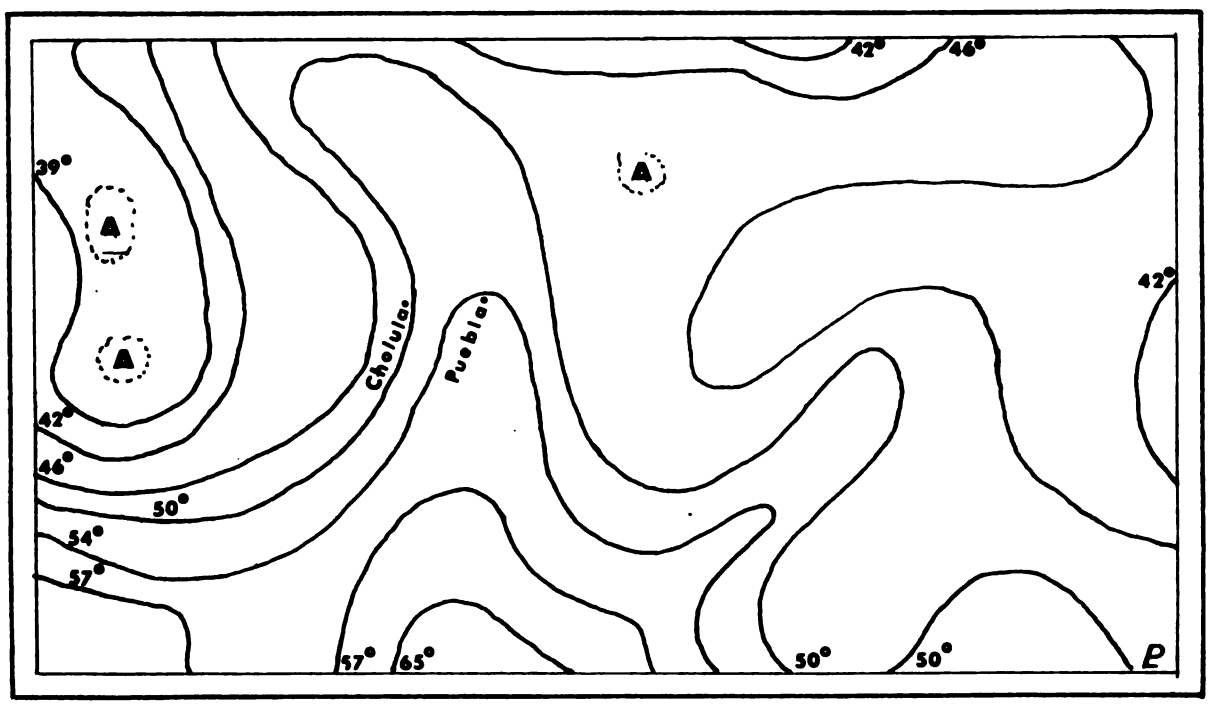

FIGURE 4

Puebla: Minimum Temperature, April

In January the corresponding averages are from the upper 30's to the low 70's (Figures 5 & 6).

Rainfall is relatively abundant. The long-range average is thirty-two inches, but since 1950 annual rainfall has increased to more than thirty-five inches. Heaviest precipitation usually occurs from May to October, whereas the driest months are December through February. Precipitation during the latter months is frequently in the form of sleet or snow.

One factor modifying local climate is high terrain to the west. The high volcanic peaks of Popocatépetl and Ixtaccihuatl act as a barrier to the passage of moisture laden clouds. The rising air cools, which reduces the amount of moisture held. As a result, western slopes of the basin receive much more rainfall than the eastern slopes. For example, in 1958, when Puebla received more than forty-seven inches, Acajete, near the eastern slope, received less than thirty-six inches and Metepec, near the western slope, received almost sixty-three inches.

The movement of the equatorial low pressure cell across the area during the year significantly influences the amount of rainfall received. Precipitation increases along the interface of the cell as it moves northward, beginning in May. As the cell moves southward in late August and early September, a second, slightly lesser rainfall maximum occurs. From December through February, when the cell has moved southward, there is little precipitation. However, cool polar

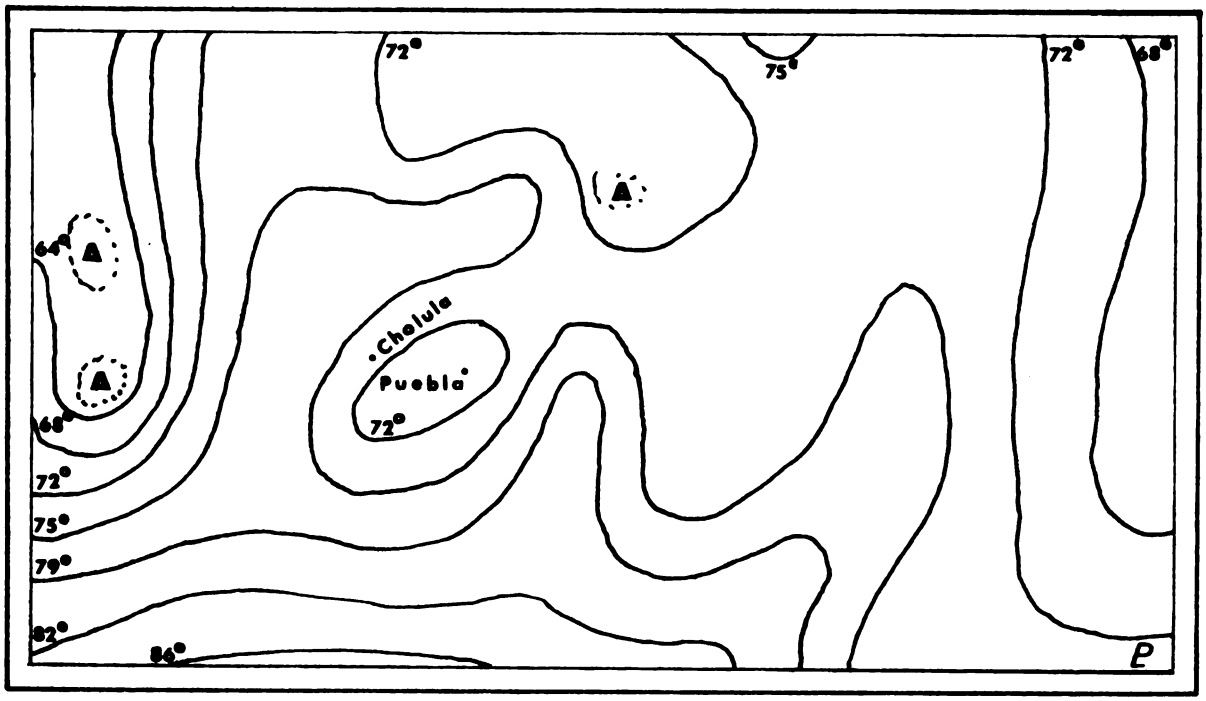

FIGURE 5

Puebla: Maximum Temperature, January

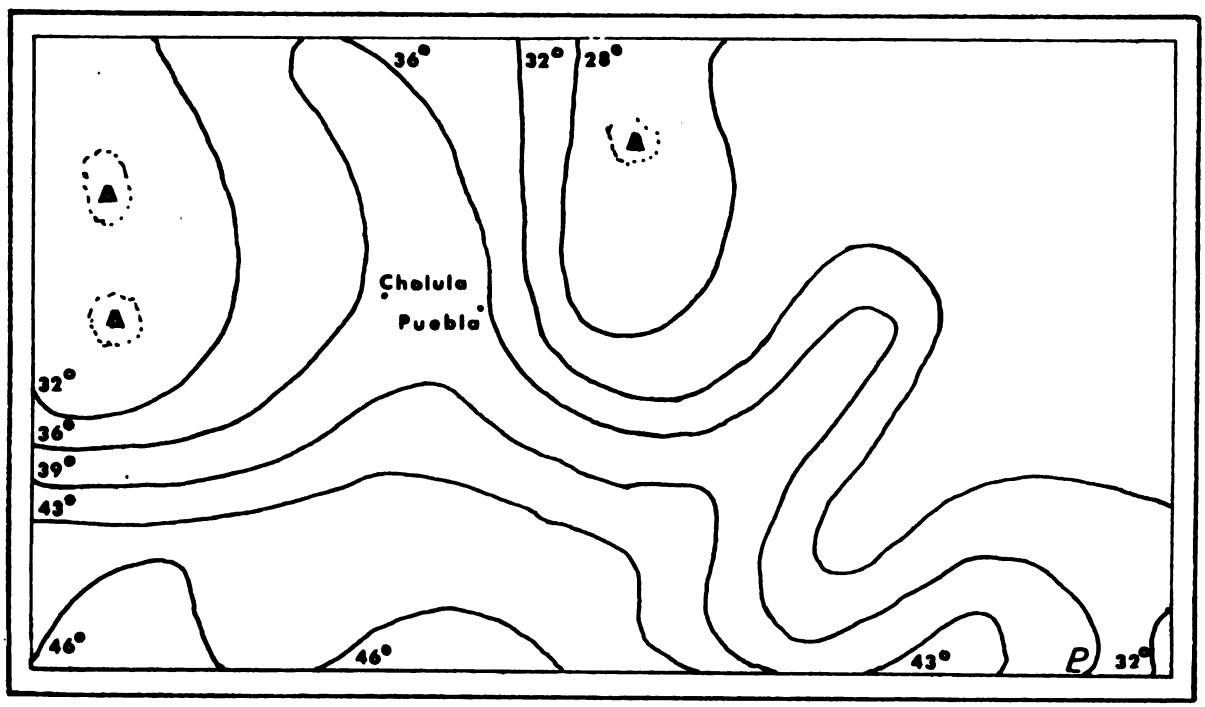

FIGURE 6

Puebla: Minimum Temperature, January

continental air from the north often penetrates the basin, bringing sudden drops in temperature and occasional killing frosts.

Tropical storms that penetrate into the basin also modify the precipitation patterns. These storms, often associated with hurricanes, originate over the Pacific Ocean, the Gulf of Mexico, or occasionally the Atlantic. Numerous such storms have penetrated the basin from the Pacific since 1960, and three were of hurricane proportions. Many also came from the Gulf of Mexico. The most notable was Hurricane Gladys, which profoundly affected the area in 1955.

In the basin of Puebla there is a definite bimodal peaking of humidity during the months of July and September, which is associated with a reduced bimodal rainfall pattern for the same period (Figure 7). Even the most humid months are comparatively comfortable, since midday humidity is near or below 60 percent. No month has less than 30 percent humidity, an important factor in the spinning of cotton thread.

Historical Background

Puebla de los Angeles[3] was officially founded at a mass celebrated on April 16, 1531. Actually, the Bishop of Tlaxcala and Cholula had been working to establish a new city since 1525. But, even before the Bishop's efforts culminated in success, two men (Esteban de Zamara and Pedro Jaime) had constructed a resting place on the banks of the Atoyac

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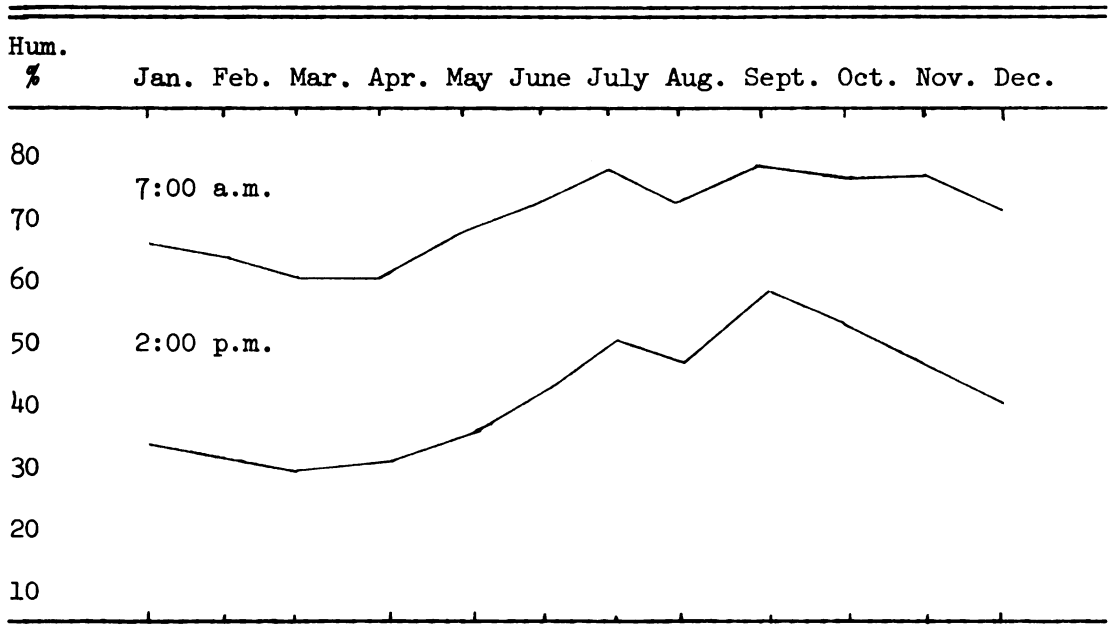
[3]Changed to Puebla de Zaragoza in honor of General Zaragoza for his defense of Puebla and defeat of the French troops there on May 5, 1862.

FIGURE 7

AVERAGE MONTHLY RELATIVE HUMIDITY IN THE BASIN OF PUEBLA, 1955-1964
(For the hours of 7:00 a.m. and 2:00 p.m. daily)



Source: Los Archivos del Servicio Meteorológico Nacional, México, D.F.

river where Puebla is now located. The reverend father is known to have stayed often at the way station.[4] His famous dream that gave impetus to the settlement of Puebla may well have resulted from his numerous travels through the region.

Puebla's beginnings were modest. Only eleven Spaniards were present the day the plain was partitioned in 1531, but by December of the same year the Spanish population had tripled.[5] In addition, numerous Indians moved there. The latter came from the surrounding area to work, trade and live near the Spaniards who represented the dominant culture. They were not allowed to live in the homes of the Spaniards nor to be taken for concubines, a departure from the usual practice elsewhere. As a result, Indian barrios were constructed nearby but apart from the core area laid out for the "city of the angels." Evidence of this separation is still visible today. Although the new city soon became the focus of a large population, the valley in which it was located was already well populated before the Spaniards came to the region.

Pre-Conquest

The origin of Mexico's people is not definitively established, nor is it known when the first inhabitants reached Central Mexico. One

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[4] Puebla sagrada y profana. Es reeditada por el centro de estudios historicos de puebla, A.C. Con la cooperación económica de la junta de majaramiento moral cívico y material del municipio de puebla. Impreso en México, 1967.

[5] Fausto Marín-Tamayo, La división racial en Puebla de los Angeles baja el régimen colonial, Publicación Número 14, p. 13. "En total, al finalizar 1531, la población española era de treinta y tres hombres y una mujer viuda."

discovery that helps delimit early arrival was that of Hombre de Tepexpán calculated to have lived in the area 13,000 B.P. Certainly it would be presumptuous to mark Tepexpán man as the forerunner of pre-conquest Indian population, except in the most general terms as one representative example clearly demonstrating the presence of some dwellers there. Arrivals from the north, plus possible penetration from coastal sections, probably increased, mixed and modified the population.

Evidence for man's early arrival in the Valley of Tehuacán more than 9,000 B.P. was uncovered between 1960 and 1963 by Dr. R. S. MacNeish and a team of interdisciplinary specialists working in the area. Cotton (Gossypium Hirsutum) boll fragments were found which, according to Smith and MacNeish, proved the presence of cotton prior to 7,000 B.P. (Figure 8)[6]. The site of the Valley of Tehuacán is approximately sixty-two miles southeast of the city of Puebla.

Two inferences can be drawn: there was a population existant that apparently practiced some sort of agriculture, and cotton, a fiber-producing plant, was also present. To move from this to a statement relative to use of the cotton fiber is not merited. Yet, the ubiquity of man, cultivated plants, and fiber-producing plants of which cotton is but one, suggests some intriguing possibilities that should not be overlooked. By 2,200 B.P. cotton weaving was well

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[6]C. Earle Smith and R. S. MacNeish, "Antiquity of American Polyploid Cotton," Science, 143: 1964, pp. 675-676.

