COTTON PRODUCTION IN SÃO PAULO STATE, BRAZIL

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Preface

The world's most important textile fiber is cotton. Upon its growth and use in textile production depends the livelihood of millions of people. Since the invention of the cotton gin in 1793 by Eli Whitney, the United States has dominated the world export market for cotton. In the early 1930's Brazil began seriously to compete with the United States for this position of dominance in the world market.

The Brazilian areas produce cotton--the North which grows chiefly long staple cotton and the South which grows the short staple type. The South dominates Brazil's cotton production today and is in turn dominated by the state of São Paulo. This study is limited to a consideration of the cotton production of São Paulo since it is from this state that the chief competition to United States cotton comes.

The purpose of this research has been to study the history and development of cotton production in São Paulo in relation to its physiography, climate and soil. The areas and acreages of production and the number of bales produced per year were investigated. Actual methods of producing cotton lint were studied in relation to the physical factors of the state. Economic, social, and political factors in cotton production were considered in some detail. Marketing methods and customers were investigated and compared to those of the United States. From an analysis of these major elements in cotton production an attempt was made to predict the future of São Paulo's cotton industry, possible competition with the United States, and future domestic and foreign markets.

The source materials of the study consist primarily of United States Government documents and periodicals, Pan American Union docu-

ments and periodicals, books by outstanding authorities on Brazil and São Paulo, and recognized geographical publications of the United States.

Personal letters containing much valuable material on raw cotton and cotton textile imports were received from Senhor Walder Lima Sarmanho, Minister and Commercial Counselor of the Brazilian Embassy at Washington, D. C., and Mr. Rolla S. Smith, Acting Chief, American Republics Branch, Office of International Trade, Department of Commerce, Washington, D.C. The writer wishes to accord grateful recognition to these officials for their assistance.

The writer translated from the Portuguese several sections of the book, Contribuição para o Estudo do Clima do Estado de São Paulo, by José Setzer. Several other passages of a book on Brazil by Raul Bopp and José Jobim were also translated from the Portuguese by the author. Numerous Portuguese words and spellings are used throughout this research paper in addition to the translated material.

The writer wishes to express her gratitude to Dr. Edward E. Keso, Head of the Department of Geography and to Dr. David C. Winslow under whose direction this research was completed. For early assistance in preparing the first chapters of the thesis and in selecting and preparing the maps used, the writer gratefully acknowledges the assistance of Professor George S. Corfield. The writer also wishes to express her gratitude to the members of the Library staff of Oklahoma A. and M. College for their able assistance in securing requested information.

C.B.S.

CHAPTER I

THE HISTORY OF COTTON IN SÃO PAULO

Cotton grew as a wild native plant along the northeast coast of Brazil at the time of Columbus' voyages and the early explorations of the Portuguese. The native peoples of the area knew about the existence of cotton, but they knew nothing concerning its use for spinning cloth. Instead of using it for cloth they tipped their war arrows with flaming cotton lint for use in burning hostile villages. Another use of cotton in the district of Maranhão was as tinder for kindling camp and cooking fires.

Columbus took cotton to Europe as a curiosity from Brazil on his fourth voyage, but no one realized its future importance as a textile fiber. The Jesuits of Brazil taught their Indian charges in the aldeias to spin cotton as early as 1549. The Jesuit knowledge of spinning obviously came from Mexico where the use of cotton as a textile was common knowledge among the Aztecs. Cotton spinners reportedly came from India to teach the colonists the art of spinning cotton. Minas Gerais became the site of the first Brazilian weaving mill as early as 1775.

Although the state of Baiá, Pernambuco, and Maranhão grew cotton in colonial times, Indian labor was not successful.

Negro slaves were first introduced in 1549, but the Brazilian export trade began much later in Ceará in 1700. The exact number of slaves imported and worked chiefly in the cotton and sugar plantations is not known as Ruy Barbosa ordered the slave import records destroyed in 1890.

Cotton reached its first boom period during the American Civil War when exports reportedly reached 368,000 bales. At the end of the Ameri-

can Civil War many of the cotton plantations reverted to sugar or coffee because of the higher prices paid for these products. Following the abolition of slavery in 1888, cotton as an export product declined to fourth place, being outranked by coffee, rubber, and sugar.

The decline of rubber export importance in the early 1900's caused the beginning of a second cotton boom following the drop in the exports of the United States in 1919.[1]

In recent years cotton again became coffee's nearest competitor for the top rank as Brazil's most valuable crop. During the period from 1939 to 1944 cotton, including the value of the seed, reached first place as the leading export. In 1945 and 1946 cotton ranked fourth as an export after coffee, corn, and rice.

Today, Brazil's chief sources of cotton are in the state of São Paulo[2] and in the adjacent areas of norther Paraná and southern Minas Gerais, in addition to the northeastern states of Paraíba, Rio Grande do Norte, and Ceará. A considerable share of the cotton of the northeast is of the long staple perennial variety but, except in a few areas, the strains have become badly mixed with the annual varieties grown in the same area. The cotton of the south in São Paulo, southern Paraná, and northern Minas Gerais is the short-staple annual variety. This study is limited chiefly to the short-staple varieties of São Paulo.

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[1] "Cotton in Brazil", Pan American Bulletin, LXIX (October, 1935), 746-763.

[2] In later chapters, the writer uses the term, "São Paulo," to refer to the province of that name. The term, "city of São Paulo", will be used specifically when the capital of the province is mentioned.

São Paulo's recent cotton boom began in the 1930's expanding until seventy-five per cent of Brazil's cotton came from this state alone in 1944. Cotton was introduced on two types of land-abandoned coffee acreages and new recently cleared lands in western São Paulo. These cotton areas centered around Sorocaba and Marilia with smaller areas to the west of the latter.

The Texas and Express varieties originally formed the basis from which were developed the present São Paulo strain. First developed in the 1920's by government agents the variety spread over a large area of the province until it became to a great extent a one variety region. Government agents took the lead in the development of the seed at the agricultural station at Campinas.[3]

Numerous factors have caused the growth of the production of cotton to 586,098 metric tons or 2,700,000 bales in 1944 and its decline since to approximately half that amount today. There were both national and international reasons for the rapid expansion of cotton since 1934. The abandonment of large areas of coffee lands on a wide-spread scale due to the depression in coffee prices in the 1930's made available large amounts of suitable cotton lands during that period and in the years following.

At the same time the British were actively engaged in the encouragement of São Paulo's short staple cotton areas as a new source of supply which might successfully compete with the American varieties. The British sought to develop a variety of cotton in São Paulo that had the even length of fiber, standard tensile strength, and good weaving quali-

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[3]George Wythe, Brazil, An Expanding Economy, pp. 69-71.

ties which American varieties often lacked. During the period from 1939 to 1944 Japan and Germany actively entered the Brazilian cotton market. With the increased demand for cotton from these three countries, cotton production expanded rapidly. Japanese settlers from Marilia, westward to the Paraná River began to grow larger amounts of cotton on the new lands in this area. Most of the farms were small in size with other crops grown in addition to cotton.

The United States reduced its export of cotton from 1934 to 1944 because of smaller acreages under the American Agricultural Adjustment Act, because of lend-lease products being sent to American allies, and because of the necessity of American supplies being shipped to her own soldiers overseas. American cotton trading firms, however, were anxious to continue serving their foreign customers when domestic cotton supplies were reduced. These firms, therefore, bought Brazilian cotton during this period and resold it under American labels to foreign customers.[4]

Although Brazil produces two and one half times as much raw cotton as she uses in her mills, seventy-five per cent of that cotton is largely concentrated in São Paulo. In the fourteen years from 1930 to 1944, the total production in São Paulo grew from five per cent to seventy-five per cent and was largely devoted to export trade. As the largest single customer was Great Britian, until the latter part of the period, São Paulo had to meet her requirements for cotton staple. The requirements for staple for use in British mills have already been discussed. To meet these British requirements the state made two drastic changes in

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[4] Henry W. Spiegel, The Brazilian Economy, p. 180.

the growing of cotton of which the distribution of all seed by the state government constituted the first. The distribution of all seed in this manner led to the development of a single uniform type. From Campinas Number 817 seed a government variety was developed with high vitality and growing ability.

The second change was the rigid ginning of São Paulo cotton under state supervision which has led to the development of a uniform staple one and one tenth to one and two tenth inches in length. This is a great improvement over the old fiber lengths of eighty-six hundredths to one and two hundredths inches which prevailed in the 1920's. São Paulo's cotton has thus become more uniform than that of any state of the United States.[5]

Still another important factor leading to the rapid expansion of São Paulo's cotton was the increase in immigration, in 1890 reaching 107,000 people. In 1891 the increase rose to 216,000 people. In the last fifty years between four and five million white immigrants have entered Brazil.

In 1937-38 only fifty-four per cent of the cotton area in São Paulo was operated by Brazilians and the remainder by foreigners--largely Italians and Japanese. Since 1938, however, cotton production has increased by seventy per cent while the amount of land held by the Japanese has remained constant and that held by the Italians has declined. Nationals now hold seventy-two per cent of the cotton land, Japanese fourteen per cent, and Italians four per cent. The apparent decline in

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[5] Ibid., p. 180.

Italian holdings is produced, in part, by the naturalization of many former Italian owners and operators. The remaining cotton land owners farming the other ten per cent are largely Portuguese and Spanish in ancestry. São Paulo's cotton production, therefore, is largely concentrated into the hands of five groups of people--the Brazilians, who are mixtures of Negro, Indian, and Portuguese; the Japanese settlers, who have arrived largely since 1930; and the Italians, Portuguese, and Spanish, who are being rapidly assimulated into the native population.[6]

As a geographical study of any area must take into account the relationships between people and their environment, this thesis will deal first with the three factors which tend to form such an environment. Probably the basic natural factor of all environment is the physiography of the particular area. Therefore, the first environmental factor which will be discussed is the physiography of São Paulo. Second only to the physiography of an area is the climate of that area. The climatic features which affect cotton production will form the subject of the third chapter. Climate and physiography form the basis of all soil thus making a discussion of São Paulo's fertile cotton soils and their location necessary. Following the discussion of the physical, climatic, and edaphic factors which make possible the growth of cotton in this area, the actual methods of cultivating cotton in relation to these factors will be discussed. Labor supplies, areas free of disease, climatic conditioners on homes, clothing, etc., and government interest in seed, ginning practices and credit will be discussed in some detail. Marketing practices, means of transportation of the product, and the place and im-

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[6]Henry W. Spiegel, The Brazilian Economy, pp. 167-168.

portance of the product in world markets, at present and in the future will also be considered.

CHAPTER II

THE PHYSIOGRAPHICAL INFLUENCE OF THE AREA UPON COTTON PRODUCTION

The basis of the growth of any crop is the soil which is a result of the combination of the physiography and climate of an area. São Paulo's location, physiographic divisions, geologic history, and drainage pattern constitute the large elements in the physiographical and topographical picture of São Paulo's influence upon the production of cotton.

The state of São Paulo at its greatest width is 575 miles from west to east, and its greatest length is 375 miles from north to south.[1] It lies between 53° 10' and 44° 10' W. Long. and between 19° 45' and 25° 15' S. Lat. Physiographically five different regions compose São Paulo.[2] All five areas are aligned in a northeast-southwest direction. Beginning as a narrow plain at the border of the state of Rio de Janeiro the plain widens somewhat as it rounds the point of land upon which São Sebastião is located. The coastal plain continues southwestward to Santos where it widens again to include the small river valleys behind Iguape then narrows again as the São Paulo-Paraná border is reached. The coastal plain varies from two miles in width at the São Paulo-Rio de Janeiro border to fifteen miles behind Santos, forty-eight miles behind Iguape, and twelve miles in width at the São Paulo-Parana border. The coastal plain

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[1] Measurements are from the United States Army Air Force maps of São Paulo.

[2] For checking elevations, locations of physiographic areas, and location of place names particular reference should be made to the transportation and physical maps of the province, pp. 77 and 10 and to the terrain map and cross sections, pp. 15 and 17.

is from sea level to 1,000 feet in altitude. Most of it, however, rises to an altitude much below the 1,000 foot level.

Inland from the coastal plain lies the sharp, southeastward facing slope of the Brazilian Highlands. This abrupt slope will be discussed as a separate physiographic division of São Paulo and will be identified as the escarpment, which is not quite continuous or of the same altitude in all places. The escarpment is known as the Serra do Mar from the Paraná-São Paulo border in its looping path from southwest to northeast across the province and just to the west of the plain. The Rio da Ribeira separates the Serra do Mar into two divisions. The outer range of the Serra do Mar is lower with altitudes reaching to over 3,000 feet and extending from south of the Paraná-São Paulo border to the northern edge of the coastal plain surrounding Iguape. The inner range of the Serra do Mar extends from the Paraná-São Paulo border in a great convex loop to within a short distance of the city of São Paulo. Beyond the city the range loops seaward again crowding the coastal plain to a narrow strip as it nears the São Paulo-Rio de Janeiro border. The crest of the outer range rises from between 2,000 and 3,000 feet at the Paraná-São Paulo border to over 4,000 feet just southwest of the city of São Paulo. Around the city, the altitude decreases to between 2,000 and 3,000 feet but again rises to 4,000 feet as this more northern loop of the Serra do Mar approaches the sea.[3]

To the west of the Serra do Mar is the third of the physiographic divisions-the Rio Paraíba Valley. The interior crests of the Serra do Mar which are called the Serra da Quebra Cangalha and the Serra da Bocaina,

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[3] United States Army Air Force Map Number 1261.

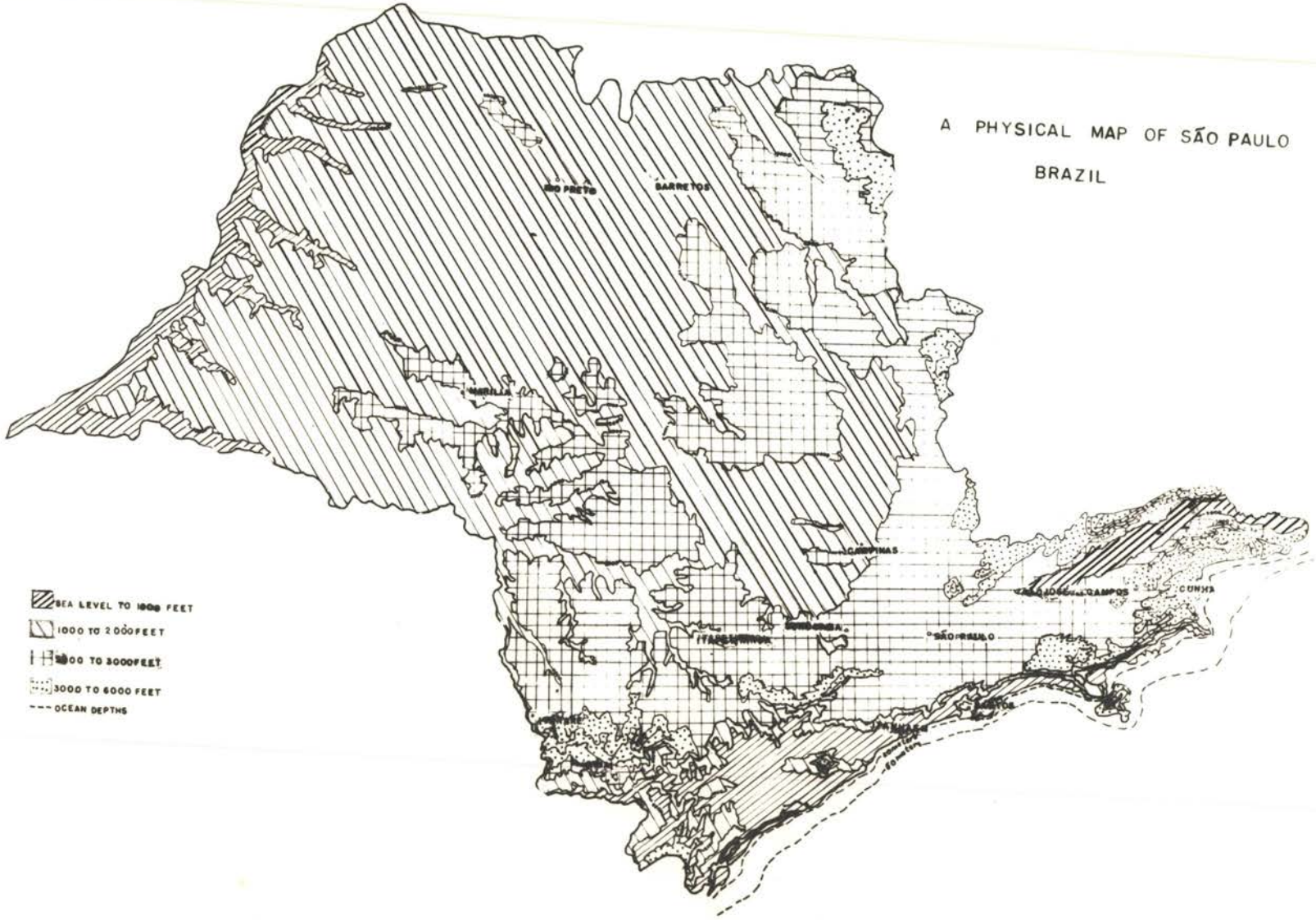

FIGURE 2

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slope, from their crests of 4,000 feet, sometimes gently sometimes abruptly to the valley of the Rio Paraíba, which is at an altitude of from 1,000 to 2,000 feet. The river valley slopes gently from the site of São José dos Campos at an altitude of 1,869 feet toward the border of the state of Rio de Janeiro.[4]

Between the escarpment of the Serra do Mar in the east and the Rio Paraná Valley and those of its tributaries in the west lie the main regions of the Brazilian Highlands. These highlands are old, worn down mountains of the folded Appalachian type with a sharp southeastern face called the Serra da Mantiqueira. The Brazilian Highlands cover approximately two-thirds of the territory of São Paulo and the average elevations range from 2,000 to 3,000 feet in the east with a gentle downward slope to the west reaching levels often as low as 1,000 feet. In general the area is rolling topography with higher elevations which give it the appearance of a partially reduced peneplain. The western edges of the highlands have been badly eroded by the tributaries of the Rio Paraná, but even these have made little headway in cutting back across the drainage divide, which is formed by the eastern slope of the Serra da Mantiqueira.[5]

The Brazilian Highlands are quite complex although its many regions have been grouped under a single classification. The granites and gneisses of the crystalline escarpment have been covered in many places by stratified rocks, the layers of which dip gently to the west and north. Geologically the highland was once a great structural basin

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[4] Ibid., Map Number 1261.

[5] Preston E. James, "The Surface Features of Southeastern Brazil, A Review," Geographical Review, XXXIII (January, 1943), 135-139.

which was filled by numerous lava flows which occurred probably first in Paleozoic times and later happened again in Tertiary and Quarternary times. Thus a great lava plateau similar to the Columbia Plateau of the United States was built up over which was later deposited, during a period under the sea, numerous sedimentary rock layers. These sedimentary layers have been eroded through the ages since by the rivers to form an inner lowland.

Streams descend into this lowland over a fall line along the margin of the crystalline rocks. Along this crystalline-sedimentary rock margin a series of towns, such as Soroceba, Itú, Campinas, and Mogi-Murím, were built to take advantage of the break in bulk necessary for transportation purposes. This inner lowland has had several low ranges of hills formed within it where the more resistant rock layers were not as easily eroded by the water. This inner lowland terminates sharply to the west and north where the steep face of a cuesta appears capped by more resistant diabase. The diabase was originally deposited in molten form in sheets or dykes just below the surface and again appeared after the erosion of the softer sedimentary rock. Wherever this diabase outcrops steep cliffs are formed. This diabase dips toward the north and west as do the sedimentaries, and thus always forms a sharp eastward and southward facing cuesta. The general level of the inner lowland formed on the eroded sedimentaries is between 1,900 and 2,200 feet above the sea but the diabase cuesta often rises as much as 600 feet higher than the lowland. This cuesta is sharp and continuous from Paraná into São Paulo and is broken in the south only by the water gaps cut into it by the westward and northward flowing rivers.

In the north the diabase cuesta crosses the inner lowlands and is

found bordering the crystallines to the east. The cuesta in the north becomes detached into pieces because of excessive faulting. From the crest of the cuesta the land slopes gently westward to the Rio Paraná. The diabase, which forms a large share of the Paraná Plateau, comprises only a narrow band in São Paulo or cuesta with large areas of sandstones covering it. These sandstones rest on the diabase which is exposed only in the valley bottoms and in the cuesta which has been discussed. On this exposed diabase has been formed the terra roxa soil of coffee fame, while the terra arenosa is formed on the overlying sandstone and is becoming the site of numerous cotton plantations.[6]

The last of the physiographical divisions is the Rio Paraná Valley and the valleys of its tributaries. The elevation of this area varies from sea level to 2,000 feet. The Rio Paraná and two of its tributaries, the Rio Paranapanema and Rio Grande, form all the western and over half the northern and southern boundaries of São Paulo.[7]

There is a definite relationship between the geologic history of the area and its present appearance. Since Paleozoic times an ancient shield of crystalline rock had remained in this area. The work of water through the eons of time produced a widespread erosion surface over the whole region of southeastern Brazil. During the Early Tertiary Period, movements in the underground areas below this surface caused tensions that produced faults and folds. Then the old erosion surface was superimposed upon the dome of the Serra da Mantiqueira and later buried beneath marginal deposits of Permian age. Domes were also formed at this

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[6]Preston E. James, Latin America, pp. 472-476.

[7]United States Air Force Maps Numbers 1262 and 1313.

time in the states of Paraná and Rio Grande do Sul.