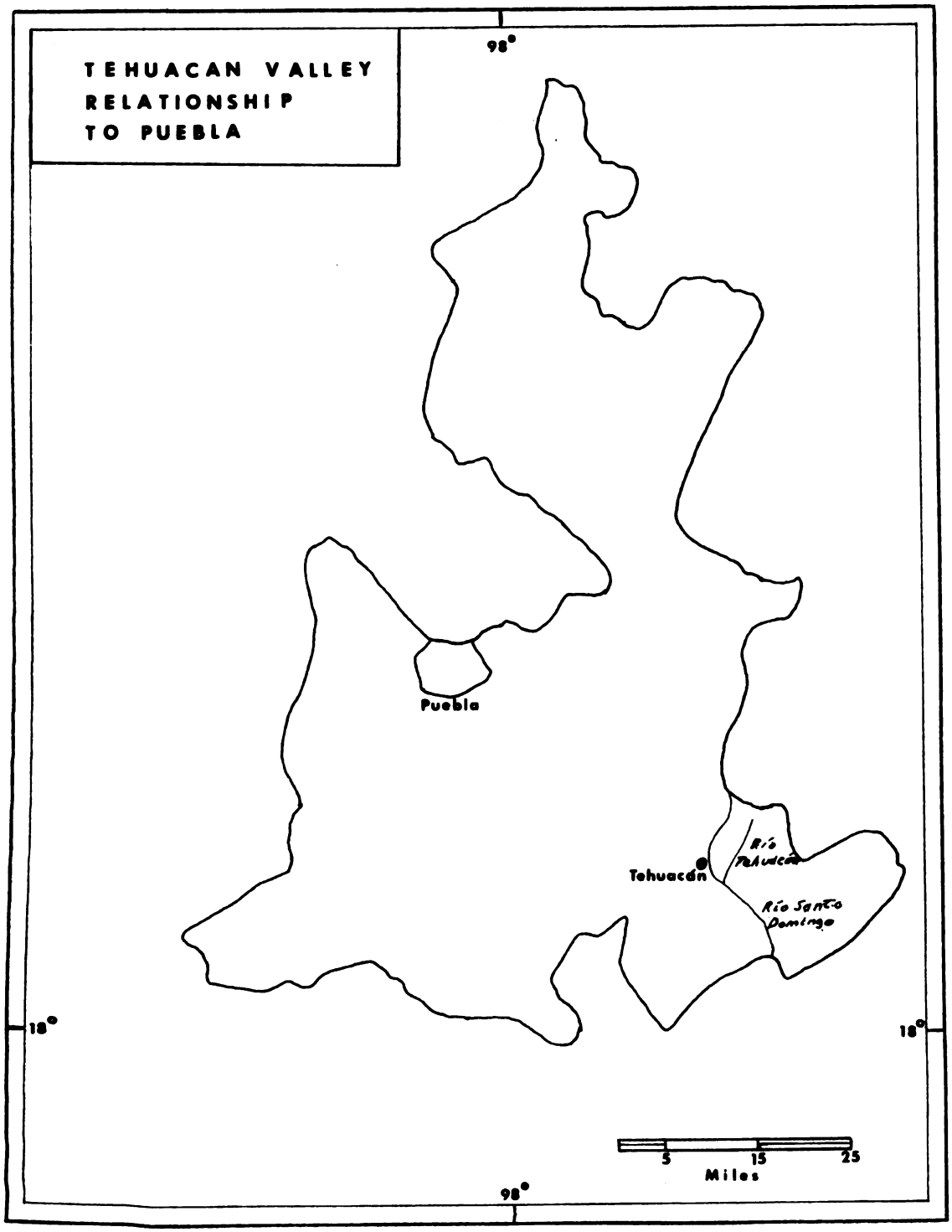
TEHUACAN VALLEY
RELATIONSHIP
TO PUEBLA
98°
Puebla
Tehuacán
Río Tehuacán
Río Santo Domingo
18°
18°
5
15
25
Miles
98°

FIGURE 8

represented, and ". . . a well established knowledge of true loom weaving . . ."[7] is evident.

Cotton was grown and used by indigenous populations throughout Central Mexico, as well as other parts of the New World. It was in production on Cat Island in the Bahamas when Columbus landed there in 1492, and his log indicates that cotton was utilized wherever he visited.[8] Certain it is that Hernán Cortés, (in a letter supposedly written from Veracruz, July 10, 1519, to the Spanish Monarch, Carlos V) describing cotton clothing worn by the Indians, also portrays a well-developed process that is the culmination of many years of evolution.[9] Montezuma's ambassadors brought fine cotton cloth to Veracruz, as well made as any European product. Later when Cortés marched into Cholula (Figure 9, p. 33) there was already a native cotton textile industry in operation.[10] Not all cotton was used for cloth or cordage. One unique use was adopted by the conquering Spaniards for protection.

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[7] Tehuacán Valley, Vol. 2, p. 217.

[8] For a discussion see Francisco Quintanar A., La historia del algodón mexicano, México, D.F., 1962. (Hereafter cited as LHDAM.)

[9] Ibid., p. 44. ". . . y las mujeres principales andan vestidas de unas muy delgadas camisas de algodón muy grandes, labradas y hechas a manera de roquetes; . . ."

[10] Ibid., p. 46. "El 13 de octubre, con batallones de los pueblos sometidos, llega a Cholula, emporio del comercio de las naciones de Anáhuac, de agricultura y la industria sobresaliendo en la fabricación de finas telas de algodón."

The Indians padded their bodies with cotton to repel enemy arrows. Cortés padded his soldiers' jerkins with cotton to protect them from Indian arrows as they marched through Mexico.[11]

Before Mexico was conquered by the Spaniards, cotton was a well known and a much used commodity. It was grown in the south of the State of Puebla for at least 9,000 years and probably longer, although evidence for its use is not clear before 4,000 B.P. By the sixteenth century, clothing woven from cotton was commonly used. In some cases the cloth was interwoven with threads of gold and silver or bright feathers to enhance its beauty. This was especially true for the ruling families. The weaving technique compares favorably with that practiced in Europe at the time of Mexico's conquest, and at least one area is noted as a center for the cotton textile industry when the Spaniards arrived there in 1519. This is Cholula, less than fifteen miles from Puebla de Zaragosa, capital of Puebla.

Colonial

New lands were added to the Spanish Empire so rapidly in the sixteenth century that local development was left to the conquerors or ignored by monarchs who were more interested in extracting precious metals from mines than in agriculture. The consequences were disastrous to localities in the New World. "Spain's concern was always

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[11]Bernal Díaz del Castillo, The Discovery and Conquest of Mexico, ed. Genero García, Trans., A. P. Maudslay (New York: Noonday Press, 1956), p. 6. Also U. S. Department of Agriculture, Cotton Production in Mexico: Recent Developments, prepared for the Foreign Agriculture Service by P. K. Norris, Report 65 (Washington, D.C.: Government Printing Office, 1952).

Spain . . . . (its) colonial economic policy, heavily influenced by mercantilist doctrines to the last, tended to regulate, restrict, and prohibit rather than encourage.[12] Cotton production was not encouraged.[13] Instead, those Europeans living in Mexico concentrated on extracting a maximum profit with minimum effort.

The textile industry, although not eliminated, was reduced to a position of neglect. It was unable to meet local demands in most instances. Even so, cotton was extremely important to Puebla, where it was grown and used for the production of thread and cloth.[14] In 1803, just eighteen years prior to independence, almost half of Puebla's population was said to have been occupied ". . . in cleaning and spinning cotton for 1,200 weavers."[15]

Post-Independence

Independence was no panacea for the solution of Mexico's many problems. In most cases probably little immediate change took place. Prisoners were still consigned to work in the small, stinking, almost

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[12]Charles C. Cumberland, Mexico, New York: Oxford University Press, 1968, p. 95.

[13]Ibid., p. 98. "Venezuelan soil and topography made cotton culture there more attractive and profitable than in Mexico, where the mountainous terrain and the dearth of roads were prohibitive for transportation, and it was the Venezuelan rather than the Mexican colony which received encouragement from the home government."

[14]LHDAM, p. 56. "En la intendencia de Puebla, . . . la industria textil algodonera era de gran importancia . . . habia poblados cuyas principales fuentes de vida eran el cultivo algodoneros y el tejidos de algodón."

[15]Charles A. Hale, Mexican Liberalism in the Age of Mora, 1821-1853, New Haven: Yale University Press, 1968, p. 254.

airless rooms. Those who were not convicts, nevertheless, were captives of the obraje system of debt-peonage. The cotton textile industry ". . . none of it mechanized but employing some 60,000 workers (was left) in complete ruins . . ."[16]

Capital to revitalize Mexico's industries was not readily available. Even though duty-free importation of machinery was granted and the import of cotton products forbidden, textile owners lacked resources with which to act alone. In 1830, the Banco de Avío was established to promote national industry. It was from this source that Esteban de Antuñano borrowed 30,000 pesos with which he was able to purchase machinery and open the Constancia Mexicana in 1835. This was the first water-driven cotton textile factory in Mexico.[17] It was Puebla's initial step toward a modern cotton textile industry. By 1843, twenty-one of fifty-nine cotton mills in Mexico were located in or near the city of Puebla.[18]

Real expansion in Puebla's cotton textile industry did not take place until the regime of Porfirio Díaz, 1876-1911. This may be partially accounted for by railroad construction, which allowed the mills to draw raw materials from the country as a whole. Self-sufficiency, a long-time desire, became a near reality as Mexico

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[16]Cumberland, Mexico, p. 167.

[17]Hale, Mexican Liberalism in the Age of Mora, p. 268-72.

[18]Colección de documentos para la historia del comercio exterior de México III. La industriales mexicanos y el comercio exterior (1848-1852). Publicaciones del Banco Nacional de Comercio Exterior, S.A., México, D.F., 1959.

embarked upon the first decade of the twentieth century. The violent strike of Puebla's mill workers in January, 1907, put down with the help of government troops, was only the forerunner of events to come.

All of Mexico suffered during the interregnum between 1910 and 1924. It was a revolution that changed the social structure and almost wrecked the economy. Haciendas were burned, businesses looted and death stalked everywhere. It was a period of utter chaos. Puebla's cotton textile industry did not escape the conflagration. By 1924 the industry was practically non-existent.[19]

Since 1924 the cotton textile industry has once more become an important factor in Mexico's economic life. A few mills were merely reopened or managed to stagger through the upheaval and have changed little. Others were rebuilt. Today, those under progressive management are modernizing their machinery or, in a few instances, have installed completely automatic machines within the past ten to fifteen years.

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[19]For more information relative to this period see: Cumberland, Mexico, p. 226, 240-59; Hubert Herring, A History of Latin America, third edition, New York: Alfred A. Knopf, 1968, p. 339-66; Raymond Vernon, The Dilemma of Mexico's Development, Cambridge: Harvard University Press, 1965, p. 59-87.

CHAPTER III

RAW MATERIALS

The original source of the cotton plant is speculative. Its recognition for use in the production of thread for making cloth is also lost in antiquity. Whether man first spun cotton fibers from the plant in Africa, Asia, India or the Americas is still a matter for botanists and anthropologists to determine. However, it is known that cotton was present near inhabited areas several thousand years ago, both in the Old World and the New World. It has been identified from the Harappá site in India some 5,000 B.P.[1] It has also been identified from a site in the south of Puebla, in the Valley of Tehuacán, approximately 7,000 B.P. Neither date is cited as representative of the oldest use for cotton in either India or the Americas. The important factor is that one of the early plants found in association with man's habitations was cotton, a fiber-producing plant of great utility in the production of thread and crude cloth. An ability to produce protective covering against the elements may have been as important to early human settlement patterns as the ability to harvest food plants.

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[1] A. L. Basham, The Wonder That Was India, New York: Grove Press, Inc., 1959, p. 18, 25.

Early Supply Regions

Cotton, under the ubiquitous influence of man, has become a peregrinating plant. It is known to have been in use by indigenous populations throughout a vast area of the Americas, and its presence was noted by the conquistadores who landed in Mexico. Cotton was grown at Medellín, near present day Tlacotalpán in Veracruz. Cortés, in correspondence to the Spanish Crown, mentioned cotton and cotton products as present along his route to Mexico City. The city of Cholula is specifically singled out as a cotton textile center. Other chroniclers, Francisco López de Gómara, Bernal Díaz del Castillo and Francisco Antonio Lorenzana, verify these observations. Unfortunately, except for archeological evidence, there are no extant records of either cotton harvest or cloth production prior to the Spanish conquest of Mexico.

Cotton-growing areas were located in what are now the states of Colima, Jalisco, Guanajuato, Querétaro, México, Morelos, Tlaxcala, Veracruz, Puebla, Guerrero, and Oaxaca and the Federal District. It is also mentioned as present in Durango, Sonora, and Sinaloa. Probably cotton was grown throughout Mexico, Central America and the Caribbean prior to the sixteenth century.

Since crude cotton is extremely bulky, it is probably accurate to assume most local production was used for local spinning. Trade in cotton products was carried on actively. Cortés was met by ambassadors of Montezuma in Veracruz and later Cholula. They brought

fine cloth interwoven with gold and silver, as well as threads of red, black, white and brown.[2] From this it is possible to infer that fine cotton cloth was a common gift item. However, it is probable that very little crude cotton was traded over extensive distances. With this in mind the area that furnished cotton to Cholula is shown relatively nearby in Figure 9. The boundary is not fixed. Raw material must either be transported to a processor or the processor must be located at or near the raw material. Initially cotton was probably harvested, spun and woven as a local product.

Present Supply Regions

Cotton may be grown in each of Mexico's political divisions. It is commercially most important where there is ample water, sun and soil. For purposes of cotton location the country may be divided into eight regions.[3] These are (1) the North Pacific Coast, consisting of Baja California Norte, the territory of Baja California Sur, Sonora, Sinaloa and Nayarit; (2) the Central Pacific Coast made up of Jalisco, Colima and Michoacán; (3) the South Pacific Coast, which includes Guerrero, Oaxaca, and Chiapas; (4) the North Interior, composed of Chihuahua, Coahuila, Nuevo León, Durango, Zacatécas, Aguascalientes and San Luis Potosí; (5) the Central Interior, which includes Guanajato,

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[2]Hernán Cortés, Cartas y documentos, México: Editorial Porrua, S.A., p. 31.

[3]In Mexico, the country is commonly divided into five zones: Central, Gulf, North, Pacific North and Pacific South. My rationale for using eight is to more clearly demonstrate relative production.

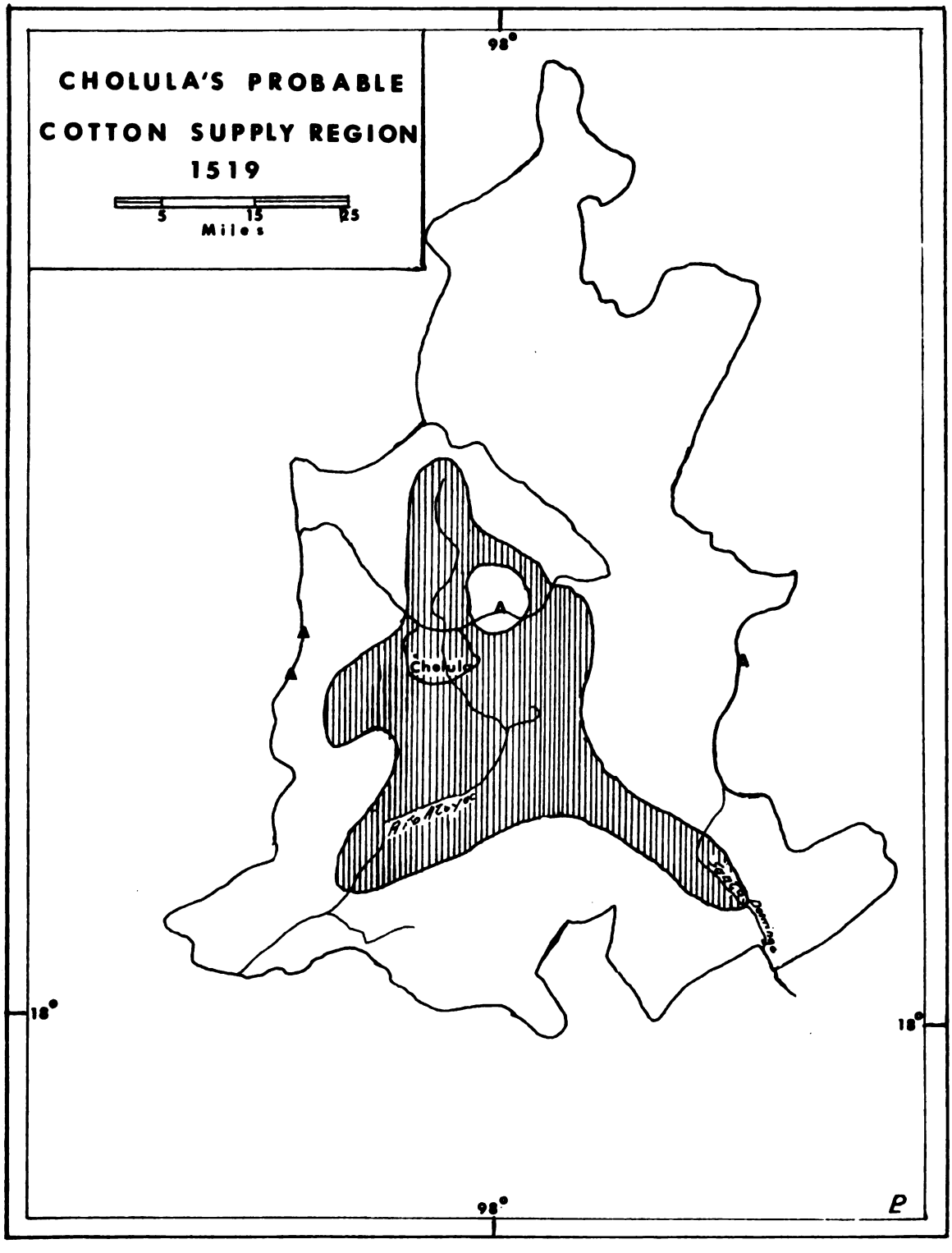
CHOLULA'S PROBABLE
COTTON SUPPLY REGION
1519
5
15
25
Miles
98°
18°
Cholula
Río Atoyac
98°
P

FIGURE 9

Querétero, Hidalgo, México, Tlaxcala, Morelos, the Federal District, and Puebla; (6) the North Gulf Coast or Tamaulipas; (7) the South Gulf Coast, composed of Veracruz and Tobasco; and (8) the Yucatán Peninsula, which includes the states of Yucatán and Campeche and the Territory of Quintana Roo. Important commercial production occurs in all but the latter. The most productive regions are the North Pacific Coast, North Interior and North Gulf Coast. (See Figure 10).