A long period of quiescence led to the formation and continuing development of the higher surface in the Rio Grande Upland. During this period the front of the Mantiqueira had already appeared, but it was not, as yet, a strongly marked physiographic feature. Later in the Tertiary Period, renewed movement and lava flows began along the old lines of weakness. The Great Escarpment of the Serra do Mar and the Serra da Mantiqueira strongly developed during this period because of the renewed uplift. Lakes were formed along the margins of the highlands following the uplift in the Late Tertiary Period. The lava plateau to the west of the ranges was being built and the present prominent cuesta of the central São Paulo area was etched out by the tributaries of the Paraná River and subsequent streams along the southern and eastern base of the inner lowland of Paraná and São Paulo.

Another period of uplift and lava flows followed along the Great Escarpment, probably in the Quarternary Period. This movement resulted in the formation of entrenched meanders and made more prominent the capture of the Tieté River by the Paraíba River. Although the Great Escarpment has been exposed to river erosion since Quarternary times, and in spite of the heavy rainfall of this area, relatively little headward erosion has occurred.[8] In recent times the various rivers of São Paulo have completed the work begun by the geologic uplifts of the Quarternary Era.

The general drainage pattern of the state has developed in relation

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[8] Preston E. James, "The Surface Features of Southern Brazil, a Review", Geographical Review, XXXIII (January, 1943), 135-139.

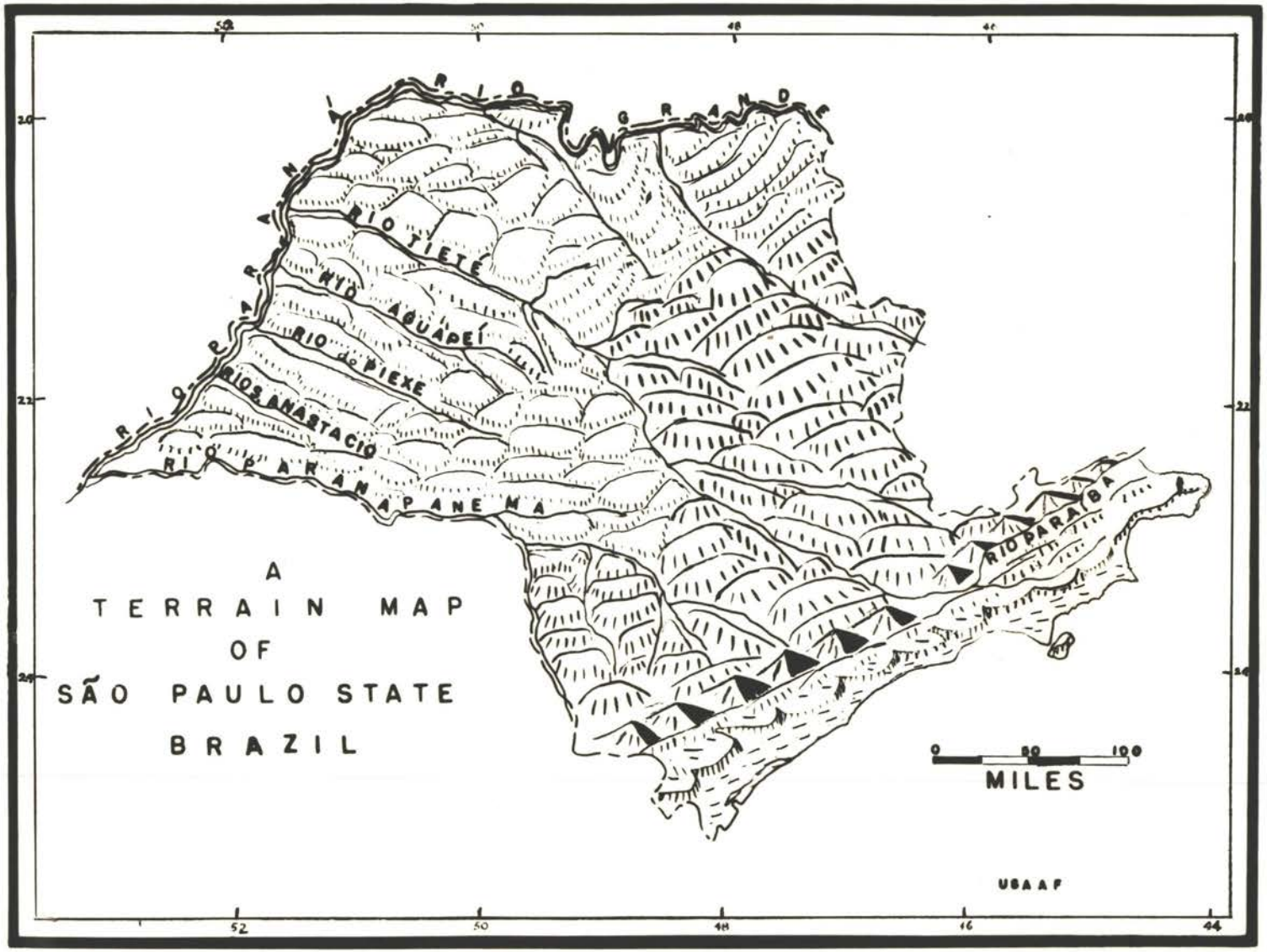
RIO GRANDE
RIO TIETE
RIO AGUAPEÍ
RIO do PEIXE
RIOS ANASTACIO
RIO PARANAPANEMA
RIO PARAIBA
A
TERRAIN MAP
OF
SÃO PAULO STATE
BRAZIL
0 50 100
MILES
USAAF
52
50
48
46
44
20
22
24

FIGURE II

to its physiography. Over the ancient Paleozoic shield was laid a deposit of limestones, shale, and schists. Into this sedimentary material the Rio Paraná and its tributaries--São Paulo's largest river which flows southwestward--has cut until it reached the hard crystalline rock that underlies the surface. Since the hard rock of the old shield has resisted erosion better than has the stratified materials, there has been less headward erosion since that point in the river's erosion cycle has been reached. The Rio Paraná forms the western boundary of São Paulo and has a meandering course. Its drainage pattern is trellis-like as its numerous tributaries flow into it at almost right angles. At the point where the Rio Tieté joins the Paraná there is a large ox-bow lake off the left shore.

Although the Rio Paraná has numerous tributaries both in São Paulo and in the neighboring states of Mato Grosso and Paraná, only the two tributaries that help form the northern and southern boundaries of the state have done much headward cutting or have fairly wide channels. These two tributaries are the Rio Grande which forms the northern boundary from 51° 10' to 47° 15' W. Long. and the Rio Paranapanema with its tributaries which comprise the southern boundary from 53° 10' to 49° 15' W. Long. Both of these rivers meander a great deal and have numerous crooks and turns in their courses. The Rio Grande has a wide channel, and even after it leaves São Paulo, the channel and valley are both wide in the province of Minas Gerais even when the 3,000 foot contour is reached at 44° 15' W. Long. From this point onward to its source at 44° 34' W. Long. and just below the 5,000 foot contour, the Rio Grande has an incised, narrow channel.

The Rio Aiuruoca, one of the tributaries of the Rio Grande, has e-

A CROSS SECTION OF SÃO PAULO STATE

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FIGURE III

roded its channel headward until it is within approximately twelve miles of tapping the Paraíba. This stream is already above the 7,000 foot contour line on the divide between the westward flowing drainage which is tributary to the Rio Paraná and the eastward flowing drainage which is tributary to the Rio Paraíba or other streams that flow directly into the Atlantic.[9]

In general, the divide between the tributaries of the Paraíba and of the Rio Paraná is along the crest of the Serra do Mar and the Serra da Mantiqueira. Exceptions, however, to this rule occur as is readily perceivable as more southerly tributaries of the Rio Paraná are traced to their sources. One of the better proofs of this statement is the course of the Rio Tieté which begins at 23° 17' S. Lat. 43° 10' W. Long. and extends in a meandering course over a large share of the width of São Paulo until it enters the Rio Paraná at 20° 30' S. Lat. 51° 35' W. Long. The headwaters of this stream have been tapped by the headwaters of the tributaries of the Rio Paraíba which have thus cut channels from the east through the front ranges of the Serra do Mar.

It is also interesting to note that the drainage of the Rio Tieté comes within twenty miles of the Atlantic Ocean before it is thus tapped by the Paraíba which flows generally north and east before it reaches the Atlantic Ocean. Therefore the drainage divide between the east-flowing and west-flowing streams of São Paulo does not always remain close to the crest of the Serra do Mar and the Serra da Mantiqueira and occasionally is completely eradicated as in this case.[10]

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[9] Information concerning the width, direction of flow, and length of rivers is taken from the United States Army Air Force Maps, Numbers 1261, 1262 and 1313.

[10] United States Army Air Force Map, Number 1262.

Two tributaries of the Rio Paraná have been traced and discussed in some detail. What of the other tributaries of the Paraná? How far eastward does the Paraná reach? How much headward cutting has it done? Another look at the map reveals some very interesting information in regard to these questions. To the south of the Rio Tieté the Rio Paraná has four tributaries flowing into it which are located within the borders of São Paulo or help to form the southern border as does the Rio Paranapanema and its tributaries, the Rio Itararé and the Rio Pardo. These rivers are from northeast to southwest, along the course of the Rio Paraná, the Rio Aguapeí, the Rio do Piexe, the Rio Santo Anastacio, and the Rio Paranapanema. In addition to these four large permanent streams, there is one short permanent stream between the Rio do Piexe and the Rio Santo Anastacio and one temporary stream between the Rio Aguapeí and the Rio do Piexe.

It is interesting to compare the number of permanent tributaries on both the left bank of the Paraná within São Paulo and the right bank within the state of Mato Grosso. On this stretch of the river on the left bank and within São Paulo there is only one temporary tributary to the Paraná. On the right bank in the same stretch of territory in Mato Grosso fourteen such streams appear. In regard to the number of permanent streams on both banks, the São Paulo bank has nine while the Mato Grosso has only four such streams. These factors appear to indicate that São Paulo, tends to be a rainier state than Mato Grosso.

The Rio Aguapeí, the Rio do Piexe, the Rio Santo Anastacio, and the Rio Paranapanema, the four large tributaries which lie south of the Rio Tieté and within São Paulo have certain definite similarities. All have long meandering courses with valleys ranging from fity to one hundred

and twenty miles before they join the Paraná, depending upon the size of the basin which each stream drains. These open valleys of the streams near the Paraná are usually from three to twenty-five miles in width. The streams do develop dendritic drainage in the steeper drainage areas, but the pattern becomes trellis-like on the gentler slopes. As steeper gradients appear the valleys narrow until they disappear almost completely and the drainage channel alone is left since the force of the water has been strong enough to cut only the channel during that time.[11]

Thus the Paraná and its tributaries have managed, by higher velocity of flow and a larger volume of water for cutting purposes, to control a very large share the drainage pattern of São Paulo. Through the ages, the Paraná has leveled a huge area of the state several hundred feet and in a third of the state has eroded the surface to 2,000 feet or lower with only long fingers of the highlands projecting westward between the Paraná's tributaries. A few monadnock-like hills are scattered over the surface of the area as a reminder that it once was several hundred feet higher before the present erosion cycle started.