Puebla draws raw cotton from the entire country, but primarily from the North Interior and North Gulf Coast. The preferred cotton is from the Laguna District near Torreón, between Durango and Coahuila. It is cleaner, better quality, and longer staple. This is usually mixed with cotton from other areas to give an improved uniformity to the processed material.

One of the difficulties often mentioned during interviews is that of dirty packs. As much as two percent of some packs contain foreign material that has to be removed before the cotton can be processed into thread. Administrators feel this is an undue burden on the mills, voicing the hope that someone will force the growers and packers to use cleaning equipment so that the cotton will be be received at the factories in better condition. Another concern is expressed over the length of cotton fibers, which is generally in the mid-range between seven-eighths and one and three-sixteenths of an inch, and often between three-quarters and one inch in length. The complaints are justified on both counts. However, it is probably not realistic to expect the growers to upgrade their planting and

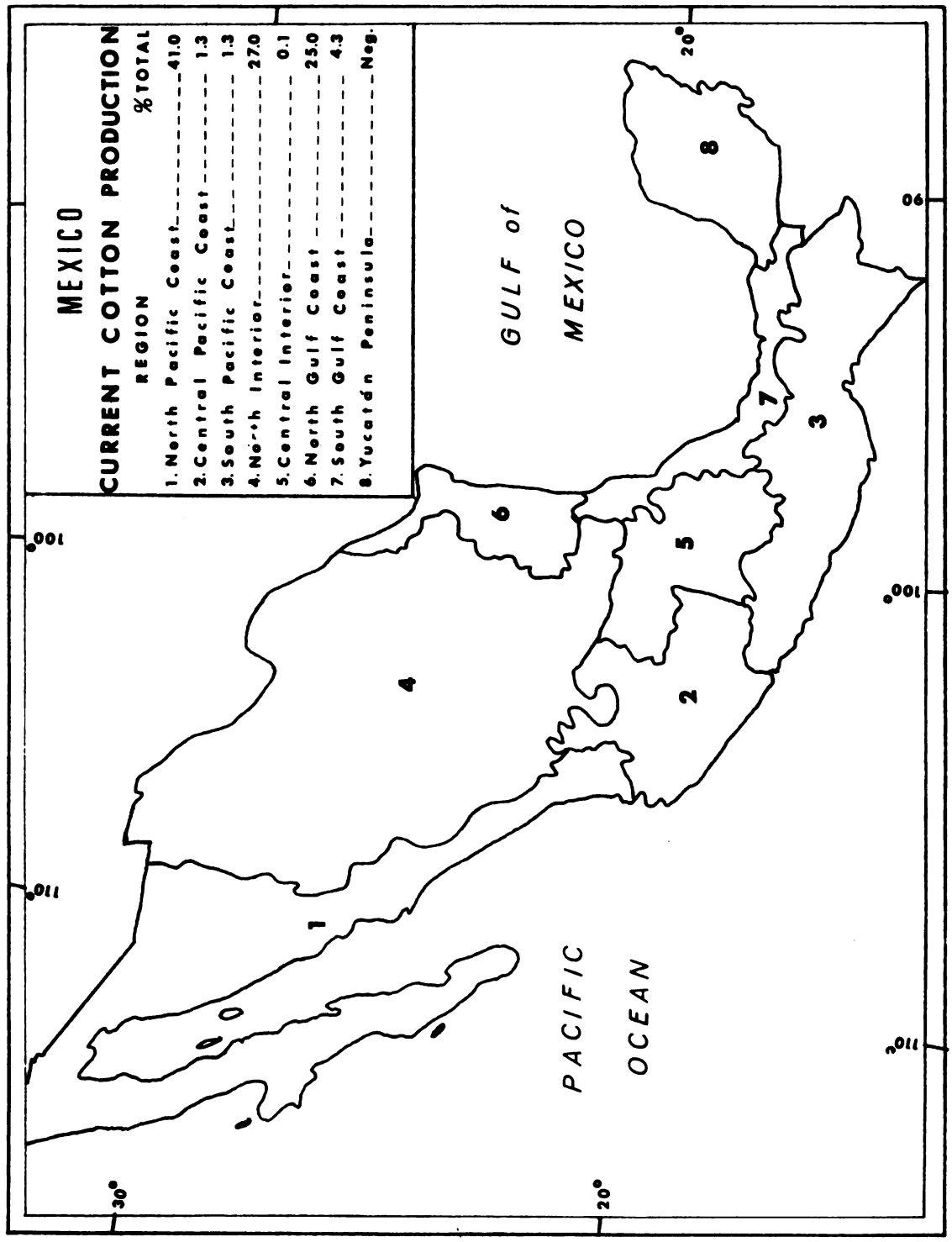
MEXICO
CURRENT COTTON PRODUCTION
REGION
% TOTAL
1. North Pacific Coast 41.0
2. Central Pacific Coast 1.3
3. South Pacific Coast 1.3
4. North Interior 27.0
5. Central Interior 0.1
6. North Gulf Coast 25.0
7. South Gulf Coast 4.3
8. Yucatán Peninsula Neg.
GULF of MEXICO
PACIFIC OCEAN
30°
20°
110°
100°
90°
20°

FIGURE 10

harvesting practices as long as there is a ready market for their current product. It is probable that purchasing practices by factories demanding cleaner, longer staple cotton will have much more effect than complaints voiced in the hope that the cotton will be upgraded.

In summary, cotton is grown in all parts of Mexico. At the present time, the better quality cotton is obtained from the Laguna District near Torreón. But, the quantity from this area has diminished since 1950, and Laguna is no longer the primary cotton growing region of Mexico. Although textile factory administrators are not happy with foreign material in the packs, nor with the length of cotton fiber, it is probable that little change will occur until the ready market for the poorer grade product is considerably reduced. There is, at present, no textile buyers association with power to enforce quality control in the purchase of raw material. Probably little change will take place in upgrading raw material until purchasers refuse to buy the uncleaned cotton from primary sources. The cotton processed in Puebla is purchased from all sections of Mexico, although the greatest quantities come from the northern part of the country. Very little cotton is imported for use in Puebla's textile mills.

CHAPTER IV

POWER

Power is no longer restricted solely to man's muscles or those of domesticated animals. It is true that in some regions of the world, power is still limited to sinews and thews. Rarely, however, is this the sole source of energy. From the first use of club or rock, which may represent an initial domain beyond his muscles, man has reached the point where nuclear energy is leashed to his needs. In a somewhat similar analogy, although less spectacular, the fabrication of cotton textiles has moved from the manual to highly mechanized processing.

Although the step from harvesting wild cotton, perhaps merely as a pad upon which to sleep, to spinning into threads for cord, later still for cloth, is conjectural, spinning and weaving are early accomplishments. Spinning is a task easily performed while walking. Indians of South America spun thread while walking even before the Spaniards arrived.[1] The Indians of Peru, Ecuador and Bolivia still spin thread in this way.[2] Since spinning is so readily performed, it

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[1]Garcilaso de la Vega. The Royal Commentaries of the Inca, ed. Alain Gheerbrant (THE INCAS), trans., María Jalas. (New York: The Orion Press, Inc., 1961), p. 138.

[2]Philip Ainsworth Means. Ancient Civilizations of the Andes. (New York: Gordian Press, 1964), p. 400.

is probable that this task was often continued by migratory populations. This same method may well have been employed by the indigenous population of Mexico. The nimble fingers of the human animal were the first power source used in the processing of cotton into thread.

Manual Power

Thread has many uses. Its manufacture is not necessarily only an immediate step to weaving cloth, and man has, in fact, found other uses for thread such as for the repair of skins, to make nets, or in the production of footwear. The original incentive may have been based upon the method used for making baskets. It probably was not a deliberate attempt to produce large quantities for clothing that is responsible for the first manufacture of cloth. Whatever the rationale, the primary power source was the human hand.

One needs but to visit a handicraft display to see the intricate work and cunning designs made by hand. The simplest weaving patterns require a skill difficult to describe. Variations may demand hours of patient endeavor which can be technically delineated by pages of complicated analysis that in no way assures reproduction. Numerous factors must be considered. The type of fiber selected may be responsible for the use to which it is put. It may be the use which, in turn, is responsible for the selection of a particular fiber. Such seemingly innocent human variables as motor skills, age, sex, and right- or left-handedness must also be considered.

A common device for weaving is the backstrap loom still used by Indian populations in some parts of South America.[3] Although fairly simple in construction and operation (see Figures 11 and 12), it produced designs that were fantastic in their fine detail. Many materials in addition to cotton, such as rabbit fur, feathers, gold and silver, were woven into the cloth.[4] Cloth a yard or more in width and up to eighteen feet long was woven on the backstrap loom. One description of the loom is given by Victor W. von Hagen, who wrote; "the backstrap loom had a horizontal rod that attached to a post or tree. The warp was then fastened to the lower wooden rod, which had a thick hemp cord that went around the ample rump of the woman weaver."[5] His description concisely indicates that women only used this type of loom.

Other types of looms were also employed. Of these, the vertical loom was usually operated by men. The others were operated by women and young girls. The backstrap loom, along with the vertical and horizontal variations remained in use as the most practical even after the conquest by the Spaniards. Little change occurred until the nineteenth century.

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[3] Tehuacán, Vol. 2, p. 191. See also Victor W. von Hagen. The Ancient Kingdoms of the Sun. (London: Thames and Hudson, 1962), p. 191.

[4] Ibid., p. 49.

[5] Ibid., p. 148.

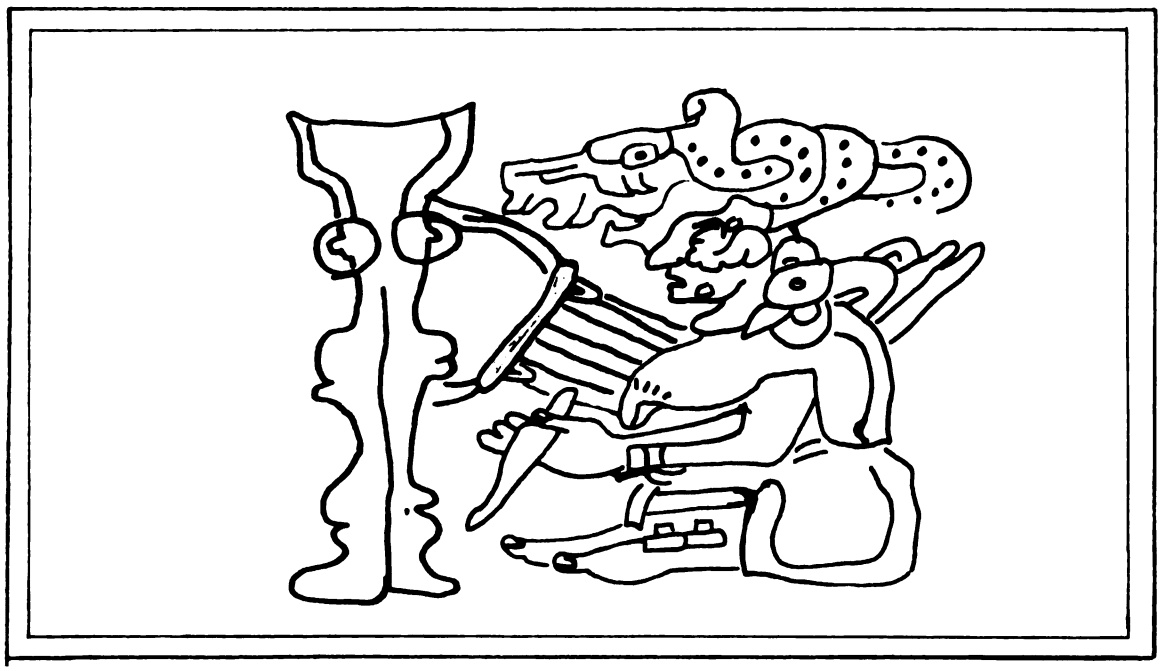

FIGURE 11

Aztec Goddess Xochiquetzal Working at a Backstrap Loom

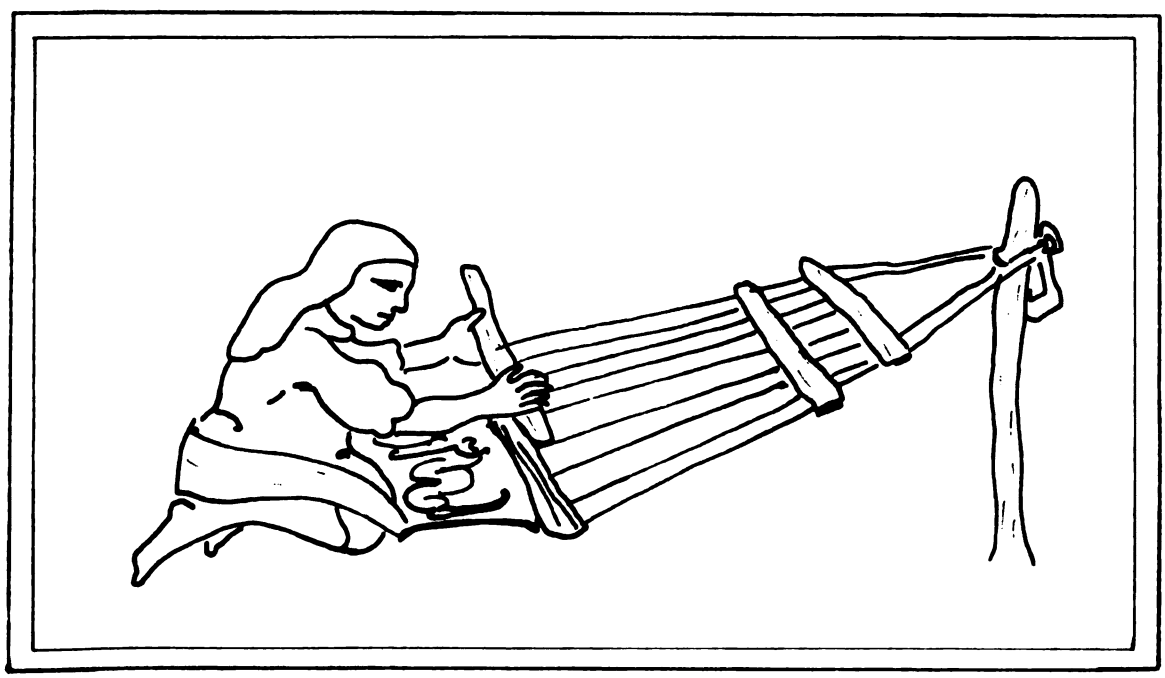

FIGURE 12

Indian Woman Working at a Backstrap Loom

Water Power

"Water-powered pounding mills for fulling . . ."[6] were in operation in Europe at the beginning of the tenth century A.D. But, few innovations were turned to spinning and weaving much before the eighteenth century, when one invention followed rapidly after another. An important step was the invention of the power-loom by Edmund Cartwright. Cartwright was a country clergyman turned inventor and is credited as the first to conceive the idea of applying machinery to weaving. Between 1785 and 1797, in addition to the power loom which was improved and developed into the modern machine, his fertile mind gave birth to a weaving mill, wool-combing machine, and an alcohol engine.