Temporary streams as direct tributaries to the Paraná or as tribute streams to the Paraná's tributaries seem to indicate that there has been some surface solution but no sink holes on the scale of area in the Lexington region of the United States. The change in the type of stream pattern from the dendritic in the more mountainous areas to the trellis type on the gentler slopes is apparently due to the fact that in the more gently sloping areas the lack of harder rock strata has the effect

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[11] Ibid., Maps, Numbers 1261,1262, and 1313.

of allowing the streams to flow at will. Also some of this pattern appears to have developed along the base of the highlands where the highlands formed a bulwark along which a parallel stream might have developed. As the highland base was eroded additional streams developed. Also the Paraná is an antecedent stream while its tributaries are subsequent streams. Since the eastern part of São Paulo was uplifted rather recently, streams naturally flowed toward the Paraná and tended to develop a parallel pattern since that was the path of least resistance.[12]

The streams of the east coast are largely subsequent ones as the uplife of Quarternary times has as yet not been completely eradicated, and the streams have not had time to revert to an antecedent drainage pattern. There are two fairly large river systems on the east coast, but neither compare with the Rio Paraná as to size of drainage basin, number and length of tributaries, or power of headward cutting. The two river systems include the Rio da Ribeira and the Rio Paraíba. Although several other small streams appear in the area, none begins to compare with either the Rio da Ribeira or the Rio Paraíba. Both streams have eroded large valleys although the Ribeira's valley is much larger and lower than is that of the Paraíba. Over half of the Rioda Ribeira's valley is below 1,000 feet in altitude while that of the Paraíba is largely over 1,000 and often up to 2,000 feet. However, the Ribeira is cutting through a lower rock formation and one that is also somewhat softer than that through which the Paraíba is cutting. The connection between the Rio Tieté which drains westward to the Paraná and the Rio Paraíba which drains eastward

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[12] James, op. cit., XXXIII, 135-139.

into the Atlantic Ocean has already been discussed.

Not only has the Rio Paraíba tapped the headwaters of the Rio Tieté, but it appears likely that in the not too distant future, speaking physiographically, the Rio da Ribeira may tap the headwaters of the Rio Paranapanema since it has cut to within four and one half miles of the headwaters of the Rio Itararé which flows north into the Rio Paranapanema. Thus there would be two completely converted drainage areas across São Paulo--the Rio Paraíba-Rio Tieté--Rio Paraná route and the Rio da Ribeira-Rio Paranapanema-Rio Paraná route.[13] Both the Rio da Ribeira and the Rio Paraíba are comparatively short, meander a great deal, and have a dendritic drainage pattern. It appears that the Rio da Ribeira does much more meandering than does the Rio Paraíba. This appears to be true because of the wider stream valley that the Rio da Ribeira does much more meandering than does the Rio Paraíba. This appears to be true because of the wider stream valley that the Rio da Ribeira has cut for itself into the base of the Serra do Mar. The Rio Paraíba has incised a rather narrow valley into the Serra da Mantiqueira as compared to that of the Rio da Ribeira. The Rio Paraíba appears to have done much of its pirating of neighboring streams as it cut headward. Several of the Rio da Ribeira's tributary streams are close to the mouth of that river. Several of the tributaries of the Rio Paraíba have cut headward in such a way that they will soon be flowing into the ocean directly rather than into the sea by way of the master stream.[14]

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[13] United States Army Air Force Maps, Numbers 1262 and 1313.

[14] Ibid., Numbers 1262 and 1313.

This then is the physiographic pattern of the province of São Paulo. A sharp crystalline escarpment in the East with a short steep eastward-facing slope and a long gentle slope to the West composes the backbone of the province. Overlaying this crystalline base are a series of stratified layers which have been partially eroded by the rivers. In the West the rivers have developed a trellis drainage pattern. In the East the pattern tends to become dendritic. The area is being peneplained to a somewhat even surface in the West. In the eastern area the rivers are shorter, swifter, and have a steeper gradient than do those of the West at the present time.[15]

The present topography is a series of rolling hills in the western part, a gradual rise to the rugged, eroded edges of the Brazilian Highlands, and a rather rapid rise to the steeper slopes of the highlands which end in the Serra do Mar and the Serra da Montiqueira. There are numerous valleys in São Paulo. Many of these head within a short distance of the east coast and cross the entire state. Many of the present immigrants into the cotton districts of the western part travel along these rivers. One of the favorite paths is along the Rio Paraíba to the point where it has captured the Rio Tieté and then westward along that river to the great cotton belt. The Rio Paraíba also makes an excellent route to the areas around Sorocaba and São Paulo where cotton is grown today.[16] Over this same route from the city of São Paulo to the city of Rio de Janeiro, the people built the modern railroad between these two towns. Modern railroads and roads follow the tributaries of the Paraná

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[15] Ibid., Numbers 1261, 1262, and 1313.

[16] Preston E. James, "Rio de Janeiro and São Paulo", Geographical Review, XXIII (April, 1933), 271-298.

westward to the master stream. Settlers for the cotton districts to the westward and cotton for the factories in the city of São Paulo and the surrounding cities travel over these railroads and roads. Along these routes also are distributed the finished products of the mills of São Paulo and the machinery to be used in making these products and in ginning the raw material.

The general cotton belt is located along the tributaries of the Rio Paraná usually in the lands between 1,000 and 2,000 feet on either the terra roxa or the terra arenosa. The lower land is too swampy for cotton as will be shown in the following chapter on the climate of the area. It is also a location for malaria and the mosquitoes that carry it. Lands above the 2,000 foot contour are not often used as they are too steep for the ideal cotton crop. Since land is cheap in São Paulo because of its abundance, the people use only the best for cotton as is the case for many other crops. In general, the cotton-producing areas are concentrated along four tributaries of the Rio Paraná. The greatest concentration is found along both banks of the Rio Tieté but again largely above the 1,000 foot contour. There are great concentrations of cotton at Sorocaba and Aracatuba which are both on the left bank of the Rio Tieté. The two other great concentrations are at Marilia between the Rio Aguapeí and one of its tributaries and along and between the Rio do Pieve and the Rio Santo Anastacio. Thus the lowlands along the tributaries of the Rio Paraná seem to make the best cotton land. No cotton is grown below the 1,000 foot contour on the master stream, however, because of the malaria, air drainage and swampiness in these areas.[17]

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[17]Reference should be made to the cotton production map on page 47.

CHAPTER III

CLIMATIC EFFECTS ON COTTON

The cotton plant requires somewhat similar climatic conditions over the entire world. Cotton requires a growing season of about two hundred ten days and an average temperature during the period of 75° to 80° F. In addition, cotton must have at least twenty inches of precipitation so distributed that the autumn precipitation does not exceed ten inches as autumn is the picking season for cotton and excessive rain might damage the bolls.

With these ideal climatic conditions in mind the various factors which compose the climates of São Paulo will be discussed in some detail. This province extends from 20 to 25° S. Lat. and from 44 to 53° W. Long. The province, although irregular in shape, lies approximately astride the Tropic of Capricorn.

Since the entire province is only twenty five degrees from the equator, the range of temperature from summer to winter is correspondingly low. The range in most of the province between the averages of the hottest and coolest months is only from ten to fifteen degrees. In January, the summer of São Paulo, the 70° F. mean isotherm runs along the northern and western boundary of the state while the 60° F. mean isotherm is far to the south of all of southern Brazil. In April, São Paulo's autumn, the 70° F. isotherm moves far to the northward running from the Andes across to the north of São Paulo in the province of Mato Grosso and Minas Gerais to Salvador on the coast. The 60° F. isotherm moves inland into southern Brazil and northern Uruguay but still to the south of São Paulo. By July, São Paulo's winter, the 70° F. isotherm just touches the

northern border of the province while the 60° F. isotherm rests just to the south of the southern border of the province. During the spring, the 70° F. isotherm shifts to approximately the center of the province, and the 60°F. isotherm shifts entirely outside São Paulo. It is noteworthy that the mean temperature of the province during the four seasons of the year as shown by the location of the isotherms usually stands between 60 and 70° F.[1] Thus the mean temperatures are high enough to allow the raising of cotton as the extremes for each month would naturally be somewhat higher than the mean temperature for cotton.

Another factor affecting the climate for the province is the Brazilian Current. The current is caused when the South Equatorial Current strikes the Brazilian coast at Cape São Roque and divides. The northern part flows north along the Caribbean coast of northern South America to become part of the Gulf Stream. The southern half of the South Equatorial Current turns south along the eastern and southern coast of Brazil and its warming influence reaches as far south as the Rio de la Plata. This control tends to ameliorate the heat of summer and the cold of winter for the entire province. This marine influence extends inland making the seasonal variation much less than it otherwise might be.[2]

The pressure system of South America also effects the climate of São Paulo to some extent. In summer there is a great low pressure area over southern Brazil and northeastern Argentina. On either side of the depression there rests a higher pressure area--one to the west over coastal Peru and Chile and one to the east over the Atlantic Ocean and

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[1] W. G. Kendrew, The Climate of the Continents, p. 356.

[2] Ibid., pp. 357-358.

SÃO PAULO CLIMATIC DIVISIONS

AFTER THE KÖPPEN SYSTEM OF CLIMATIC CLASSIFICATION

AFTER SETZER

FIGURE IV

the coast of Brazil from Cape São Roque to the La Plata estuary. The winds from both highs tend to blow into the low pressure area in northern Argentina and southern Brazil. Therefore, São Paulo from its northern border to the Tropic of Capricorn tends to have onshore winds in January which blow from the east or northeast.

In July the low pressure belt over southern Brazil and northern Argentina moves north as the direct rays of the sun cross the equator until the low pressure area stands over the Amazon River Valley. Over the entire southern half of South America there is high pressure in July which is the winter season of the continent. The winds blow from this high into the low pressure belt over the Amazon Valley. Since the gradient is greatest in the southwest part of this area the winds tend to blow from the southwest into the Amazon low, giving southwest winds in northern São Paulo from the northern border to the Tropic of Capricorn.

The east and northeast winds of January blow inland and are reinforced by monsoonal influences due to the excessive heating of the continent during the summer. From the Tropic of Capricorn to the mouth of the Rio de la Plata, the southern part of São Paulo and the remainder of southern Brazil lie to the west of the South Atlantic anticyclone all the year. This area, therefore, has moist, warm, rainy, northeast winds the entire year. Thus northern São Paulo tends to have rain during the summer while the southern part of the province from 23° 30' S. Lat. to the southern border also has some winter as well as summer rain. This gives northern São Paulo a summer rainfall maximum while southern São Paulo has more evenly distributed precipitation the entire year with a

RAINFALL AND TEMPERATURE GRAPHS OF TWO TYPICAL C_{wa} STATIONS OF SÃO PAULO

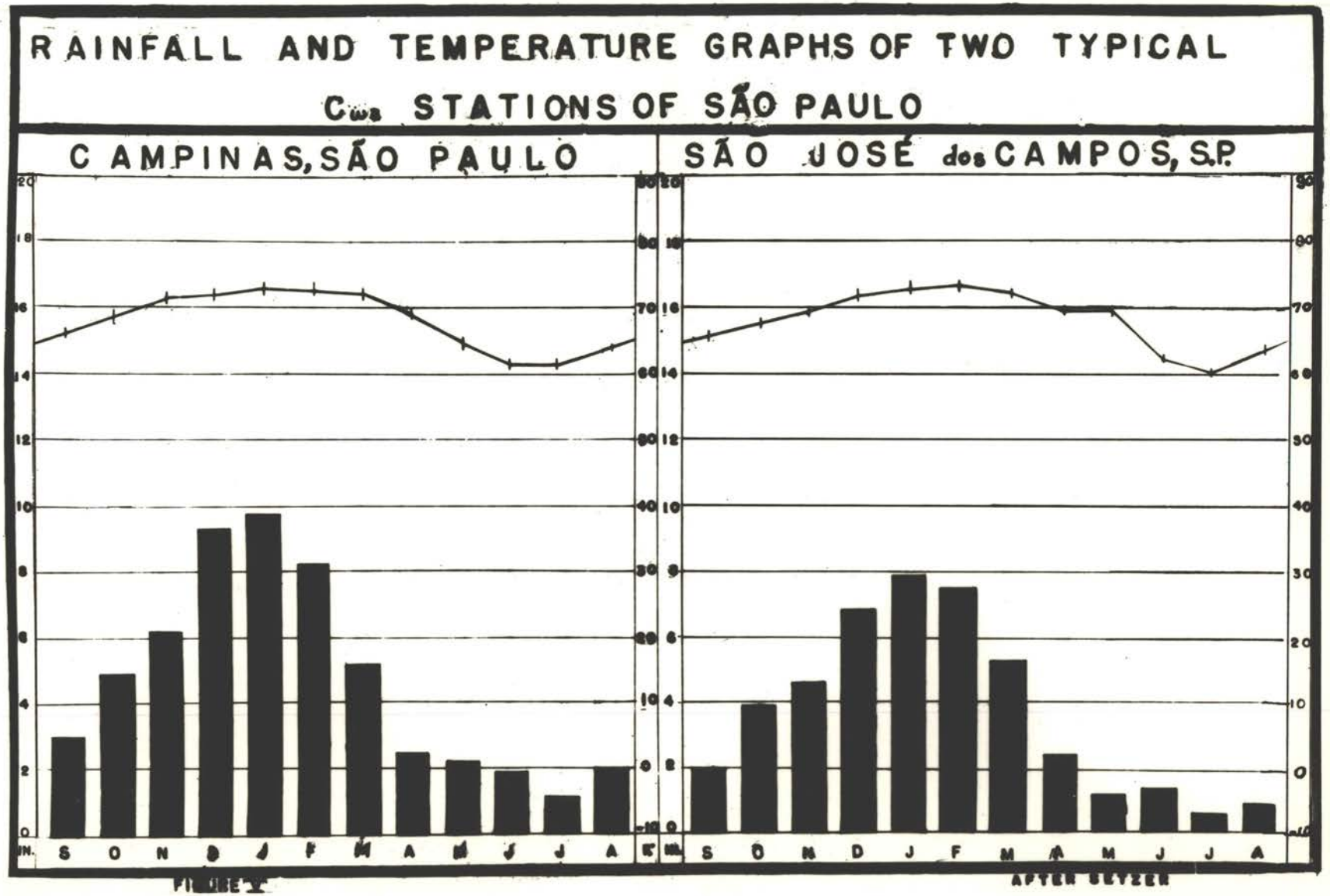

FIGURE V

AFTER SEYZER

slight summer maximum.[3]

Certain stations in São Paulo have their climate influenced because of their location. Some of these such as the city of Sao Paulo are in the rain shadow of the mountains causing the lower precipitation because of the loss of moisture as the winds cross the mountains. São Paulo thus has less moisture than Santos because it is on the lee side of the Serra do Mar giving it an annual precipitation of 41.4 inches as compared to 87.8 inches for Santos. Differences in altitude may also cause temperature differences as is definitely proved by the same two stations which were previously mentioned. São Paulo has an altitude of 2,460 feet and Santos 16.4 feet. São Paulo has an average maximum temperature of 70 F. in February and an average minimum temperature of 58.5° F. Santos, however, has an average maximum temperature in January of 85.5° F. and an average minimum of 73.9° F. in July. Thus the difference in altitudes makes a marked difference in the extremes of temperature in these two locations although the range of temperature is approximately the same as a result of the closeness of their astronomical locations.[4]

In order to locate the cotton areas of São Paulo, it is necessary to consider the location of the various types of climates found in the

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[3] Ibid., pp. 358-360.

[4] José Setzer, Contribuição para o Estudo do Clima do Estado de São Paulo, pp. 73, 201.

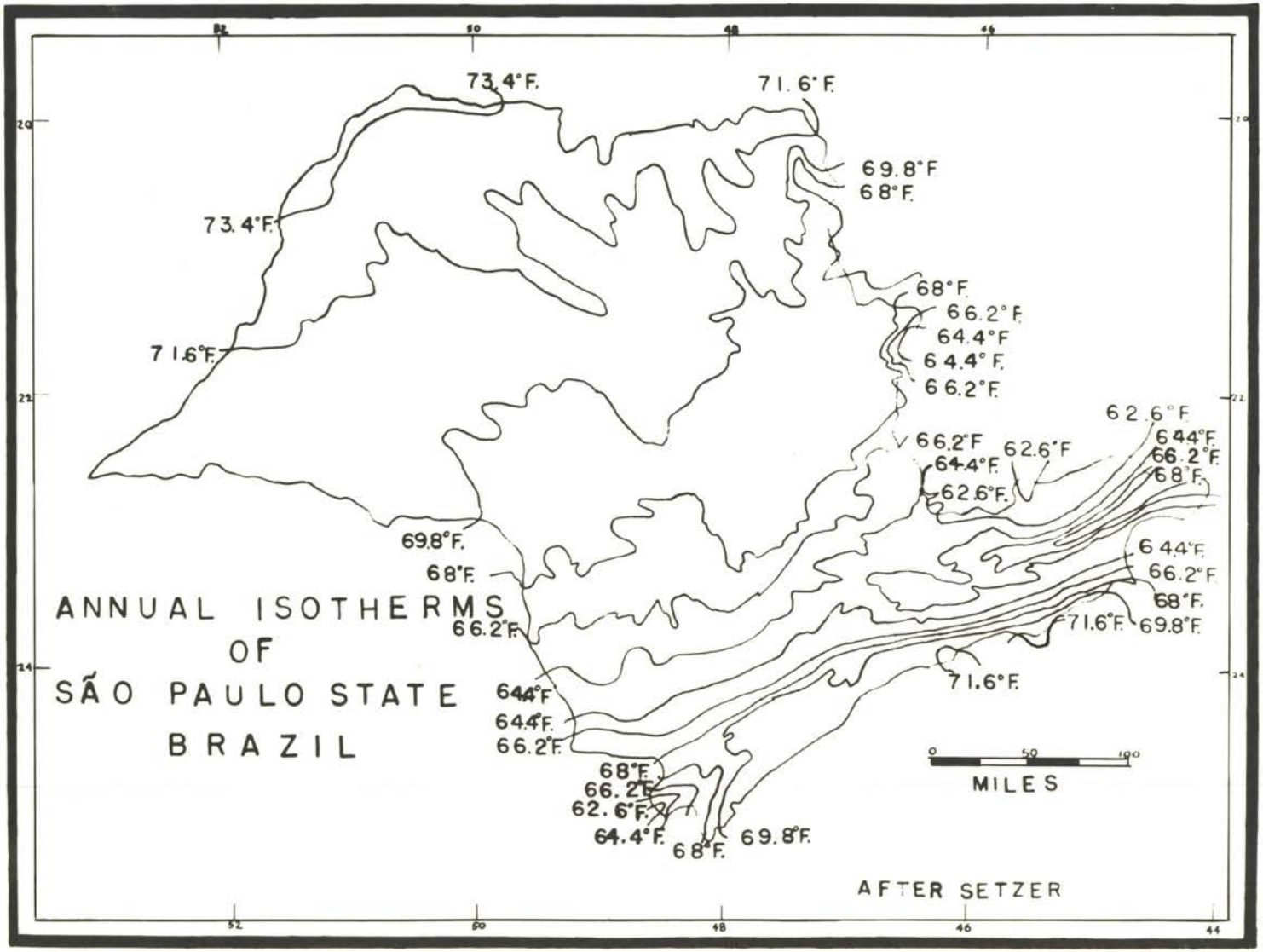
ANNUAL ISOTHERMS
OF
SÃO PAULO STATE
BRAZIL
73.4°F.
71.6°F.
69.8°F
68°F.
66.2°F.
64.4°F
62.6°F.
0 50 100
MILES
AFTER SETZER

FIGURE VI

province. According to the Köppen climatic classification,[5] São Paulo has six different climates. These climates are the Af, Aw, Cwa, Cwb, Cfa, and Cfb climates.[6] Extending in a narrow belt from Ilha do Bon Abrigo in the south to the northern border with the province of Rio de Janeiro is found the Af form of climate. This climate extends inland in a belt from three and one tenth miles to ninety miles in width. Its coldest month is above 64.4° F., and it is moist and warm. Two interesting stations, Santos and Itanhaem, are located in the Af climatic belt. Santos is located at 23° 56' S. Lat. 46° 19' W. Long. and Itanhaem at 24° 11' S. Lat. 46° 47' W. Long. Thus Itanhaem is slightly south and west of Santos. Both have the same altitude of 16.4 feet. Santos has 87.8 inches of rainfall as compared to 75.6 inches at Itanhaem.

The rainfall maximum comes at both Santos and Itanhaem in summer. The highest monthly rainfall comes in March at Santos and in February at Itanhaem with 11.7 inches and 9.4 inches respectively. In temperatures, there is again a similarity between these two stations. Summer temperatures at Santos are slightly higher than those at Itanhaem, averaging 76.8° F. at the former as compared to 76.3° F. at the latter. The same

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[5]The Köppen system uses various letter symbols, with each letter having an exact definition. The letter combinations form climatic types. The letter combinations for São Paulo are listed below with brief characterizations:

Af Wet climate with no cool season and no really dry season.
Aw Wet climate with distinct dry seasons, but no cool season.
Cwa Wet climate with mild, dry winters and hot, rainy summers.
Cwb Wet climate with mild, dry winters and cool, rainy summers.
Cfa Wet climate with mild winters, hot summers, and no dry season.
Cfb Wet climate with mild winters, cool summers, and no dry season.

For a more detailed discussion of these types in the world see V.C. Finch and G. T. Trewartha, Elements of Geography, pp. 156-159.