Two types of wheel were used (See Figures 13 and 14) to transfer water-power by way of a cog wheel to mill machines. These are the float-board and over-shot wheels sometimes referred to as the breast-mill and bucket. Where the velocity of the water passing beside the mill is slow the float-board wheel is generally chosen. Speed from the slowly turning wheel may be increased by using a greater number of cogs on the cog-wheel. An over-shot wheel requires a smaller quantity of water but must be used where there is a significant fall. It is often used where streams run swift and shallow. Water is diverted to mill-dams. The stored water is let out by means of a sluice which

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[6]Lyn White, Jr., "Medieval Uses of Air", Scientific American, (92-100), August, 1970, p. 95.

terminates above the over-shot wheel. When power is not needed, the sluice may be shut off by lowering the penstock. Excess water is carried away from the dam by either a spillway (when the dam is located a short distance from the stream) or an over-spill (when the dam is interposed across the stream).

Both types of mill wheel were used to generate power for Puebla's early cotton textile mills. But the float-board, although exceedingly well suited to heavy grinding, was displaced by the over-shot wheel because of the type of water supply most readily available. Irrespective of the wheel used, water power tied mills to locations along streams or where a sluice was employed nearby. In some instances mills were at some distance from population centers, where the most desirable sites had already been pre-empted for other uses.

A partial response to isolation was the construction of massive, high-roofed buildings surrounded by protective walls. Where production of both thread and cloth took place the two operations were usually kept separate. Also, warehousing of raw materials was seperate from the fabricating area. Generally a colony of workers lived nearby, often in company housing built on company land. An analogy might be made to early frontier forts of the United States. Although the primary reason for existence was dissimilar, a similar need for protection and self-preservation existed. The forts served to protect settlers taming a frontier from an indigenous population that resented the invasion of its territory. The fort like mills served an identical function, except that it was for protection during a

period of extensive political turmoil and unrest. One result of bringing workers to the mill was that colonies were formed. Many of these are readily identifiable today.

Little change occurred until the twentieth century, well after hydroelectric power became available. Massive buildings were still constructed after 1910. Isolation continued and water-power was often the primary driving force for mills. Although water-power was at times converted to electric-power, this has been generally practical only since World War II.

Hydroelectric Power

Electricity as a power source dominates modern industry. It is readily transported, easily modified to meet special conditions, may be used at any time, and works tirelessly. More important, the cost of electric power compares favorably with that of any other power source. The use of electricity makes it possible for industry to locate almost anywhere.

Initially, electric-power was generated from water resources. These are still the most prominent. However, a comparison of electric-power generated for Puebla de Zaragosa and the Federal District illustrates the extent to which other methods of generation have been introduced (see Table 3). The only recent development in the production of electric-power not shown is the use of atomic energy. These data clearly demonstrate Puebla's electric-power dominance over the Federal District. It should not be forgotten that the State of Mexico, surrounding the Federal District on three sides is also an excellent electric-

power source. And Mexico City, which occupies the major portion of the Federal District as well as part of the State of Mexico, draws power from the latter and other nearby areas, including Puebla.

TABLE 3

GENERATION OF ELECTRICITY IN THE FEDERAL DISTRICT AND PUEBLA, 1960 AND 1967

Area and Date	Hydraulic (KW)	Thermal[a] (KW)	Total
Federal District:			
1960	2,760	164,004	166,764
1967	1,360	195,207	196,567
Puebla:			
1960	243,658	48,749	292,397
1967	444,437	52,205	496,642

[a]Includes generation by combustion and gas.

Source: Estados Unidos de México, Secretaría de Industria y Comercio, Dirección General Estadística. Anuario estadístico de los Estados Unidos Mexicanos, 1960-1961 and 1966-1967. México, D.F.: Tellares Gráficos de la Nación, 1963 and 1969.

Puebla has adequate power for the present and foreseeable future, most of it generated by water. In contrast, more than 99 percent of the electricity generated for the Federal District is from sources other than water.

CHAPTER V

TECHNOLOGY

Use of the word "technology" is widespread. A popular understanding views it as synonymous with machines, for example automobiles, ships and airplanes, and the development of photography, television, computers, printing and many more. This view is not incorrect, merely incomplete. Technology is spectacular in success. It is proudly touted as a savior by some and as an invidious slave-maker by others. Failures, such as the perpetual motion machine, are waggishly laughed away. Yet, both failures and successes are a part of technology. In a real sense, all aspects of man's attempts to satisfy his requirements are manifestations of technology.

Pre-Spanish Technology

Sixteenth century Mexico was in no way a barren waste. It was a land occupied by several sophistocated social units acting and interacting among and between themselves. An elaborate bureaucratic government prevailed. Structured statuses with well-defined privileges, duties and powers supported, and in turn were supported by, the governing force. War and the techniques developed to prosecute it represent one facet of technology, e.g. weapons and body-armor. Both massive and monolithic architecture were practiced. Trade took place

over long distances and included such items as washed gold, quetzal feathers, cocoa and cloth.

Tenochtitlán may have been one of the largest cities in the world in the sixteenth century, with a population of more than a quarter-million.[1] Nearby, Teotihuacán, a fallen empire little more than a zone of admired structures to the rulers of Tenochtitlán, is estimated to have held sway over more than a million inhabitants and to have been a city of 100,000.[2] Cholula, a vassel state of the Aztecs, may also have had a population of 100,000.[3] One description portrays Cholula as rich, solidly built, with more than four hundred lofty towers. Outlying areas were irrigated, and its inhabitants were well dressed in fine clothes made of cotton.[4] Cholula was also called a cotton textile center by the Spaniards.

Although spinning and weaving were well developed, power was manual. But, so impressed were the conquerors by the results of

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[1]Gordon R. Willey, An Introduction to American Archeaology, Vol. 1, North and Middle America, Englewood Cliffs: Prentice-Hall, Inc., 1966, p. 157.

[2]Ibid., p. 114 and William T. Sanders and Barbara J. Price, Mesoamerica, New York: Random House, 1968, p. 31, 208.

[3]_____., Ibid., p. 208.

[4]Peter Martyr, De orbo novo, Francisco Augustus MacNull, trans., London: G. P. Putnam and Sons, 1912, p. 83. See also LHDAM, p. 44 and Sanders and Price, Mesoamerica, p. 145-151.

Cholula's spinning and weaving artisans that an entire ship was filled with their products and returned to Carlos V as representative of the indigenous population's production.[5]

Technology of the Interim Period, 1521-1831

It is necessary to understand the social atmosphere to recognize how it contributed to maintaining a stability that neither desired nor encouraged innovative technological change.

Although it seems obvious from a current vantage point that the population of Mexico represented a skilled and capable civilization, much of the Spanish colonial policy was based upon the presumed incapacity of the Indians. An assumption of childlike characteristics, which prevented the natives from learning the complex economic system of the Spaniards, was fabricated upon false premises which gave birth to the repartamiento, encomienda, and debt peonage. Although unfounded, these assumptions so tenaciously adhered to were superimposed with such determination that debt peonage survived into the early twentieth century and was partially responsible for embittered relations between labor and capital.

Because technology was sparingly applied to the textile industry, very little change in the manner of spinning and weaving occurred prior to Independence. Even so, the Puebla area dominated in the production of cotton textiles despite apparent lack of interest by

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[5] LHDAM, p. 44, and Sanders and Price, Mesoamerica, p. 145-151.

the Spaniards in promoting the cotton textile industry of Mexico. Fine quality was possible, but the usual product was coarse and used almost exclusively by non-Europeans. Little attention was given to improving the source material, and imports were often unreliable due to transportation costs, confiscation or unavailability. Yet, the textile industry grew in spite of problems, rather than because of any determined effort on the part of the Spaniards. "Of the three hundred years that Mexico was a colony, no historical evidence exists to demonstrate Spain's special interest in cultivating and exploiting cotton."[6]

Soon after their conquest of Mexico, the Spaniards founded the city of Puebla de los Angeles less than twelve miles from Cholula. Native weaving, with no change of technology, was transferred to the new city where the only innovation introduced by the Spaniards was congestion. Many weavers were brought together in almost airless, ill-lighted rooms to produce textiles. Quantity at first increased, but quality was almost lost.

In the textile industry, at least, very little technology was brought to Puebla other than that employed in constructing the buildings where the spinning and weaving took place.

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[6] LHDAM, p. 142, "De los 300 años que vivió México como Colonia, no hay dato histórico que recuerde se haya algodonero [sic], por los conquistadores."

Modern Technology

Modern technology began about the time of Mexico's independence from Spain, and the introduction of water-powered machinery marks the primary technological advance of the nineteenth century. Although some innovation began soon after Edmund Cartwright's invention of the power loom late in the eighteenth century and the rapid application of water-power to spinning and weaving early in the nineteenth century, modern technology applied to the cotton textile industry occurred in Mexico after 1830. The first modern cotton textile factory was the Constancia Mexicana, which opened in 1835 at Puebla. By 1843 more than 35 percent of Mexico's water-powered cotton textile factories in operation were in or near the city of Puebla. Water-power remained the primary source of Puebla's cotton textile industry until the twentieth century.

A few cotton textile factories introduced electric-power late in the nineteenth century. But, because only the major ones had the resources to install large generating plants, its use was not widespread. For those plants where a central generator was in operation, numerous shaft and pulley devices were installed with belts to operate the machinery. With power machinery, during a period of relative political calm, the cotton textile industry used technological gains brought to Mexico from Europe and the United States to increase productive capacity to a point of almost meeting domestic needs.

Beginning in the 1940's new mills employing modern machinery were constructed. Old mills were converted to electric-power. Because of obsolete machinery, even though the quantity increased, quality suffered. Machinery constructed to operate with water-power, although converted to electric-power, was less and less able to compete with new all-electric machines.

Since World War II high-speed cleaning, packing, carding, spinning, weaving and other automatic and semi-automatic cotton textile industrial machinery has been introduced (See Figures 15-22). Highly automated mills are capable of producing higher quality textiles more rapidly than the older converted mills. Some of the largest mills in Mexico, unable to compete, are now out of business. The mix in Puebla runs the gamut from textile mills with machinery installed before the turn of the century, and still operating, to those put into operation within the past five years. The latter, with thirty employees and running at less than full capacity, often produce more than older mills with as many as 150 employees.

Although modern machinery is imported from such diverse countries as the United States, England, France, Portugal, Italy and Czechoslovakia, much of it is now manufactured in Mexico. Toyoda of Mexico produces almost one-half of the new machinery.

FIGURE 15

Statue of Esteban de Antuñano, in the Paseo Bravo, Puebla, Mexico

FIGURE 16

Legend on the Statue of Esteban de Antuñano, in the Paseo Bravo, Puebla, Mexico

FIGURE 17

Cleaning Preparation

FIGURE 18

Packer

FIGURE 19

Carding

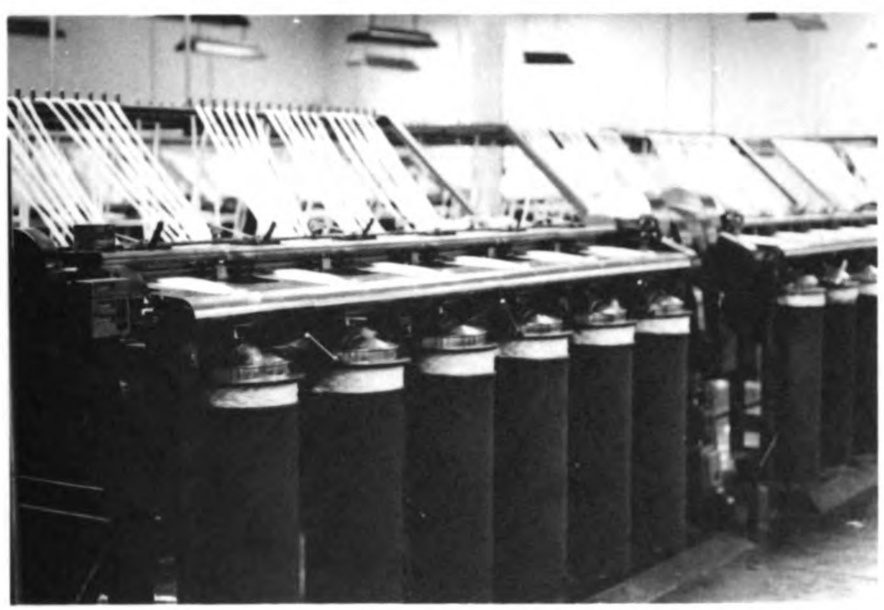

FIGURE 20

Reprocessing

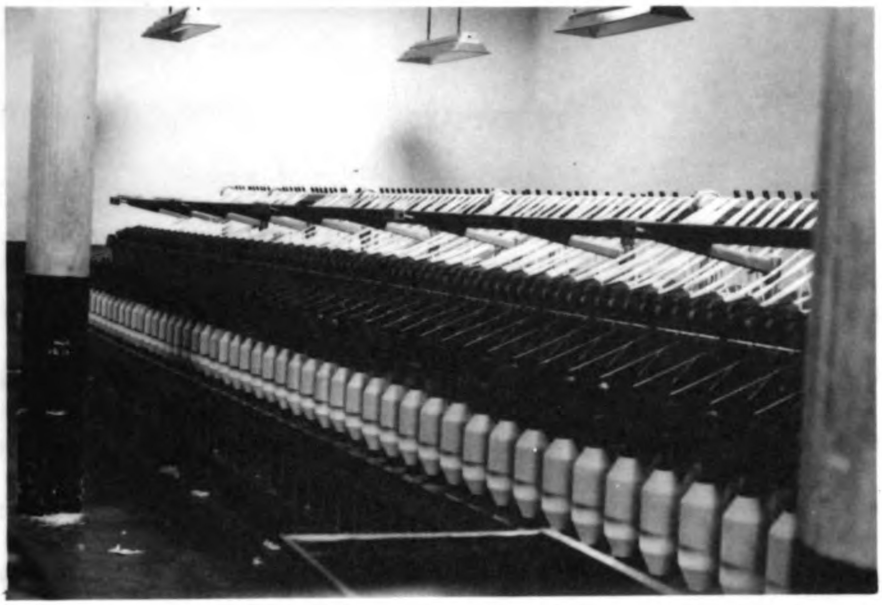

FIGURE 21

Loom

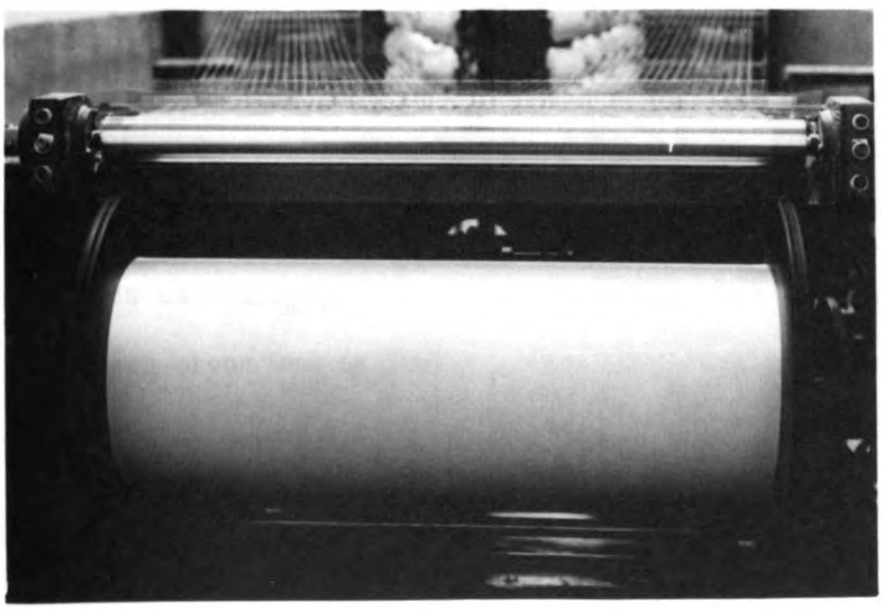

FIGURE 22

Sizing Drum

CHAPTER VI

TRANSPORTATION

Land transportation throughout pre-conquest Mexico was confined to foot travel and litters borne by humans. Although the wheel was known, as evidenced by its use on clay toys, no archeological discovery indicates that it was ever put to more practical use. Since draft animals were unknown, foot travel was the connective of commerce. But travelers were not forced to blaze new pathways for each trip, because trails were well known and routes well marked throughout all of the settled area. Regular paths connecting Central Mexico with other parts of Middle America, the coasts, and the north were also well known and marked.

Some broad highways existed. These connected major ceremonial centers, and some extended to a distance of seventy miles.[1] Shorter roadways served major population centers, radiating to and from market places. Such carefully prepared roads were not common because primary travel between areas was on foot.

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[1] J. E. S. Thompson, The Rise and Fall of Maya Civilization, Norman: University of Oklahoma Press, 1954, p. 66.