[6]For exact location, turn to the map of the climatic divisions of São Paulo, p 27 .

is true of winter temperatures with Santos registering an average of 66° F. as compared to 64.6° F. at Itanhaem. It is possible the slightly more marine location of Itanhaem tends to cause lower temperatures in summer and winter as it is not sheltered by an island as is Santos.[7]

Just inland from the Af climate is the Cfa climate which extends in two areas. The more coastal section lies just inland from the Af climate and widens out between 48° W. Long. and 50° W. Long., but narrows again to a band to the east. Extending from 24° S. Lat. to 23° S. Lat. in the west and running in an arc to the east past 22° 39' S. Lat. is a second band of Cfa climate. Cfa climates, according to Köppen have temperatures between 64.4° F. and 26.6° F. In addition, the driest month must have at least 1.2 inches of rainfall, and the warmest month must be above 71.6° F.

Two interesting stations located in this area are Itapetininga located 2,132 feet above sea level at 23° 34' S. Lat. 48° 03' W. Long. and Sorocaba located 1,804 feet above sea level at 23° 30' S. Lat. 47° 28' W. Long. Itapetininga received 48.7 inches of precipitation as compared to 42.2 inches at Sorocaba. The difference in rainfall is probably due to the 328 foot difference in elevation which would be enough to give the five inches variation.

The 328 foot difference is also noticeable as the yearly temperature of Itapetininga is 66.2° F. as compared to 69° F. at Sorocaba. The yearly difference is apparent in all the seasons of the year with the seasonal difference being most marked in winter and least evident in summer. Itapetininga most accurately fits the Cfa climate as the lowest

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[7]José Setzer, op. cit., p. 201.

precipitation is in July with 1.3 inches, while Sorocaba has July with 1.1 inches as the least rainy of its months. Both stations have their warmest month above 71.6° F.[8]

The Cwa climate of São Paulo lies between the Aw and Cfa climates. Slightly higher areas found within the Cwa climate zone have Cwb climate because of altitude. In the upper valley of the Rio Paraíba is also found another area of Cwa climate. The lower slopes of this valley are Cwa because they are slightly warmer than the upper slopes. These two areas then make up the Cwa climate in the province. The Köppen system requires that the coldest month of a C climate be between 26.6° F. and 64.4° F. and that the warmest month be above 71.6° F. The month with the most rain in summer must have ten times as much rain as the driest month in winter.

Three Cwa stations will be used as examples. They are Marilia with an altitude of 2,148.4 feet above sea level and located at 22° 13' S. Lat. 49° 57' W. Long., São José dos Campos with an altitude of 1,869 feet above sea level and located at 23° 11' S. Lat. 45° 53' W. Long., and Campinas with an altitude of 2,197.6 feet and located at 22° 53' S. Lat. 47° 04' W. Long. Campinas has the most rain of these three stations with 56.5 inches because of its higher elevation. Also it is a great deal closer to the sea than is Marilia which thus gives it an advantage over that station in receiving rain from the north and northwest winds. The location of São José dos Campos in the valley of the Paraíba River cuts it off from the moisture-bearing winds from the north and northeast

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[8] Ibid., p. 149.

and reduces its precipitation due to its rain shadow location to 44.6 inches. Marilia receives 49.3 inches of rainfall.

The annual average temperature varies from 68° F. at Campinas to 67.5° F. at São José dos Campos. The temperature data for Marilia were unavailable with the exception that its temperatures were high enough to meet the requirements for a Cwa climate according to the Köppen system of classification. Both Campinas and São José dos Campos meet the requirement that the coldest month of the year be between 26.6° F. and 64.4° F. The warmest month at Campinas is February with a temperature of 72.7° F. and the warmest month at São José dos Campos is February with a temperature of 73° F.

The rainfall requirements for a Cwa climate are not met equally well by these three stations, but the similarities between the ideal and actual circumstances are not too inaccurate. The rainiest month of Campinas, January with 9.7 inches of rain, is not quite ten times as much as its driest month which is July with 1.1 inches. Marilia meets the rainfall requirement quite well as its rainiest month is November with 8.5 inches and its driest month is August with .3 inches. São José dos Campos has its driest month in July with .6 inches and its wettest month in January with 7.9 inches. All three of these stations have the monsoonal late spring and early summer rainfall maximum which is typical of the Cwa climates.[9]

The Cwb climates extend in an arc to the northwest and south of the Paraíba Valley. This climate also is found in a few higher eleva-

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[9] Ibid., pp. 43, 53, 73.

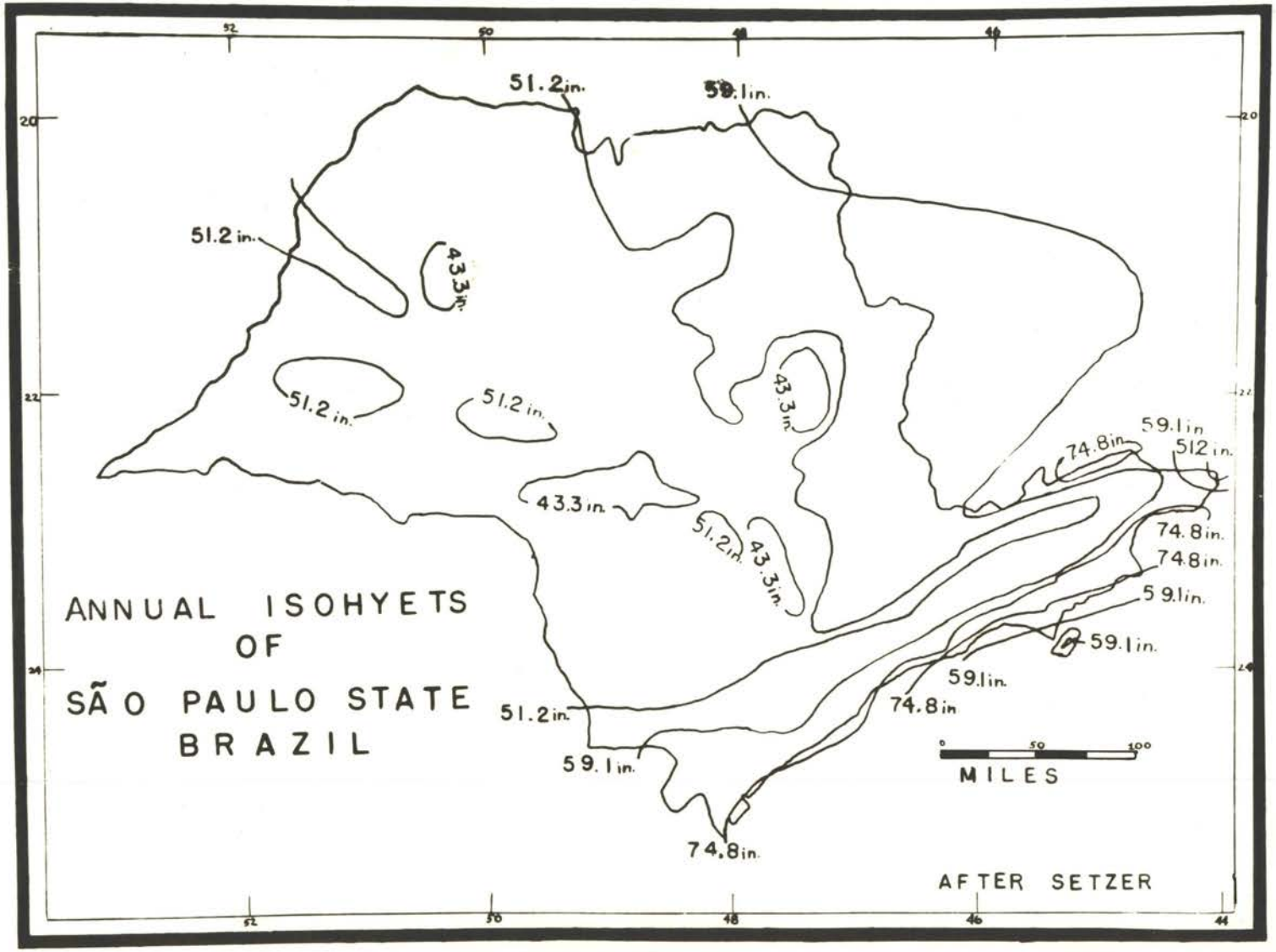
ANNUAL ISOHYETS
OF
SÃO PAULO STATE
BRAZIL
51.2in.
59.1in.
51.2 in.
43.3in.
51.2 in.
51.2 in.
43.3 in.
59.1in
74.8in
512 in.
43.3in.
51.2in.
43.3in.
74.8in.
74.8in.
59.1in.
59.1in.
59.1in.
74.8in
51.2in.
59.1in.
74.8in.
0
50
100
MILES
AFTER SETZER

FIGURE VII

tions of the large central area of Cwa climate just to the south of the Aw climate of the upper Rio Paraná and its tributaries. The Cwb climates has the same characteristics as the Cwa climate with one important difference. The Cwb climate has its warmest month below 71.6° F. rather than above this temperature as in a Cwa climate and has at least four months of the year above 50° C.

Cunha and the city of São Paulo are the two stations which are among São Paulo's better examples of the Cwb climate. São Paulo, the capital, lies at 24° 33' S. Lat., 46° 39' W. Long. at an altitude of 2,460 feet above sea level. Cunha is slightly higher than the capital at 2,525 feet and with an astronomical location of 23° 05' S. Lat. 44° 57' W. Long. Cunha, due to its higher altitude and its windward position, receives 51.6 inches of rainfall as compared to the 41.4 inches received at the city of São Paulo in the rain shadow of the Serra do Mar.

Both the stations have January as their rainiest month and July the month with the least rainfall. The rainfall extremes at the capital are 8.2 inches in January and 1.1 in July. The capital, as a result of its leeward position has extremes of temperature ranging from 58.5° F. in July to 70.7° F. in February while Cunha temperatures range from 57.9° F. in July to 68.4° F. in January. The annual temperature at the capital is 64.9° F. while that at Cunha is 63.3° F. The location of the city of São Paulo in the rain shadow of the Serra do Mar and at a lower position than Cunha makes the temperature higher at São Paulo than at Cunha.[10]

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[10] José Setzer, Contribuição para o Estudo do Clima do Estado de São Paulo, pp. 56-57.

Surrounding the Cwb climate and between the two sections of the Cfa climate lies the Cfb climate. The characteristics of the Cfb climate are that the coldest month must be between 26.6° F. and 64.4° F., the driest month must have at least 1.2 inches of rainfall, and the warmest month must be below 71.6° F. This climate is the typical west coast type of climate which is found poleward of 40° N. and 40° S. Lat. It is unusual to find the climate inland and on the eastern coast of a continent as it is in São Paulo.

The stations which are good examples of this climate in São Paulo are Apiaí and Itararé. Apiaí lies at 24° 30' S. Lat. 48° 51' W. Long. and is 3,050 feet in altitude. The altitude of Itararé is 2,378 feet while its astronomical location is 24° 07' S. Lat. 49° 20' W. Long. Itararé is slightly farther north and west than is Apiaí. The more inland position of Itararé, as compared to Apiaí, gives it a slightly smaller rainfall—some 4.7 inches lower than Apiaí's. Also since Apiaí is at an altitude 700 feet above Itararé, that causes greater precipitation at Apiaí.