It is safe to assume that factors in addition to the shipment of goods contributed to Cholula's reputation as a textile center. The praise for Cholula's textiles by the invading Spaniards may be cited as an indication of the quality of cotton products. Movement of Cholula's cotton textiles was probably associated with market days and people coming to the city for trade, rather than by traders from the city going out to the surrounding countryside.

Animal Transport

Cortés landed his men and horses at the harbor of San Juan de Ulloa in 1519. In a relatively short span of time the horse spread until its wild descendents roamed the mountains and plains of western North America. The aborigines' initial reaction of fear and bewilderment was replaced by exploitation. Although horses originally belonged only to the Spanish conquistadores and their descendents, it soon became impossible to keep them out of the hands of the natives.

More important than the horse for relieving the burdensome loads carried by human convoys was the mule. Although somewhat intransigent, mules became the primary movers of goods, and the call of the muleteer became common. So important was the mule to trade in Mexico that without it commerce would have floundered. As late as the 1850's, more than three centuries after the arrival of the conquerors, "the arriero [muleteer] served as the instrument for the small commercial interchange then going on."[2]

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[2]Cumberland, Mexico, p. 160.

Without the mule Puebla's cotton textile industry might well have languished. Crude cotton is extremely bulky and difficult to transport long distances by human carriers. Since the mule is able to carry relatively heavy loads over difficult terrain, it was the primary mover of the raw material for the cotton textile mills until late in the nineteenth century. During the difficult period immediately following independence from Spain, the mule was practically the only means of transporting supplies to keep the textile mills of Puebla in operation, while in Guadalajara the mills were forced to produce for local consumption only because raw material brought in, even by muleback, was too expensive.

Highways

"Mexico will add more than 50 percent of its highway network during the next five years . . . . plans call for construction of 31,000 kilometers (about 20,000 miles) of highways during the remaining five years of the administration of President Luis Echaverría . . . ."[3] Even so, hundreds of small villages remain isolated. Baja California Sur territory does not have an all-weather highway connection to the north, and much of interior Oaxaca and Chiapas are without satisfactory roads. Nevertheless, nearly all primary highways converge upon the capital. As a result, it is almost a necessity to drive through Mexico City when travelling from one part of Mexico to another. Nor is this a recent development in Mexico.

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[3] Times of the Americas, July 14, 1971, Vol. XV, No. 27, p. 7, Col. 3.

During the colonial period mine-roads were marked out, but though well guarded and secure they were uncomfortable and poorly maintained. "The roads in general were so miserable and so scarce that most materials moved by pack train rather than wagon. The transportation system was so ineffectual, . . . [that] in some regions corn would go begging . . . while less than 100 miles away the poor could not afford to buy it . . . . Every road leading to the mines had its towns surrounded by agricultural or pastoral activities."[4] Even during this period the presence of roads had a positive effect upon land use. But in the three hundred years of Spanish control, "the Spanish Crown . . . did almost nothing for road construction."[5]

Independence brought little change. The only roads worthy of the name connected Veracruz, via Puebla, with Mexico City. Although highly successful toll roads, they were abandoned between Hidalgo's unsuccessful revolt in 1810 and 1829 when Guerrero's short-lived term of office began. Only intermittent attention was given to highway construction, and in 1928 less than 400 miles of roads were in existence. Of this total, 162 miles were all-weather roadways and approximately the same mileage was paved.

Since 1928 Mexico's highway mileage has more than doubled each decade to a total exceeding 43,000 miles by 1970. Broad super-highways

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[4]Cumberland, Mexico, p. 94.

[5]Ibid., p. 155.

connect the capital with Guadalajara, Veracruz, and other cities of central Mexico. Others are under construction so that eventually a network of four-lane highways will connect the cities of the north with central and southern Mexico. But, all roads still lead to Mexico City.

One of the fine highways of Mexico connects Puebla with Mexico City. Much of the raw material presently used by the cotton textile mills is brought in by truck. It is the most flexible method for transporting bulky cotton bales to the mills. Even when brought to Puebla by train, final shipment is generally by truck because only the largest cotton textile mills have railroad spurs. The majority rely upon truck transportation to bring raw material to the plant and to distribute finished cotton goods.

Railroads

"In 1837, amid great enthusiasm and glowing oratory, the government let the first concession for a railroad to connect Veracruz and Mexico City."[6] Santa Anna granted a new concession for the same route five years later because nothing had been done. After three miles, and seven years, the contract was again concelled, after which the State of Veracruz took over and opened the first rail line in 1850. By 1860 only fifteen miles of railroad existed in all of Mexico. Construction began initially at Veracruz, where twelve miles extended from the port

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[6] Ibid., p. 162.

inland. Three miles were in Mexico City. In 1880 some 400 miles of railroad were in operation. The primary route connected Veracruz and Mexico City via Tlaxcala, where (at Calpulalpan) a feeder line tied in from Puebla. Toluca and Cuautla tied in near Mexico City and Jalapa Enríquez, north of Veracruz, was also connected by rail to the main line.

Except for the trans-isthmian railroad across the Tehuantepec, east-west networks were not completed until after 1910. Cities less than 100 miles apart were connected only through the United States, forcing long and expensive shipment by rail or the use of pack animals which might take equally as long and were at times even less reliable. Since no direct connection existed, commercial intercourse was ignored. Even now some areas are connected only by way of circuitous north-south railroad lines or graded highways that are sometimes closed.

It was not until the years 1945-1950 that Mexico began rebuilding its railroads to one standard guage. Prior to this time multi-guage service forced expensive rehandling. By 1956 good rail service became available, completing the crucial task of tying the nation together. Progressive rail management and accelerating highway construction are eliminating pockets of isolation and helping to create a national market economy.

Puebla's rail shipments must still move far northward via Calpulalpan or south and then north through Cuautla to Mexico City. From Veracruz, railroads connect at Calpulalpan or extend northwest to

Jalapa Enríquez, then southwest to Puebla. All crude cotton shipped by rail must come through the capital city, unless it is brought to Veracruz by ship and freighted from there to Puebla.

Water Transport

Canoes and boats plied the waters of Lake Texcoco, bringing produce to Tenochtitlán from the surrounding areas. Probably lakes Zumpango, Joltoca, Xochimilco and Chalco also served for transporting goods, and rivers, where possible, undoubtedly aided in the movement of produce. Since none of the waterways connected to the coastal area without the interference of natural barriers to navigation, nor were they extensive enough to permit the development of large trade areas, they helped the local trade without contributing significantly as a means for transporting large commercial shipments.

Until independence, sea commerce was by law limited to trade with Spain and consisted primarily of precious metals extracted from the mines. But independence brought no commercial panacea to the new country. Since internal industry was practically non-existent except for mining, almost all machinery for the fledgling industries came from Europe to Veracruz where it was dismantled and packed overland. Because of an ardent protectionist policy, international trade was extremely slow to develop.

Puebla imported crude cotton through the port at Veracruz. Without raw material from the United States during the early years

following independence it is doubtful whether the cotton textile industry would have survived. Imported cotton remained important until well into the twentieth century when Mexico became self-sufficient in production. Although some special long staple cotton is still purchased from overseas, almost all of Puebla's raw cotton is now grown in Mexico.

Air Transport

Air transportation to and from Puebla is not well developed. Although there is an airport in Puebla it is located near the military base and utilized primarily by the armed forces. Charters may be arranged, but no regular passenger service is in operation. Air service does not contribute significantly to the cotton textile industry at the present time.

Summary

Transportation of goods, although well developed, was primarily by human convoys until well after the conquest. Pack animals introduced by the conquerors of Mexico served only to change the burdens from human to animal without greatly improving existing paths and trails, and as late as the mid-nineteenth century movement of goods was laborious, circuitous, and expensive over poorly developed roads that were ill-marked and often the target of local brigands. Because of natural barriers, internal water transportation never became a significant factor for the movement of produce. Only relatively

recently have good overland road and rail transporation networks been developed.

The mule brought raw material to the mills of Puebla for processing and also first permitted the wide dissemination of finished goods. Today, the ubiquitous truck has replaced the mule and moves both the raw material to the mills and finished products to all parts of Mexico. Since neither rail, water, nor air transport is well developed in Puebla, the importance of the truck should not be underestimated.

CHAPTER VII

MARKETS

"Markets are a good index to the principal products of a region. Most Mexican markets . . . have not changed greatly from pre-Hispanic times . . . ."[1] Although they have been supplemented by goods from Europe and Asia, those items most in evidence are related to indigenous products with a long history of use.

Internal Markets

Pearls from the Gulf of California, shells from the Pacific, quetzal feathers from Central America and copper from northern Michigan all contributed to the pre-historic trade of Central Mexico. Cacao beans, in addition to furnishing a comestible, also functioned as a medium of exchange. Tribute from satellite areas increased both the variety and volume of useful items brought to the Aztecs. Cotton and cotton cloth were among the main tribute items furnished the Aztecs by conquered peoples.

Cholula, noted for fine cloth, furnished much of the cotton material used by the Aztecs. The Cholultecas owed allegiance to

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[1]Hugh C. Cutler and Thomas W. Whitaker, "Cucurbits from the Tehuacán Caves," The Prehistory of the Tehuacán Valley, Douglas S. Byers, General Editor, Vol. 1, Environment and Substance, Austin: University of Texas Press, 1967, p. 218.

Central Mexico because they were conquered from there. Tribute, in the form of cloth woven from thread spun at Cholula, commonly adorned the Aztec nobles. Cholula's production of cotton cloth resulted from a long tradition of spinning and weaving in the territory under its control.

Occupation levels from Coscatlán Cave, in the Valley of Tehuacán, have permitted almost complete reconstruction of the chronology of the life and activity of the people of this area for 12,000 years. At approximately 7,000 BP domesticated plants such as corn, squash, beans, chili, gourds and cotton began, and those tools and implements associated with such domestication laid the foundation for a more sedentary life-style.

Numerous fibres and yarns found _in situ_ provide evidence of a developing spinning and weaving tradition carried forward in the surrounding area. There is little doubt that the immediate precursors of the Cholultecas were skilled in the arts of cotton textile fabrication for at least a millenia before the arrival of Cortés.[2]

Although fine textiles were also traded from Oaxaca, and by the Huastecans and the Tarascans, the colonial and modern development of Mexico's cotton textile industry concentrated in the Puebla area. Puebla has been the focal point not because it was the prehistoric

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[2]Irmgard W. Johnson, "Textiles," Byers, _Ibid._, Vol. 2, pp. 191-226 inc.

textile center, but simply because subsequent development continued the tradition of spinning and weaving begun in Cholula.

Historical Trade

"When Cortez first visited the market at Tlaltelolco [he] saw the vendors of herbs and medicinal plants . . . Passing on, he encountered a section devoted exclusively to clothing--some of it beautifully embrodered--and to materials from which clothing could be fashioned; here lay heaps of cotton textiles, . . . the coarser textiles made from the fibres of various maguey-like plants, the tanned and untanned skins of animals, and occasionally a rare piece of textile made from animal hair."[3] Tlaltelolco, Tenochtitlán's rival in central Mexico, was roughly analogous to an industrial center, with raw materials supplied from outlying areas. Although goods and produce flowed into the Aztec's home territory at the time of its conquest and for a time thereafter, colonial policy soon reduced this flow to a trickle and eliminated certain trade items altogether.

Almost from the moment Cortés set foot on Mexican soil, mineral wealth (especially gold and silver) lured him and those who accompanied him, blinding them to all else. Small deposits exploited at Taxco whetted appetites. But, even the failure of Coronado's expeditions to locate the fabulous seven Cities of Cíbola failed to deter the adventurers. Finally, in 1546 Juan de Tolosa, with native help, discovered a vast deposit of low-grade but exploitable ore, and the

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[3]Cumberland, Mexico, p. 34.

subsequent swarming miners and mine operators built the city of Zacatecas at the foot of La Bufa. Thus began extraction of the primary export and, although more than 500 districts eventually contributed their precious ore to Spain's coffers, more than 90 percent came from only thirteen.[4]

Spain exercised tight monopolistic control of all trade. Mining occupied the pre-eminent position while cotton, indigenous to Mexico and serving as the common clothing fibre for the pre-conquest population, deteriorated to such an extent that the entire colony failed to produce enough to maintain its stumbling textile industry despite a population decline. The Spanish market was supplied from Venezuela, where soil and topography made cotton culture more attractive.

Central Mexico, indeed all of Mexico's thriving internal markets, were divided into self-sufficient enclaves each striving to survive. ". . . Mexican colonial output presents a dismal picture . . . Cotton, paper, cacao and distilled beverages, all of which could have been produced in Mexico at less cost . . ."[5] accounted for almost 75 percent of all imports. Such cotton textile manufacture as survived did so more as an accident than from any deliberate policy attributable to the conquerers.

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[4]Guanajato, Catorce, Zacatecas, Real de Monte, Balaños, Guarisamey, Sombrerete, Taxco, Batopilas, Zamapán Fresnillo, Ramos, and Parral.

[5]Ibid., p. 105.

Current Trade

Mexico City, with a metropolitan population approaching 8,000,000, draws marketable goods from every section of the country. The city is the lure for business, the destination for produce and the seat of government. Mexico City dominates Mexico and the life of the nation, yet the cotton textile center is Puebla, the historical focus for the spinning, weaving and finishing of cotton products.

Puebla's raw material is drawn from the north, especially Tamaulipas, but the warm Pacific coastal areas of Oaxaca and Chiapas, and Veracruz along the Gulf, also furnish some cotton. Other areas, too, supply raw material to be finished in Puebla. Although some cotton is imported, the bulk is grown in Mexico. The preferred source remains the Laguna District, around Torreón, because of its better quality and longer staple. Nevertheless, present sources vary considerably.

Although Puebla markets cotton goods to all of the nation, most of the medium to large mills have warehouses in Mexico City for distribution there. Approximately 23 percent, by volume, is distributed in the capital city. Warehouses are also maintained in other major interior cities, as well as in Veracruz where supplies are accumulated and prepared for shipment overseas.

External Markets

The pre-Hispanic settlers of central Mexico, an expansion-minded people, occupied themselves by extending and securing their own borders. The greatest export may well have been their fighting ability rather than any products. They were consumers of tribute goods from conquered peoples, as well as from unconquered neighbors.

Spanish Policy

Spain's dedication to mercantilism led to a welter of regulations, most of them restrictive, that stimulated little in the way of sound economic development. Trade between the colonies flowed through Spanish hands, bringing little profit to the primary producer. Although Mexico occupied the premier trading position among the colonies during the colonial period, Mexican industry scarely got off the ground because of the monopolistic practices of Spanish merchants who fought any local colonial manufacturing development.

The only exception within private industry to these monopolistic practices was the textile industry of Puebla, Guadalajara, and Querétaro, where some 5,000 laborers produced textiles valued at 1,800,000 pesos. Yet, not enough was produced to meet the clothing needs of the Mexican market, even when supplemented with the cheaper textiles from thousands of native looms. The textile industry that furnished the first five shiploads of fine cloth to Spain was, under colonial policy, unable to clothe the reduced population of Mexico.

"Exports always exceeded imports . . . Precious metals accounted for about three-quarters of the total export value . . ."[6] The extractive industry so dominated that everything else came in last, and on the eve of Mexican independence it was almost the only developed exporting segment of the economy. However, "marching armies, roving bands, and fleeing citizenry . . . devastated the colonial economy upon which the new nation was to be founded."[7] By 1822 gold and silver production scarcely reached 40 percent of pre-independence totals.

Mexican Policy

Rhetoric to the contrary, Mexican policy was little more than one staggering attempt after another to stabilize a national government. The struggle for independence left the country in precarious financial straits without a firm base upon which to rebuild. Fleeing peninsulares took their capital with them. Since this was often in the form of silver coin and plate, their flight removed the circulating medium. The economy was paralyzed.

The cotton-textile industry, which could not supply colonial needs, produced less than half its pre-independence output. Shipments of cotton over almost non-existent roads, or roads and trails under constant attack, came to a complete stop, and although import restrictions encouraged domestic textile production it never met domestic demands.

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[6] Ibid., p. 105.

[7] Ibid., p. 130.

Raw cotton brought as much as fifty cents per pound, yet for lack of adequate transportation the economic feasibility of production was limited to haciendas near the textile mills of Guadalajara and Puebla. Even so, much of Puebla's industry operated on raw cotton packed in from Veracruz that had been imported from the United States, where cotton sold for fifteen cents a pound. By 1868, transporting raw material from coastal regions added so much to costs that the textile industry of Guadalajara faltered and was forced into producing only for local markets.

Mexico's entire export pattern attests to the lack of any real industrialization for almost 400 years. Decendents of the conquerors in the early twentieth century were still dreaming of El Dorado, and minerals still dominated.

An interregnum of utter chaos followed. During the bitter second revolution, 1911-1924, the most spectacular growth attained took place in the national debt. For the third time in less than 100 years, Puebla's cotton textile mills were destroyed or reduced to ineffective arbitrary production. Any export that had developed ceased to exist. And, until World War II progress was almost capricious.

The interruption of supply lines throughout the world caused by the Second World War actually gave impetus to the cotton textile industry in Puebla. However, with the end of war came a need for readjustment that was not forthcoming, and even though inertia carried high productivity into the decade of the fifties business began to

decline. The boom year 1951 found the industry operating at less than 50 percent of capacity, and two years later 27,000,000 Mexicans consumed less cotton cloth than 19,000,000 had in 1936.[8]

Two factors have aided recent performance in the world market. First, new machinery purchases, ignored by manufacturers during and immediately after World War II, were once more encouraged. Yet, even in 1960 less than 250 million pesos went for new machinery, whereas by 1969 new machinery and parts, importation alone, amounted to almost a billion pesos. This is an increase of more than 300 percent. Much of the cotton textile industry, especially the larger mills, converted to blends. "During the year [1969], the industry oftentimes worked on a four-shift basis, and unlike 1968 it was not affected by a mid-year nationwide strike."[9] Even so, two mills in Puebla, La Beneficiencia and San Alfonso, closed during 1969. Second, the agricultural sector not only meets most of the domestic needs but also produces a sufficient surplus to permit export of crude cotton. This allows Puebla's cotton textile mills a self-sufficiency almost impossible when crude cotton imports were necessary.

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[8] H. G. Aubrey, "Structure and Balance in Rapid Economic Growth: The Example of Mexico," Political Science Quarterly, 690 (December, 1954), 514-520.

[9] Business Trends. The Mexican Economy. First National Bank, Mexico Branch, Mexico 1, D.F. 1969.

CHAPTER VIII

CAPITAL

"Economic growth is associated with an increase in capital per head."[1] But no amount of data manipulation demonstrates such an increase in Mexico for more than 400 years. The apparent increase during the early colonial years is the illusory effect of a rapidly declining indigenous population and the exploitation of previously unused non-renewable and sub-surface resources. Until well into the twentieth century the extractive industry exercised an almost hypnotic effect upon the investors in Mexican economic development.

Foreign Investment

In one sense the first foreign investment may be considered to be the early colonos who settled the newly discovered lands. Certainly Spain invested heavily in the support system, but other than knowledge little capital flowed to Mexico. Capital flow moved in the opposite direction as the deposits of gold and silver from a seemingly inexhaustable source poured in to support the Spanish monarchy. Spain's investment brought rich rewards.

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[1] W. Arthur Lewis, The Theory of Economic Growth, Homewood, Illinois: Richard D. Irwin, Inc., 1955, p. 201.

When Mexico finally separated from Spain, two "foreign" interests dominated the emergent nation. The church's control of large tracts of land remained unbroken for almost 100 years. Spanish economic control, more visible and therefore more galling, merely shifted to the hands of the creoles. Even under Juárez both firmly maintained their privileged status.

Under Díaz, foreign investment increased until American capital alone controlled more than half of Mexico's national wealth. "Foreign capital completely monopolized certain economic activities, and the entire public debt rested in the hands of foreigners."[2] Americans controlled much of the cement industry, utilities, railroads and minerals; Spanish and French interests dominated foodstores and the textile industry; Germans owned the hardware business; Englishmen concentrated upon electric power, utilities, railroads and minerals along with the Americans; and, even the Belgians and Canadians invested heavily in power, utilities and railroads.

Ironically, Porfirio Díaz is also responsible for much upon which the modern economy of Mexico is based. The reality of railroads, electric power facilities, cement plants, textile mills, a steel mill

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[2]Frank R. Brandenburg, The Making of Modern Mexico, Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1964, pp. 214-215. See also: Justo Sierra, The Political Evolution of the Mexican People, Charles Ramsdell, trans., Austin: Austin University Press, 1969, The Texas Pan-American series, p. 197-198. "The exploiters of hunger and the government penury had a clear field, and they began their very simple system of sucking the blood of an anemic organism . . . "

and the impetus given for the discovery and exploitation of oil took shape under Díaz. Foreigners financed, constructed and owned these industries along with a small select group of Mexicans whose very presence opened the eyes of the populace to what might be accomplished. Without the political stability Díaz brought, real material progress in commercial, industrial and mineral development would have been delayed. " . . . By 1910 his 'order and progress' policies, despite their adverse effects on society as a whole, had succeeded in establishing a reasonable base upon which the Mexican Revolution could, and to a substantial degree did, build a modern industrial nation."[3]

Although foreign investment continues to be welcome in Mexico, a basic policy shift took place after 1910 and especially after the stability of the 1930's. No longer may foreign funds exploit the Mexican market primarily to benefit the investing nations. No longer are the major industries in the hands of non-nationals. Some traditional types of foreign investment still operate, but expropriation and nationalization (rarely confiscation) judiciously used by the government limit the possibility of traditional-style foreign investment as a dominant factor. Consequently, foreign capital to accelerate internal economic growth, while acceptable, is regulated by national needs. Certain strategic activities are excluded from all foreign investment because they are considered to be the sole province of the government.

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[3]Ibid., p. 265.

Domestic Investment

Almost 40 percent of the revenues collected by Mexico's first independent government in 1821 came from loans. From this beginning, a pattern of external financing was established by the Mexican government until by 1867 the total obligations exceeded $450 million and "almost 95 percent of the customs and revenues had been hypothecated to the payment of various debts. The sorry state of public finance merely reflected general economic conditions which, save for a few faintly bright spots, floundered deeper into a quagmire of inefficiency, poor productivity, and regional isolation."[4] For numerous reasons, revenues were never sufficient to meet the needs of the government. Except for protective tariffs, which promoted inefficiency and encouraged countraband activity, the government was in no position to offer much aid for Mexican industrial development.

Despite its failure financially, one early government venture toward financing internal development was the Banco de Avío, established in 1830, which stimulated mechanization of the textile industry. Seventy percent of the bank's initial capital of 1,000,000 pesos went to aid the cotton textile industry. An inability to collect outstanding loans contributed to the bank's collapse but the financial impetus given to the hard-pressed cotton textile industry initiated much needed modernization. This was achieved despite the fact that the

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[4]Cumberland, Mexico, p. 147.

total funds invested represented less than 10 percent of the amount eventually required. Some of the capital, borrowed by Esteban de Antuñano, made possible the first water-powered cotton textile factory in Puebla. During this same period, the Orizaba region of Veracruz state was being promoted as a textile center by Lucas Alemán.

The cotton textile industry occupied first place in non-extractive industrial activity, notwithstanding wars, insurrections, and internal instability. Under Díaz, foreign capital flowed into the country as the government laid the base for the industrialization of the nation. Per capita purchase of cloth actually increased until by 1910 cheap cotton imports represented only 3 percent of total consumption. Nevertheless actual production by the cotton textile industry declined.

Between 1910 and 1940 several important events occurred which are directly reflected in the post-1940 economic spurt. Because of the military struggles of the revolution, especially between 1910 and 1920, almost no government investment was possible. The dynamism begun under Díaz, even though limited by a predominantly closed society, declined for lack of direction as the country's economic resources were dissipated by contending military parties. Political instability continued until the Cárdenas administration in 1934. Government investment was certainly retarded by competition for political power, and private investment undoubtedly continued only with caution. Yet the social and institutional structure which was emerging and

became established by 1940 constituted a framework upon which the later government-private cooperative investment structure was built.

In retrospect, the Revolution and subsequent period of instability may be cited as contributing significant stimuli for economic development. Certainly the constraints of a feudal aristocracy were broken by a land reform that, although sometimes questionable in performance, did plant the seeds of a more favorable incentive system. Peonage was reduced, permitting greater mobility which in turn contributed to the urban labor market and the rise of worker organizations. In association, ascribed status, although still present, became less reliable as a measure of success. The possibility of social mobility from merit, rather than by accident of birth, contributed frequently as a basis for leadership. Wealth in forms other than land also began to emerge as an important source of prestige.

Although developing slowly, political stability aided organized labor, a growing middle class, and the intellectuals in replacing a stagnant status quo oligarchy dominated by large landholders, contending factional militarists and the church. This new combination, recognizing social responsibilities, unburdened by historical necessity, and born from the bloody contention of the Revolution, has gradually gained ascendence over Mexico's economic affairs. In turn, this control permits the country to gain from foreign investments by terms most favorable to Mexico.

Rapid modernization in the cotton textile industry is relatively recent, for as late as 1951 some 85 percent of the spindles and 95 percent of the looms were considered outdated.[5] Automated production outran the domestic capacity to consume, although internal markets improved dramatically after 1960. Indirect government establishment of all industrial goals, including those for the cotton textile industry, remains a potent force through the CONCAMIN (Confederación de Cámaras Industriales de los Estados Mexicanos), and the CONCANACO (Confederación de Cámeras Nacionales de Comercio), as well as various labor organizations. Since ". . . an industrial or commercial firm with the mere capitalization of over 500 pesos must belong to one of the chambers, . . ."[6] that make up CONCAMIN and CONCANACO, few fail to come under government direction. In addition, an arrangement between the government and organized labor serves all segments of the economy and aids in the government's development programs.

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[5]Morris Singer, Growth, Equality, and the Mexican Experience, (Latin American Monographs, No. 16). University of Texas Press, Austin: 1969, p. 168.

[6]Ibid., p. 270.

CHAPTER IX

LABOR

Labor may be considered " . . . any human effort to create an economic good or provide a service for the purpose of acquiring an income."[1] Unfortunately this does not come to grips with forced service for the benefit of someone or something other than the one who labors. Much labor is regulated by slavery, caste, race, or religious, economic and social snobbery that fails to reward the producer.

Indian Labor

There is no historically firm data from which to extract any precise relationship between voluntary and involuntary labor prior to Mexico's subjugation by the Spaniards. Servitude in one form or another was practiced by every invader who entered the central montane basin, and tribute was extracted from the loser in every case, often in the form of labor.

Gods were propitiated by the labor of thousands, some of whom died for the privilege. Huitzilopochtli, (god of Fire-Sun), Quetzalcoatl (god of Learning), Tlaloc, (Rain god), Tezcatlipoco, (War god) and Xipe Totec (god of Growth) were no ambrosia and nector gods. They required the ". . . fire-singed flesh of the still-beating

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[1]John T. Zadronzny, Dictionary of Social Science, Washington, D.C.: Public Affairs Press, 1959, p. 182.

human heart and the gushing blood of mortal man,"[2] in order to remain strong and protect their people. Not all of the prisoners who died to give strength to these gods appreciated the honor.

On a less abstract level, the dominant social unit was a rigidly stratified society with a rapidly developing aristocratic group pyramiding a sophisticated power structure that affected the lives of every member. Almost the entire burden of maintaining the Aztec society fell to the three lowest groups in the hierarchy: the slaves, the tlamatl (landless peasants), and the macehules (common people). In between fell the skilled craftsmen, the pochteca, and the priests. The highest echelons were composed of military leaders and the tecuhtli (nobility), usually taken from the military. At the apex, the ruler exercised practically absolute power.

Much of the labor was unproductive in that, while necessary for maintaining an accepted pattern of life, it gave no help to the production of necessary consumable goods. Neither the bureaucrats, the army, nor the priests contributed to supportive consumption. Rather, the opposite may be construed as each relied upon the productivity of the tlalmatl, macehuale, and the slaves.

Of particular interest is the unique position held by cotton, cotton cloth, and other tribute items. The pochteca (hereditary traders) could and did trade a variety of items but were forbidden

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[2]Cumberland, Mexico, p. 20.

to trade in cotton and cotton cloth that had not been reworked in Tenochtitlán. Tribute was transported under rigid control by special imperial emissaries. So, although cotton fabrics were common throughout Mexico at the time of conquest they represented the labor of individual craftsmen, not the produce of guild members. Because cotton cloth represented small increments from necessary familial labor, their limited surplus quickly vanished under the onslaught of the Spaniards' demands.

Although the Puebla area was noted as a textile center, there are no records to identify what percentage of the native population was employed in spinning and weaving. The natives must have been excellent craftsmen and certainly represented a labor pool upon which Puebla's textile industry was built. It is probable that a large percentage of the population of Cholula, the chief urban center of the area when Cortés arrived, was involved in producing cotton products for tribute. When the city of Puebla was founded and became the seat of power, Cholula's craftsmen moved to the new population center where they continued spinning and weaving cotton products. Puebla soon surpassed Cholula as the textile center-but only in quantity, for quality suffered.

Colonial Labor

As the countryside was carved into large estates and death stalked the Indians, bringing about a population decline, many natives abandoned their homes and took to urban living near the Spaniards. Consequently, the population center shifted eastward from Cholula,

and the Spaniards rather than the Aztecs extracted tribute. The city of Puebla grew rapidly until it was second only to the capital. The primary industry, cotton textiles, employed almost half of the population in growing and processing cotton.

The most prominant innovation introduced by the Spaniards was the confinement of several spinners or weavers to a single room. Although this increased production, quality was almost completely lost. Combined with a system of debt-peonage, the laborers had little hope of escape. The work was poor, and the product was used almost exclusively for local consumption and never managed to meet Mexico's needs. Even so, and despite textile production at Guadalajara, Querétero, and toward the end of the eighteenth century in western Veracruz state, Puebla remained the cotton textile center of Mexico.

The composition of the labor force did change during the colonial period, but not because of any deliberate attempt by the Spaniards. An increasing population of mestizos began replacing the Indian craftsmen. Since the mestizo was neither Spanish nor Indian, and lacked legal status under the laws enacted to benefit the one and protect the other, small cotton textile shops permitted them a way of earning a precarious living. When the _creoles_ replaced the _peninsulares_ as masters in Mexico, although representing a political change, little social change took place. The laborers in Puebla's cotton textile industry were Indians and mestizos, with the mestizo representing a majority.

Modern Labor

Although both skilled and unskilled industrial laborers were in short supply, their bargaining power was weak until well into the 1900's. Neither public nor private authorities would tolerate unions, and the penal code of 1872 condemned labor associations and strikes. As late as 1910 one-eighth of all textile workers were children who could perform many tasks as well as adults, but at lower wages.[3]

The law aided the industrialist, the government furnished strike breakers in the form of troops, and any laborers who objected too strenuously were discharged and black-balled. The early labor movement was consequently slow to develop. In 1898 the army broke the textile strike at Apizaco and punished many of the strikers. Nine years later when mill workers in Puebla struck for a shorter working day, an increase in wages, compensation for on-the-job injuries and an end to the wage discount system, federal troops shot hundreds before quelling the strikers. Again in 1916 a major strike was surpressed by troops, this time upon orders from Carranza, and as late as 1959 troops were used to arrest CNT (Central Nacional de Trabajadores) leaders and several hundred of their followers.

One of the oldest labor union movements in Mexico dates from 1918. CROM (Confederación Regional de Obreros Mexicanos) is the only

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[3] Ibid., p. 224.

extant labor organization founded immediately after the adoption of the constitution. Article 123 required labor legislation by state and national governments. In addition, the right to organize, conditions of employment, safety features and employee indebtedness to employers were stipulated by article 123, which " . . . put the laborer in Mexico on a legal par with any worker in the world . . . ."[4] Although Mexico's laborers were on a legal par with any others, they still had a long way to go.

Labor, swelled by the ranks of textile workers, helped elect Obregón in 1920 and one of its top leaders, Luis Morones, served in the cabinet of Calles in 1924. However, when Obregón sought re-election in 1928 CROM opposed him and disassociated itself from the government. Factionalism broke the labor movement apart. The CGT (Confederación General de Trabajadores), was founded in 1922 as a dissident group opposed to political involvement. It gained members rapidly, but neither CROM nor CGT represents labor's strength today since both now operate under BUO (Bloque de Unidad Obrera).

Although there are many small central and autonomous labor unions, all but a few are affiliated with the BUO or the CNT. Of these two, the CNT is the smaller and is considered the most radical. CROC (Confederación Revolucionaria de Obreros y Campesinos), an affiliate of CNT, is considered to be one of the most radical components of CNT. Much of CROC's strength comes from the textile workers, who are among the most resistent to technological change.

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[4] Ibid., p. 269.

Organized labor does not represent all or even a majority of the Mexican workers. Of approximately 16 million workers fewer than 3 million belong to a union. Although the government strongly supports the union movement, it will, as in 1959, move against over-disruptive strikes considered counter to the country's best interests.

A unique partnership exists between labor and government. Heads of labor unions have political support to lend, and political leaders tend to utilize this support by dispensing political favors that bring the union leaders into the government. This permits the government to exercise a paternalism that benefits both the government and the union. In a real sense it reduces potential militancy because few unions have either the economic or member strength to operate counter to government wishes. At the same time, since the union heads are part of the political community, the unions have a stake in accepting wage increases which, although somewhat smaller than a strong militant union might obtain, maintain a profile that enjoys nationwide public support. When this balancing act fails, as it did in the textile industry in 1968, a costly strike may take place.