Spring and summer have the most rainfall although there is a great deal the year round. Both stations have approximately the same amount of rainfall during the summer months with both having January as the rainiest month. The driest season for both of these stations is winter but even during this period Itararé receives 7.1 inches and Apiaí 7.6 inches. There is little difference at Apiaí in the rainfall of July and August, but there is a marked drop at this station from the 3.1 inches recorded in June. During the autumn at Itararé the drop in rainfall during June, July, and August is still more marked. During this

period, which is winter in São Paulo, the monthly precipitation records show 2.9 inches in June, 1.9 inches in July, and 2.3 inches in August. In summary then these stations show a large rainfall over the entire year, with a somewhat marked summer maximum which is probably caused by their inland location behind the Serra do Mar.

A comparison of temperatures at these stations is interesting. Both stations have their highest temperatures during the summer months with those of Apiaí averaging 68.7° F. as compared to 70.9° F. at Itararé. This difference in summer temperatures is probably due to the 700 feet difference in altitude between Apiaí at 3,050 feet and Itararé at 2,378 feet. These stations reveal interesting comparisons in temperature on the basis of the data for the other seasons and for the yearly average. Apiaí recorded a spring average of 62.4° F., a fall average of 63.9° F., a winter average of 57.7° F., and a yearly average of 63.2° F. as compared to the 65.7° F. in spring, 66° F. in fall, 59.5° in winter, and 65.6° F. for the year recorded at Itararé.

A comparison of these figures shows that Apiaí because of its altitude, in general, heats up more slowly and cools off more rapidly than does Itararé. Apparently also, the marine influence seems to have made Apiaí have lower temperatures than it ordinarily would have. In addition, Itararé is in a more equatorial position than Apiaí. In summary, then, the stations apparently have the typical Cfb climate except for the marked summer rainfall maximum than is usual in such types of climate.[11]

The last type of climate in São Paulo is the Aw climate according

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[11] Ibid., p. 172.

to Köppen's classification. This climate lies largely along the Rio Paraná and its tributaries from approximately 22° S. Lat. in a great arc which swings southward in a long narrow loop between 20 and 22° S. Lat. and 47 and 48° W. Long. This climate extends slightly over the São Paulo-Minas Gerais border also. In general, the climate is restricted to altitudes below the 1,000 foot level or contour on both the Rio Paraná and its tributaries.

The two stations which will be discussed are Rio Preto, which lies at 20° 49' S. Lat. 49° 23' W. Long. and is at an altitude of 1574.4 feet and Barretos which is located at 20° 33' S. Lat. 48° 35' W. Long. at an altitude of 1738. 4 feet. The altitudes of these stations have some effect on their rainfall and temperature as Rio Preto records 71.4° F. for a yearly temperature average and 48.1 inches for a yearly rainfall average as compared to the readings at Barretos of 71.1° F. and 51.2 inches for the yearly averages.

At both stations summer is the rainiest season of the year and winter the driest. Barretos, due to its greater altitude, has some three inches more rainfall and a slightly lower temperature average for the year. It is interesting to note that the rainfall averages at Barretos for spring and fall are identical while Rio Preto has a markedly higher average for spring than for fall. Barretos, which is somewhat farther east than Rio Preto, is probably more subject to marine influence. Therefore, Rio Preto then can be said to have a more continental influence on its rainfall than has Barretos.

In general, then, these two stations can be said to be rather good examples of the Aw climate. Although neither station is completely dry

in winter, there is a marked dry season in both cases during that season. The coldest month at Barretos meets the Aw climatic requirement of at least 64.4° F., but the coldest month at Rio Preto is only 63.5° F. This discrepancy in temperature is probably caused by the more continental location of Rio Preto and its location in the valley of a tributary of the Rio Grande whereas Barretos is on the side of the valley rather than on the valley floor of the tributary of the Rio Grande near which it is located.[12]

From observation and discussion of the data of the thirteen stations which have been mentioned, it is apparent that the zone of the Cwa climate is most fitted for cotton production.[13] This is apparent as the study of the stations at Marilia, São José dos Campos, and Campinas show. All three of these stations recorded precipitations of over forty inches with Campinas recording the most with 56.5 inches for the year and São José dos Campos recording the least with only 44.6 inches. The other station, Marilia, recorded 49.3 inches. Therefore this area has plenty of rainfall for growing cotton. In regard to the necessity of the ten inches of rainfall or less in the fall which is required to allow for the picking of the bolls, Marilia records 8.1 inches and São José dos Campos records 9 inches in that season. Campinas records 10.7 inches which is slightly over the 10 inch limit for fall.

The third climatic requirement is for an average temperature of 75 to 80° F. The average temperatures recorded for these representative

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[12] Ibid., pp. 9 and 11.

[13] Additional information may be secured on these stations and their climates from the Appendix, pp. 113 from the maps of annual isohyets and isotherms, pp. 36 and 31 , and from the temperature and rainfall graph, p. 29 .

stations is 68° F. at Campinas and 67.5° F. at São José dos Campos for the yearly averages with 72.5° F. for the summer average at both of these stations. Of course maxima of these two stations probably would be much higher than these readings. No temperature data were available for Marilia. Both Campinas and São José dos Campos have approximately a seven months growing season from September through March. Therefore this area is suitable for cotton production. A study of the cotton produced in 1947, which is shown on a map on page 74, definitely proves that this is the ideal cotton producing area in São Paulo. The lower, more rainy areas of the Aw climate region and the higher cooler areas are of the Cwb climate region are both avoided.

Cotton tends to grow best between the 1,000 and 2,000 foot contour zones which are neither too rainy nor subject to air drainage. Cotton, to a great degree, shows the vertical zonation which is often true of areas close to the equator. Below it grow such crops as rice or bananas; above it grow wheat and other crops which require less rainfall and a shorter growing season. A few smaller areas of cotton are found in the Cfa climate although the temperature and rainfall requirements are not quite perfect for cotton in this area. In summary cotton grows at levels of 1,000 to 2,000 feet in the Cwa climatic zone of São Paulo because of lack of malaria, air drainage, and swampiness at these altitudes.

The physiography and climate of São Paulo show striking relationships to cotton production. The combination of these two factors help to produce the soil so important in relation to cotton production.

CHAPTER IV

COTTON SOILS, AREAS, ACREAGES, AND PRODUCTION OF SÃO PAULO

São Paulo's cotton grows on two types of soil--terra roxa and terra arenosa. The basic difference in these soils is their formation on different types of rock. Terra roxa develops on numerous layers of diabase laid down in ancient lava flows during Archaen times and eroded during more recent geological history.[1] Terra arenosa matures over the Devonian and Permian sandstone and shale deposits in western São Paulo.[2]

The qualities of these soils make them both excellent cotton soils. Both have good porosity and friability. Both, however, lack many of the plant nutrients often found in other soils. Both soils, because of these characteristics usually need fertilization after a few years of use. Since good land is cheap in São Paulo, little fertilization is done on the cotton plantations and farms.

Color and soil texture vary widely within these two soil types. Colors may vary from almost black to white, and textures may vary from coarse to very fine. Either the terra roxa or the terra arenosa may be red thus making exact classification of these soils difficult. Usually both types of soil are classified as red loam which is one form of the great classification of laterites. Apparently these red loams are a phase of an incomplete laterization process but this has not been definitely proved as yet. Richness in clay-like aluminum silicates apparent-

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[1]John Casper Branner, "Outlines of the Geology of Brazil to Accompany the Geological Map of Brazil", Bulletin of the Geological Society of America, XXX (June, 1919), 189-337.

[2]Preston E. James, "Coffee Lands of Brazil," Geographical Review, XXII (April, 1932), 225-244.

ly indicate that this may be the proper explanation for the formation of this soil.[3]

Krasnozems, as they are called in the Caucasus region of Russia, occur where the vegetation consists of mixed or pure stands of forests and where a rather even rainfall regime has a slight summer maximum. Podzolization is imposed upon the laterization process which develops a soil with some of the characteristics of both types of processes.[4] Therefore Sao Paulo's soils which occur in this type of a location have similarities to both the podzols and the laterites. The soil, which is easily eroded, is heavily leached and needs lime. Both the terra roxa and terra arenosa occur under a sandy surface.[5]

The principal areas of cotton land have steadily moved westward but usually remained on either the terra roxa or terra arenosa soils. The Campinas-Sorocaba area originally raised cotton and continues to grow some of it today. These facts may be readily observed on the map of cotton production in 1947 on page 47. Other cotton areas are in the vicinity of Marilia, Ribeira Preto, Araçatuba, and several areas west and southwest of Araçatuba. Temporary cotton lands west of Barretos were developed in the 1930's, but malaria and lack of transportation forced their abandonment.[6] Today transportation is available to Barretos,

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[3]Konstantin D. Glinka, The Great Soil Groups of the World and Their Development, pp. 46-68.

[4]Jacob S. Joffee, The ABC of Soils, pp. 155-160.

[5]William H. Ukers, All About Coffee, pp. 135 and 153.

[6]Irvin P. Keeler and Richard F. Lankenau, "Agriculture in the São Paulo-Northern Paraná Region", Bulletin of the Pan American Union, LXXV (October, 1941), 570-585.

and the area is again growing some cotton because of this fact and as a result of better health conditions.[7]

Cotton lands located on the newly-cleared terra arenosa of the West form two-thirds of the state's cotton lands today. The other one-third of the cotton area consists of terra roxa where cotton occupies the valleys and coffee grows on the ridges. Very little terracing occurs because of the cheapness of virgin land to the west. Areas which have been cropped too long with cotton become badly leached, and the people move on westward.[8]

The cotton acreage of São Paulo has increased rapidly from the 1930's to the present time. In 1932 there were approximately 200,000 acres of land devoted to cotton in the state. By 1935, cotton grew on 1,500,000 acres.[9] For the crop years 1943-44 and 1944-45, the areas planted were 4,681,000 and 4,227,000 acres respectively. Reduction in acres planted and unfavorable weather conditions tended to cut the crop production forty per cent during 1944-45. The ten leading counties in cotton acreages planted were in the new zones in the western part of the state.[10] Estimates made by the Bureau of Agronomy of the Ministry of Agriculture at the capital were for a thirty per cent decrease in the acreage planted in 1945-46 as compared to that of the previous year. These estimates were based upon the sales of seed in the state which for 1944-45 were

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[7] See the transportation map on page 77 .

[8] George Wythe, Brazil, An Expanding Economy, pp. 70-71.

[9] Preston E. James, Latin America, p. 500.

[10] "Cotton Acreage, São Paulo, Brazil", Foreign Commerce Weekly, XX (September, 1945), 30.

664,138 bags as compared to 408,731 bags by the end of October in 1945-46.[11] Each bag contained thirty kilograms or approximately sixty-six pounds.[12]

Less than five per cent of this acreage was mechanically cultivated in 1944-45. There was a two per cent increase in the number of cotton growers who owned their own farms although forty-five per cent are still tenants. Only approximately eight per cent of the farms were artificially fertilized in the 1944-45 season.[13]

Production over several years has risen in the state. The following table gives the estimated production of cotton in São Paulo from 1912 to 1947. Several fluctuations in production occurred during the period as can be seen from the table on page 48. For comparison the production figures for Brazil as a whole are also given.