Labor unionism is strong in the Puebla area. Average minimum legal salaries for cotton textile workers in Puebla increased more than 200 percent between 1954 and 1967 and were projected to increase to nearly 400 percent by 1970. Although the salaries, Table 4, would seem to indicate a 1967 average of twenty-one pesos per worker in Puebla, actual income was approximately 25 percent higher due to other benefits associated with shift differential, length of service, Sunday pay and equalization bonuses. The monthly average was 654 pesos, which indicates both a higher and lower income since averages merely level out the extremes.

TABLE 4

MINIMUM LEGAL SALARIES IN THE COTTON TEXTILE INDUSTRY
OF THE PUEBLA METROPOLITAN AREA
(Base Index 1954-1955)

Period	Avg. City Sal.	% Inc. Biennium	Index	Avg. External Sal.	% Inc. Biennium	Index
1954-1955	9.00	---	100.0	7.00	---	100.0
1956-1957	9.50	5.6	105.6	7.00	---	100.0
1958-1959	10.50	10.5	116.7	8.00	14.3	114.3
1960-1961	11.50	9.5	127.8	9.50	18.8	135.7
1962-1963	13.80	20.0	153.3	11.40	20.0	162.9
1964-1965[a]	18.00	30.4	200.0	14.25	25.0	203.7
1966-1967[a]	21.00	16.7	233.3	16.50	15.8	235.7
1968-1969[b]	26.10	24.3	290.0	20.65	25.1	295.0
1970-1973[c]	39.30	50.5	439.0	33.95	64.4	485.0

[a]Figures for the entire Puebla area.

[b]Estimates based upon personal interviews.

[c]Projections based upon information from Diario Oficial de México, Martes 30 de Junio de 1970, Tomo CCC, No. 50.

Source: Comissión Nacional de los Salarios Mínimos, Memoria de los Trabajadores de 1964 y 1965. Descripciones geográficas, económicas y sociales de los zonas, México, D.F., 1966. pp. 119-122.

These salaries affect almost 20,000 laborers in Puebla, more than 39 percent of the total working in the cotton textile industry in Mexico. The average number of employees is more than 80 for each mill. Location of a plant in an area represents an appreciable income for the locality as well as the workers.

Labor, especially in the cotton textile industry, faces problems similar to those confronted by the leaders of the coal miners in the United States immediately following World War II. Technology exists that will increase productivity but at the expense of numbers of personnel employed. Although the unions have generally supported technological change, in the cotton textile industry they have not permitted this change to take place as rapidly as the owners would like. The union fears that if the industries are allowed to modernize rapidly, many of its members will be displaced, as happened with members of the coal miners union in the United States. Consequently, the union resists change that introduces automated machinery.

In an effort to overcome the reluctance of labor, some cotton textile industries have built completely new mills. Since operators of automated machinery were not specifically designated under former contracts, fewer personnel were needed. These new job classifications are covered by the 1970 contract and, although much higher wages were gained by the union, the increased productivity plus fewer required operating personnel do help reduce labor costs.

Additional changes, by both labor and management, may be required to meet the goals of each. Labor wishes to maintain as many members as possible at work, without locking the industry into a non-profitable enterprise. The industry wishes to maintain a profitable production by keeping costs down without antagonizing labor. Both will be required to negotiate and accommodate if the cotton textile industry in Puebla is to remain strong and competitive. Some adjustment by the unions may be necessary to permit the cotton textile industry to modernize even more than it has to date. At the same time the cotton textile industry may find it necessary to pay the costs of early retirement, and perhaps retraining, to help soften the impact of automation. The decade of the 1970's may well be pivotal for both labor and management in the cotton textile industry of Puebla.

CHAPTER X

SUMMARY AND CONCLUSIONS

The location of Mexico's cotton textile center in Puebla presents a challenging anomoly to geographers that becomes even more puzzling when one attempts to draw comparisons based upon cotton textile industries in other parts of the world. Certain physical characteristics may be identified that promote spinning and weaving in given localities. In addition, specific social phenomena associated with the operation of cotton textile mills may be identified. Yet, neither suffices to verify the continuing eminence of Puebla's cotton textile industry.

Summary

Puebla's physical location exemplifies many of the characteristics common to spinning and weaving. There is adequate water power for exploitation. The climate is salubrious with near optimum humidity. All are important considerations, but humidity is particularly significant in the spinning of cotton into thread. Even so, with climate control possible within mills, an industry can be located almost anywhere that is convenient. An example of how little effect climate presently has on location is the movement in the United States of New England's cotton textile mills to the Appalachian Piedmont.

One aspect of a specific social phenomenon, although perhaps less clear, may be the development of a pool of skilled labor and the subsequent materialization of strong unions and relatively high wages so well documented for Europe and the United States. Skilled labor is necessary, and the location of cotton textile mills in a given area encouraged migration and settlement of craftsmen nearby. The resultant mill towns are well-known social entities.

Both the physical characteristics and the social phenomena are identifiable in Puebla. So, too, are other factors such as inefficient machinery and old buildings which contributed to the flight of the cotton textile industry in the United States from New England to the South. However, Puebla's cotton textile industry remained in Puebla despite many apparent negative elements.

Initially six factors were identified that persuasively place Puebla's dominance as the cotton textile center of Mexico in a negative light. These are:

1. Puebla is neither a major cotton production center nor significantly close to a major cotton producing area. Over 40 percent of the crude cotton is grown in the Northwest (Sonora, Sinaloa, Nayarit, and Baja California Norte). The North Interior area (Chihuahua, Coahuila, Nuevo León, Durango, Zacatécas, Aguascalientes and San Luis Potosí) accounts for more than 25 percent, and the North Gulf Coast (Tamaulipas) produces approximately 25 percent. None of these major cotton growing areas are directly tied to Puebla. In actuality, Tamaulipas is the most convenient source.

2. Puebla is not the major market, nor has it ever been the major market area for cotton textiles. Historically, the primary market area was the populous Valley of Mexico. This is still true. In addition, Guadalajara, Monterrey and Ciudad Juárez all represent larger market potential, with Mexicali, Tijuana and León nearly as large as Puebla.

Admittedly Puebla's market rival was only Mexico City until the eighteenth century, but the population center and potential primary market has always been the Valley of Mexico, where Mexico City is located.

3. Puebla is not the major transportation center. To the contrary, railroad service is circuitous, there is no primary navigable river system, the highway system is a recent development and the air service is essentially local. Several areas had better developed transportation networks. Both the Mayan centers and the Aztec capital exemplify more mature transportation networks. Recently, Mexico City has served as the focus for transportation and it remains the major transportation center of the Republic.

4. Puebla is not the major center of investment capital. Although Puebla, as the capital of the state of Puebla, may present some advantages for capital investment, it is common practice for both foreign and domestic investment to concentrate in the capital city of a country, in this case Mexico City. Certainly both foreign and domestic investment occur in Puebla, as evidenced by the completion of the Manual Avilla Comácho dam at Valsiquillo and the recent construction of a large Volkswagon assembly plant, but Puebla is not the major center.

5. Puebla is not the major labor center. All of the reasons cited for the market area are true as related to labor. A direct comparison with Mexico City for any known period is to the advantage of the latter, and at present several other areas are larger labor centers than Puebla. However, some consideration must be given to the specialized labor associated with the cotton textile industry. If administrative and sales personnel are ignored, Puebla is the center for Mexico's cotton textile production workers. Although skills acquired in one trade may be transplanted to another, it is more often that specific abilities are maintained in the trade in which they were first acquired. Workers in the cotton textile industry are well paid in comparison with other trades, and most prefer to remain with the cotton textile industry.

6. Puebla is not the major political center. It was a satellite to the Valley of Mexico prior to the arrival of the Spaniards and remains essentially so today. Often industrialists, especially in Latin America, will tend to locate where they can exercise some influence over the political process which is usually associated with the capital city.

Individually, any one of the apparently negative factors can readily be overcome. Collectively, they present a difficult barrier for development into a dominant position, especially in the cotton textile industry. But these are not the only contrary elements. In addition to the previously cited components, library research at Mexico City and Puebla, plus field research at Puebla, revealed historical evidence controverting development of the cotton textile industry in Puebla.

The city of Puebla de Los Angeles was founded primarily as a stopover between the coast and the Central Valley. A second important function was that of a religious and cultural center erected new and away from the indigenous population center at Cholula. A third feature was the division of the city into parcels given to the Spaniards. Indians were not permitted to live in the homes of the Spaniards, and in a departure from the usual practice elsewhere, the Spaniards were denied the privilege of concubinage. Evidence of this separation is still present.

Although the Spanish Monarchy was aware of the spinning and weaving craftsmanship displayed by the Cholultecas in nearby Cholula, as evidenced by Cortés' shipment of fine textiles from the area, there is no evidence that the rulers of Spain either encouraged cotton textile production or offered any inducement for its growth. The opposite is more nearly true. "Venezuelan soil and topography made cotton culture there more attractive and profitable than in Mexico, where the mountainous terrain and the dearth of roads were prohibitive for transportation, and it was the Venezuelan rather than the Mexican colony which received

encouragement from the home government. The natives [of Mexico] continued to grow enough for their own use in those regions where climate and social systems allowed it, but the colony as a whole did not produce enough cotton even to maintain a stumbling textile industry which never met local needs."[1] The growth of a cotton textile industry was not because of any deliberate plan on the part of the Spaniards.

Three wars plus numerous factional struggles almost destroyed the cotton textile industry of Puebla, yet each time, Phoenix like, it emerged from the ruins stronger and more viable than before. In brief, Puebla's cotton textile industry was ignored by the Spanish mercantilists, nearly destroyed by the emerging Mexican nationalists, put out of production by aggressors from the United States, devastated by French invaders, and finally ruined by Mexican revolutionaries. Despite these setbacks, and despite challenges from other areas, Puebla remained the primary cotton textile center. This collapsed sequence of events, plus the other negative factors given, almost seems to suggest that Mexico's cotton textile industry should have developed anywhere but Puebla.

In the face of such a general lack of encouragement one might adduce strong endorsement associated with the physical location. Unquestionably the area is physically well suited for spinning cotton fibers into cloth. Rainfall is relatively abundant, averaging a little more than thirty-two inches annually. Humidity remains comfortably consistent, but above 30 percent, which is important for spinning

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[1]Cumberland, Mexico, p. 98.

cotton thread. Temperatures, too, although diurnal variation may be as great as 30°F., are pleasant at an annual average near 63°F. The panorama is little short of spectacular, with three snow-capped volcanic peaks visible from the city of Puebla. Yet, almost the same is true for Calpulalpan, Tlaxcala, about seventy miles north, and it didn't develop into Mexico's cotton textile center. With only slight modification the same general observations may be stated for Mexico City which is the transportation, labor, political, market, investment, and population center of the country. But Mexico City is not the cotton textile center. Orizaba, approximately fifty miles east, also has adequate physical factors in its favor yet, although a cotton textile center, it undeniably is not the primary cotton textile center of Mexico. Even so, physical location may not be entirely ruled out as a factor supporting Puebla's position as the historical and present cotton textile center of Mexico.

Although raw material is locally available, it is not grown in sufficient quantity to support the cotton textile industry without massive infusion from other areas. Despite archeological evidence that cotton has been present in the general area for at least nine millenia, no evidence identifies it as the primary crop for any period. Because crude cotton is extremely bulky, it is improbable that raw materials were transported the great distances common today. Nevertheless, a relatively large quantity of thread may be spun from a bundle of crude cotton which might, under certain circumstances, make transport to a spinning and weaving location economical.

Because the Cholultecas were noted for their cotton textile products at the time of contact with the Spaniards, and no particular mention is made of cotton plantations nearby, one may infer that the raw material was brought to Cholula. The crude cotton was then processed into cloth. Certain additional considerations remain. The area must have had artisans whose ability to produce cotton textiles made transportation of the raw material profitable. The development of spinning and weaving to such a high degree further implies a cause and effect relationship associated with processing. Low humidity may cause threads to break easily, which makes spinning difficult, while humidity too high brings problems of rot. Thus, choice of the area may well represent an intuitive knowledge of those physical conditions most favorable for spinning and weaving crude cotton into cloth. The area's traditional connection with cotton textiles and archeological support for the association of the cotton plant and man in the area for an extended period of time, tends to endorse the implication of an extensive accumulation of knowledge related to cotton culture by the inhabitants. Furthermore, a large supportive population is necessary to maintain a group of craftsmen as well as a ready market within a reasonable distance for disposing of the finished goods. Ample historical evidence supports these assumptions.

Tribute was an important motive for the movement of goods throughout central Mexico. The population of Cholula at the time of Cortés' arrival may have been nearly 100,000.[2] Initially raw

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[2]Sanders and Price, Mesoamerica, p. 208.

cotton may have been extracted as tribute by the Cholultecas, which in turn would have reinforced their dominance in processing cotton products. Evidence for Cholula's extraction of tribute is conjectural, but certain it is that the Aztecs did receive duty in the form of cotton cloth from Cholula. A well established movement of cotton textiles to the Valley of Mexico was in effect and remains in effect today. Mexico City's (Tenochtitlán's) population did, and does, represent a large market relatively near the basin of Puebla. Modern cotton textiles are warehoused at Mexico City. Although no longer tribute in the same manner, the movement of the cotton textiles to the large population center represented by Mexico City is in effect following the tribute route and may be considered a kind of political tribute.

For Puebla to continue as the primary textile center some way to meet the need for increased productivity was necessary. The amount of hand labor required, for example, to furnish Mexico's present needs is tremendous. As a result, some form of powered machinery is a practical necessity unless productive growth is to be stultified. When water-powered machinery for use in producing cotton textiles became available early in the nineteenth century, Puebla's location promoted the installation of technologically advanced equipment in mills constructed along the Atoyac and its tributaries. Water power was adequate. As the development of hydroelectric power progressed, the Puebla area once more benefited from a surplus of available resources.

During the water-powered phase, the cotton textile mills located outside of Puebla along the Río Atoyac and tributary streams. Apizaco, north of Puebla, is one of the early locations. Another was Metepec, south of Puebla. Others, both north and south, were added until the city proper no longer represented the dominant site of the cotton textile industry. Although some mills were located east as well as west of the city, the primary axis remained generally along a north-south route. Power was adequate, readily available, and quickly exploited. Power is still adequate and furnishes not only Puebla's needs but is exported to help meet the voracious demands of Mexico City as well.

Since the Spanish Monarchy did not actually promote the cotton textile industry in Puebla, the native inhabitants were able to continue in much the same manner as their ancestors. Spinning and weaving remained an important part of the life of the local populace, modified by only two factors. The founding of Puebla by the dominant culture induced the natives to move nearer the political power center represented by the new city. This, in part, explains the phenomenal growth of Puebla over Cholula to a position of eminence in the processing of cotton into textiles. The second factor was the collection of several artisans into rooms where they were more easily controlled and exploited by the conquerers' overseers. Production of cotton textiles continued practically unchanged until the introduction of water-powered machinery in the early 1800's. This

furthered the continuance of a ready labor pool, skilled in the production of cotton textiles, that was readily exploitable for training to operate the new equipment.

This ready labor resource may well have contributed significantly to Puebla's continued position of dominance in the cotton textile industry. The initial capitalization of the skilled craftsmen may also account for Esteban Antuñano's choice of Puebla as the site for the Constancia Mexicana, the first water-powered cotton textile mill in Mexico. Undoubtedly the proximity of a power resource, as well as a skilled labor resource, proved to be a valuable asset for promoting mill location in the Puebla area.

The growth of Puebla's cotton textile industry can not be attributed to an aggressive merchandising policy. Until recently the industry was more interested in survival than in expansion. Development responded to population increase, rather than to an increase in per capita consumption. The apparent average annual consumption rose from approximately five and one-half pounds per person in 1961 to a near six and one-half pounds in 1968 (see Table 5). Much of this increase is associated with the demand for cotton and synthetic mixes, rather than with a growing demand for finished cotton products.

Because some problems in field research arose that no amount of pre-preparation could have eliminated, the initial research design for this study was field modified to permit the generation of useful

TABLE 5

MEXICO: CONSUMPTION OF COTTON TEXTILE PRODUCTS, 1961-1968

Year	Population (in 000's)	Domestic Consumption	
		Total-Metric Tons	Per capita -lbs.
1961	37,263	92,289	5.46
1962	38,567	96,663	5.52
1963	39,917	101,040	5.57
1964	41,314	116,852	6.24
1965	42,809	118,404	6.09
1966	44,307	121,560	6.03
1967	45,947	134,157	6.42
1968	47,597	139,488	6.45

Source: Población--Proyecciones de la población de México, 1960-1980. Raúl Benítez Zenteno y Gustavo Cabrera Acevedo, Departamiento de Investigaciones Industriales, Banco de México, S.A., 1966. 1961 a 1964 y 1966 a 1968. Calculadas por interpolación de las cifras de 1960, 1965, 1970. Consumo--Banco de México, S.A., Departamiento de Investigaciones Industriales.

data for identifying causal relationships. Upon arrival at Puebla it immediately became apparent that the magnitude of the cotton textile industry had been underestimated. The initial intent had been to study all of Puebla state. Recognition of the implausibility of completing a three-month study for the entire area permitted an early redefinition to include primarily the city of Puebla and it's immediate environs. Labor negotiations, underway at the time, temporarily slowed data collection. In addition, early efforts to visit Puebla's cotton textile mills were in some cases forstalled at the gates when permission to enter the premises was refused. In those cases where entry was gained it soon became clear that the original questionnaire was unsatisfactory because administrators did not wish to reply to direct questions, replied only to selected questions, or gave information that conflicted with other sources. The settlement of the labor contracts, memorization of a set of questions to be introduced during interviews with plant administrators, and concentration upon a sampling of the cotton textile industry, assisted in completing the field research. Even so, recognition that the sample is one of convenience renders the conclusions less satisfactory than might be desired.

The sample establishments included spinning, weaving, finishing and various combinations of these. The number of employees ranged from twenty-three to more than 600, operating machinery as new as a few months or more than a half-century of age. Production varied considerably. In some of the newer mills fewer than thirty men were

able to produce more than 100 men working with older machinery. In at least one case according to the administrator, 180 workers producing at 85 to 95 percent of capacity were unable to spin and weave as much as a plant with twenty-seven men producing at 80 to 90 percent capacity. Since the former worked with machinery ranging to more than forty years old, the dramatic difference modern equipment makes in productive capacity becomes obvious.

None of the cotton textile mills sampled were operating at full capacity. The highest percentage of productive capacity cited by administrators was 95 percent, by their own estimates. In every case where estimates exceeded 90 percent of the productive capacity the machinery was more than fifteen years old. However, all but one of the administrators were either purchasing new equipment, had issued purchase orders, or had projected budgets that include the purchase of new machinery. The one administrator who neither had particularly new equipment nor a budget projected for the acquisition of modern machinery indicated that he was able to sell all of his current production. He feared that expensive new machines, although capable of higher production, would not be efficiently used because it might be difficult to dispose of the increase.

Most of the industry is working with mixes ranging from 60 percent to 90 percent cotton. Three are using cotton exclusively, one of which employs more than 500 workers. The latter also operates some machinery over forty years old. However, no direct relationship

between age of machinery and the exclusive processing of cotton can be established, since the most modern textile plant visited also uses only cotton in its production. In addition, the large mill processing 100 percent cotton and employing over 500 workers is aggressively replacing the old machinery, and complete renewal is projected for 1975.

The number of spindles in operation ranges from a low of 2,500 to a high of 40,000 and averages near 4,000. These figures include spinning as well as spinning and weaving mills, without considering those mills operating looms only or involved only in the process of finishing cloth. All have laboratories and some type of humidity control to help maintain the quality of the spinning and weaving.

Most of the looms are standard size, although a few of the newer ones produce double-width cloth. Of the mills operating looms, none of those visited have less than fifty in operation. The range is from fifty to 530, with the average slightly less than 130. Machine productivity averages approximately 800 linear feet per day, depending upon the tightness of the weave and the size of thread used.

In addition to questions related to production, number of workers, hours of employment, types of equipment and sales area, questions to elicit attitude toward location in Puebla were worked into the conversation. Each administrator was asked the following: (1) What do you like most about living in the Puebla area? (2) What do you dislike most about living in the Puebla area? (3) In what area

would you prefer to live if you could choose any place in Mexico? (4) Would you transfer to another cotton textile plant in Mexico if the salary were high enough?

None of the administrators stated any strong dislike about being located in Puebla, and all but two felt the thing they most disliked was the increase in Puebla's population. They either stated that the city is becoming too crowded or that it is growing too rapidly. All but one stated they prefer to live in the Puebla area because (a) their family is located there, (b) other parts of Mexico are less pleasant, or, (c) all their friends are in Puebla. These answers imply strong family and area ties.

The things most liked range from statements that their fathers were interred in the Puebla area to statements that the scenery is better than at any other place in Mexico. Most admitted that it is nice to visit other parts of Mexico, and many remarked "todos son bonito pero ni uno como Puebla" (All are pretty, but none like Puebla). Although the question, what do you like most about living in the Puebla area?, elicited the most diverse replies, all demonstrated strong area ties, even though many administrators are relative newcomers to Puebla.

When asked, would you transfer to another cotton textile plant in Mexico if the salary were high enough?, the initial response was, "la ciudad o el país?" After being assured that I referred to the entire country, all but seven stated they would be willing to work

in Mexico City if they could come home every week but that the other sections of Mexico really didn't have a cotton textile industry that needed them. Besides all of their friends, their family and their homes are in Puebla and it would be too far to travel to other sections just to work. Two of the seven stated they might move but that it would depend upon the circumstances. The remaining five simply said their life is in Puebla. Again the answers demonstrated a strong predeliction for the Puebla area. Stated in percentages, less than 9 percent indicated they would move any distance and that depended upon the circumstances. A little over 21 percent simply said no, while almost 70 percent felt Mexico City, if they could come home every week, would be acceptable as a place to work.

Conclusions

The cotton textile industry in Puebla is modernizing its equipment. Although some of the oldest mills have closed, and a few are not yet installing the newest machinery, the majority of textile companies recognize a need to modernize in order to remain competitive. These are changing to high speed automatic and semi-automatic spinning, weaving, and finishing equipment with deliberate speed. Since new machinery often requires a program for retraining personnel, each factory has its own timetable. Because of resistance to change by older employees, the most modern plants generally have younger employees, who are easier to train to operate the new machines. Also, since the newer equipment may be operated with fewer personnel, there

is a tendency not to replace all retiring employees. As modernization continues, some readjustment for both the mill owners and the workers may be required.

Apparent growth evidenced by the cotton textile industry in Puebla is associated with population increase, not with an aggressive merchandising policy. Per capita consumption, although demonstrating a slight increase in the decade of the 1960's, is only a little more than it was prior to 1900 when it stood at approximately five and three-quarters pounds. Much of the recent increase in per capita consumption may also reflect the upswing in demand for cotton and synthetic mixes.

Most of the mills are operating at less than full capacity. Those cotton textile mills operating nearest full production generally represent factories utilizing the oldest equipment. Some of the most modern cotton textile plants operating at 80 percent of capacity are able to out-produce mills employing more than six and one-half times as many workers. The implications are obvious.

The cotton textile industry in Puebla remains the largest segment of the total cotton textile industry in Mexico. More than 200 mills are located in Puebla, which represents nearly 46 percent of the total number for all of Mexico. Nearly 40 percent of all employees working in the cotton textile industry live and work in Puebla. Almost 40 percent of all the looms, and a little more than 30 percent of the spindles, are also in Puebla. Although the largest quantities of modern equipment are in Puebla, the most outdated

machinery still in operation is also operating in the Puebla area. Approximately 33 percent of the looms and 40 percent of the spindles are older equipment that might better be replaced. Comparative percentages for Mexico City are 10 percent for both looms and spindles.

Puebla's early and continued dominance is related to its location near the traditional indigenous cotton textile center of Cholula, where fine textiles were produced. The craftsmen of Cholula were supported by a large population. Their ability to spin and weave crude cotton into fine textiles, although interrupted by the arrival of the Spaniards and voluntary removal to Puebla, was essentially unchallenged by the mercantilistic policy of the Spanish Monarchs. Those Cholultecas who moved to Puebla, continued their ancestral trade with little interference from the Spaniards in an area well suited to processing raw cotton into finished products, maintaining a trained labor resource by supplying local needs and shipping occasional surplus to Mexico City. The impetus this ready labor source may have given to Antuñano's choice of Puebla as a site for his water-powered cotton textile mill is difficult to assess but merits consideration.

The ready accessibility of streams for power also proved of value to the cotton textile industry of Puebla. With an adequate power source, a long tradition of spinning and weaving, a trained and functioning labor pool, and a climate particularly suited to processing cotton, the cotton textile industry flourished in Puebla despite wars, insurrections, and lack of encouragement. The workers' strong

attachment to the area encouraged location of the cotton textile industry in Puebla. Current attitudes toward working and living in the area reflect this continuing attachment which has promoted the maintenance of Mexico's cotton textile industry in Puebla, assisted by a surplus of hydroelectric power.

Mexico's cotton textile industry is not moving from Puebla to other areas. It is true that some of the oldest plants have closed, but they were inefficient and no longer competitive. It is also true that some of the most modern mills are located in Puebla, and the vast majority of the mills are modernizing. Some readjustment will be required as both labor and management recognize the need for continuing modernization to remain competitive. Changes will be required as automatic equipment displaces workers. Among these may well be:

1. An aggressive merchandising policy both domestically and internationally.

2. Integration of the cotton textile mills producing at less than optimum efficiency and/or encouragement for small progressive industries, perhaps in the form of liberal tax inducements.

3. Recognition of the need for technical personnel and support for technical institutions to provide their training.

4. In association with a need for technical personnel, recognition of the need for retraining workers displaced by automatic machinery. Some updating of skills is possible, but in many cases training for totally new occupations will be required.

5. Some kind of area planning to identify optimal productivity for the cotton textile industry. Planning implies some control over new construction, except as a replacement for obsolete facilities. It also implies some projection of demand for cotton products.

A positive statement that Puebla will remain the cotton textile center of Mexico is unwarranted. Nevertheless, the persistence of Puebla as the major producing area for all of Mexico's cotton textile industry, plus the strong attachment by Puebla's population to the area, implies the likelihood that it will not be easily displaced within the foreseeable future.

APPENDIX A

QUESTIONNAIRE

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Estado._____

Fecha. _____

Cuest. _____

Nombre de la Compañía._____

Localización actual._____

Puesto de la persona entrevistada._____

Fecha y lugar de fundación de la Empresa, motivos de su localización inicial._____

_____

_____

Si ha habido cambios de localización especificar fechas, lugares y motivos de ellos._____

_____

Productos elaborados por la fábrica y cantidad producida de cada uno.

_____

_____

_____

_____

Maquinaria y técnicas empleadas para cada producto._____

_____

_____

_____

_____

Cambios que ha habido en la elaboración de cada producto. Motivo de tales cambios._____

_____

_____

Si tienen sucursales o relaciones con otras plantas de textiles, dónde se localizan y que productos elaboran éstas._____

_____

_____

_____

Qué materia prima se utiliza en la producción. De dónde la traen y como._____

Precio al que se adquiere la materia prima._____

Cómo se distribuye el producto: Centros de distribución nacionales e internacionales. Medios de transporte empleados para llegar al mercado consumidor._____

Qué tanto por ciento se consume nacionalmente y que tanto internacionalmente_____

Si hay algún intermediario entre la fábrica productora y el mercado consumidor, quien es y dónde se localiza._____

Precios de distribución (al mayoreo, etc.)_____

Estadística del personal:

Número total de empleados._____ Hombres_____ Mujeres_____

Edades_____

Horarios (Turnos)_____

Salarios promedios de 1940 en adelante._____

Forma de contratación._____

Agrupaciones sindicales. Prestaciones sociales._____

Planes futuros._____

_____

_____

Cambios que ha habido en la estructuración de la Empresa._____

_____

_____

APPENDIX B

MEXICAN COTTON TEXTILE EXPORTERS, 1962-1969

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MEXICAN COTTON TEXTILE EXPORTERS, 1962-1969

List of enterprises exporting cotton textiles since 1962 furnished by the National Chamber of the cotton textile industry.

1. Acabados Textiles San Francisco, S.A.
*2. Alianza Textile, S.A.
3. Amado Rodríguez Veracruz.
*4. Atoyac Textil, S.A.
5. Ayotla Textil, S.A.
6. Cía. Hilandera de Torreón, S.A.
7. Cía Industrial de Orizaba, S.A.
8. Cía Industrial de Parras, S.A.
9. Cía Industrial de Tlaxcala, S.A.
10. Cía Industrial Río Bravo, S.A.
*11. Cía. Industrial San Jorge, S.A.
*12. Cía. Manufacturera de Covadonga, S.A.
13. Cía Poblana Manufacturera de Hilos, S.A.
14. Cía Textil de Roble, S.A.
15. Cía. Textil Jalisciense, S.A.
16. Cía Textil la Purisima, S.A.
17. Cierres Ideal de México, S.A.
18. Comercial de Telas, S.A.
19. Corvera Textil, S.A.
*20. El Carmen, S.A.
21. El Centro Textil, S.A.
*22. El Pilar, S.A.
*23. El Rosario, S.A.
*24. El Triunfo, S.A.
25. Escocia, S.A.
26. Fábrica de Hilados y Tejidos Sindec, S.A.
27. Fábrica de Hilos la Aurora, S.A.
*28. Fábrica Santa María de Guadalupe, S.A.
29. Fábrica el Carmen, S.A.
*30. Fábricas Unidas San Manuel, S.A.

31. Fantex, S.A.
*32. Filatex, S.A.
*33. Hilados Blanca, S.A.
34. Hilados Coyoacán, S.A.
35. Hilados de México, S.A.
36. Hilados del Norte, S.A.
37. Hilados Friac, S.A.
38. Hilados Finos, S.A.
*39. Hilados la Barranca, S.A.
40. Hilados la Esperanza, S.A.
41. Hilados la Luz, S.A.
42. Hilados Teca, S.A.
*43. Hilados y Retorcidos la Moderna, S.A.
44. Hilados y Tejidos Puente Sierra, S.A.
*45. Hilandera San Andrés, S.A.
46. Hilaturas de Oriente, S.A.
47. Hilaturas Ideal, S.A.
*48. Hilaturas Leab, S.A.
49. Hilaturas Lourdes, S.A.
*50. Hilaturas Perfectas, S.A.
*51. Hilaturas Santa Bárbara, S.A.
52. Hilos Cadena, S.A.
53. Hilos Renau, S.A.
54. Industrial del Fresno, S.A.
55. Industrias Alta Mar, S.A.
*56. Industrias Textiles, S.A.
57. Industria Textil de Toluca, S.A.
58. J. de la Torre e Hijo Sucesores, S. de R.L.
59. La Azteca, S.A.
60. La Carolina y Reforma, S.A.
61. La Concha, S.A.
*62. La Constancia Mexicana, S.A.
63. La Magdalena, S.A.

64. La Hormiga, S.A.
65. La Marina, S.A.
66. La Nueva Perfeccionada, S.A.
*67. La Poblana, S.A.
68. La Tirolesa, S.A.
69. Lomas el León, S.A.
*70. La Pongueta, S.A.
*71. Manufacturera de Algodón la Angélica, S.A.
72. Martín Mexicana, S.A.
73. Nacional Textil Manufacturera, S.A.
*74. Ocotlán Textil, S.A.
75. Nueva Aurrera, S.A.
*76. Productora de Hilos, S.A.
*77. Productos el Volcán, S.A.
*78. Puebla Industrial, S.A.
*79. Sánchez Gavito, S.A.
*80. San Alfonso, S.A.
81. San Diego Textil, S.A.
82. San Eduardo, S.A.
*83. San Ignacio Textil, S.A.
*84. Santiago, S.A.
*85. Scala Textil, S.A.
86. Telas Plan, S.A.
87. Telas Patritismo, S.A.
88. Telas Blanco, S.A.
*89. Tejidos Especiales de Puebla, S.A.
90. Textiles Acozac, S.A.
91. Textiles Aga, S.A.
92. Textiles de Occidente, S.A.
*93. Textiles Agua Azul, S.A.
*94. Textiles de Puebla, S.A.
95. Textiles del Centenario, S.A.
*96. Textiles el Mirador, S.A.
97. Textiles Hercules, S.A.
98. Textiles Hidalgo, S.A.

99. Textiles Industriales, S.A.
100. Textiles Josefina, S.A.
*101. Textiles la Libertad, S.A.
102. Textiles Mar, S.A.
103. Textiles Marte Lou, S.A.
*104. Textiles Miguel, S.A.
105. Textiles Modernos de Monterrey, S.A.
106. Textiles Morelos, S.A.
*107. Textiles Nalén, S.A.
108. Textiles Nueva Vizcaya, S.A.
*109. Textiles Peña Santa, S.A.
*110. Textiles Perfectos, S.A.
*111. Textiles San Juan de Amandi, S.A.
*112. Textiles Santa Isabel, S.A.
*113. Textiles Senar, S.A.
114. Textiles Sonara, S.A.
115. Textiles Tacubaya, S.A.
116. Textiles Talames, S.A.
*117. Textiles Teja, S.A.
*118. Toallas y Bramantes, S.A.
119. Treviño Madero Hermanos, S.de R.L.
120. Zahuapán, S.A.

*These are textile industries located in the Puebla area

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