There are several interesting facts apparent in this table. Marked decreases occurred in São Paulo from 1925 to 1930 because of the state's interest in coffee growing. Although there was a decrease in cotton growing in the remainder of Brazil it was not so noticeable as in São Paulo as these areas were more dependent upon cotton as a staple crop than was São Paulo.

The increases in São Paulo and Brazil after 1930 were largely the result of the removal of the United States as a dominant factor in the

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[11] "Decreased Acreage and Yield, São Paulo, Brazil", Foreign Commerce Weekly, XXII (January 12, 1946), 37.

[12] One kilogram equals two and two tenths pounds.

[13] "Cotton Acreage, São Paulo, Brazil", Foreign Commerce Weekly, XXII (January 12, 1946), 37.

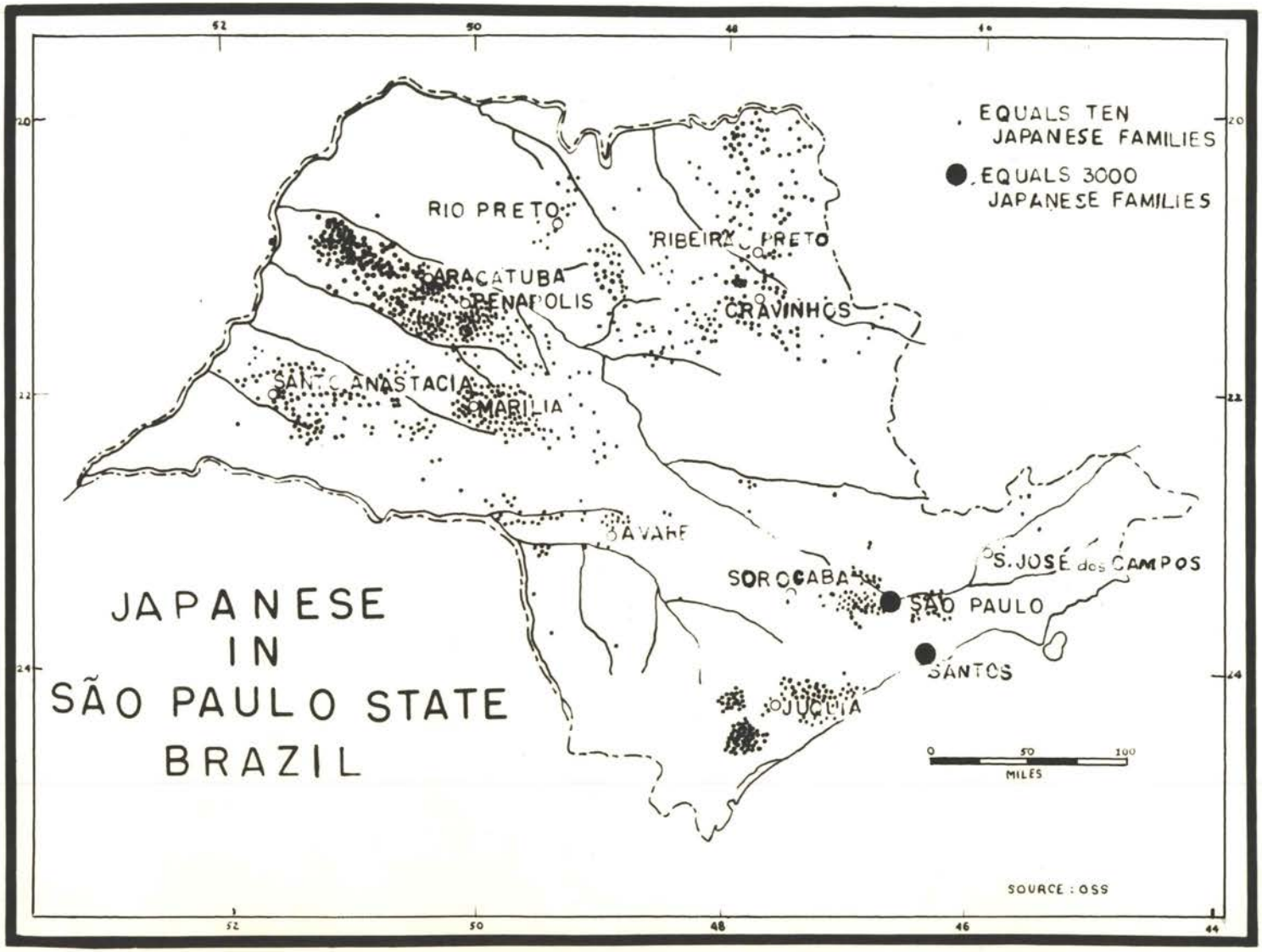
52
50
48
46
44
20
22
24
. EQUALS TEN JAPANESE FAMILIES
● EQUALS 3000 JAPANESE FAMILIES
RIO PRETO
RIBEIRÃO PRETO
ARACATUBA
PENAPOLIS
CRAVINHOS
SANTA ANASTACIA
MARILIA
BAVARE
SOROCABA
S. JOSÉ dos CAMPOS
SÃO PAULO
SANTOS
JUQUIA
JAPANESE IN SÃO PAULO STATE BRAZIL
0 50 100
MILES
SOURCE : OSS

FIGURE VIII

TABLE I

ESTIMATED COTTON PRODUCTION FOR SÃO PAULO AND BRAZIL, 1912-1947[14]

(in bales)(1)

Year	São Paulo	Brazil
1912	25,900	360,300
1913	55,100	418,000
1914	45,200	476,800
1915	50,000	464,800
1916	33,900	338,700
1917	46,700	336,700
1918	76,500	413,500
1919	91,100	406,400
1920	105,800	460,500
1921	99,400	476,200
1922	105,200	504,100
1923	128,600	553,000
1924	140,300	575,900
1925	177,300	793,200
1926	81,200	601,600
1927	60,400	512,400
1928	46,100	509,100
1929	20,500	445,800
1930	18,100	583,200
1931	50,700	471,200
1932	97,500	574,700
1933	160,100	447,800
1934	417,300	968,700
1935	(2)	1,591,200
1936	821,548	1,618,001
1937	932,085	(2)
1938	1,142,615	(2)
1939	1,257,491	1,972,282
1940	1,414,706	2,157,174
1941	1,919,848	2,334,729
1942	1,259,128	1,734,935
1943	1,726,328	2,284,889
1944	2,131,851	2,714,576
1945	1,070,885	1,636,993
1946	811,127	1,311,715
1947	806,613	1,339,335

(1) Each bale weighs 478 pounds.
(2) Data for the year were not available

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[14] The following sources were used for Table I: Benjamin J. Hunnicutt, Brazil World Frontier, p. 125; "Cotton in Brazil", Bulletin of the Pan American Union LXIX (October, 1935), 746-762; "Industrial Brazil" Commercial Pan America, XIV, (August, September, 1945), 192.

world cotton production because of the passage of the American Agricultural Adjustment Act which limited production and the reduced price of coffee which was the chief export of São Paulo.

Fluctuations in São Paulo's production in 1942, 1945, 1946 and 1947 were caused by lack of rainfall in the first three cases, excessive rain in 1947, reduced acreages, reduced world markets, and increased insect attacks on the cotton. The increase in Brazilian cotton production as a whole in 1947 was the result of exceptionally good growing conditions for cotton in the northeast although poor conditions existed in São Paulo.

The tendency of São Paulo to decrease her cotton acreage and production has continued as weather conditions continued bad through 1946 and 1947. Weather and market conditions improved after 1948 as shown by 1949 figures and estimates for 1950. Figures for 1949 and estimates for 1950 were 950,658 bales and 1,150,628 bales respectively. The late arrival of the rains and the consequent later planting of the crop did not prevent increased production in 1950.[15]

In summary, cotton grows on two types of soil, terra roxa formed on diabase and terra arenosa on sandstone. Approximately one-third of the cotton grows on the terra roxa, while the terra arenosa soil produces the remaining two-thirds. As cultivated land is exhausted, the settlers move westward into new virgin lands. Cotton and coffee often grow together in the same areas with the cotton occupying the valleys and coffee the ridges. Both soils are apparently, forms of red loam which is one

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[15]"Arigram from the United States Embassy, Rio de Janeiro", Foreign Commerce Weekly, XXXVIII (February 6, 1950), 19-20.

stage in the formation of laterites. Soils in the cotton areas are not fertilized since new virgin soils are cheap and plentiful when old soils have been eroded.

During the 1930's cotton acreages and production increased because of the removal of the United States as a world competitor in the cotton markets and because of the necessity of securing a money crop to replace coffee when the price of that product slumped during that period. Production consistently rose from 1930 until 1942 when bad weather conditions caused the first of the decreases in production which occurred in 1942, 1944, 1946, 1947 and 1948. Reduced planting also had its effect upon the production during these years. The reduced planting was the result of bad weather conditions and reduced world markets since 1941. Improved weather conditions and increased markets caused the rises in production for 1949 and 1950.

Soil conditions and climate effectively increase or decrease the production of cotton, the acreage used for the product, and the areas of cotton planting in the state.

CHAPTER V

PRODUCTION METHODS AND THEIR RELATIONSHIP TO PHYSICAL FACTORS

Several factors caused the rapid development of cotton in the state of São Paulo. One important reason for such development was the timeliness of the cotton breeding work of the São Paulo Department of Agriculture at its Campinas station. Other factors which led to the firm position of cotton in São Paulo were the necessity for finding a crop to replace coffee in the early 1930's, the adaptation of the American Texas Big Boll and Express varieties to São Paulo, the shift in world trade during the 1920's, the relatively stable cotton price since the 1932 depression, the currency devaluation within the state, the exchange control, the barter arrangements with other countries and the desire of other countries to develop alternative sources of supply independent of those of the United States.

American investments by experienced cotton producers and three successive good cotton growing seasons in the area also influenced this rapid increase in production.[1] Cotton production, as a result of the above reasons, developed rapidly.

Cotton cultivation and ginning practices differ somewhat from those in the United States. All seed planted in the state must be purchased from the Formente or Extension Division of the São Paulo Department of

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[1] Omer W. Herrmann, South Brazil, New Land of Cotton, Circular No. C-117, Farm Credit Administration, United States Department of Agriculture, Washington, D. C. (May, 1940), pp. 1-4.

Agriculture. Seed are developed by the department's agronomy division and then sent to the Formente where they are distributed to the 230 co-operating farms that help to multiply the seed.

These seed are planted by the co-operating farms, and seed thus produced are sold to the Formente at slightly less than the original seed cost per bushel. These seed are then resold to the individual farmers for approximately thirty-three per cent more than was paid the co-operating farm owners. This additional percentage is used by the Formente to cover transportation of the seed to the storage warehouse, the purchase of cotton sacks for resacking the seed, the hiring of labor for warehouse operations, the expense of seed germination, the fumigating of the seed, the cleaning and delinting process, the storage in the warehouse, the transportation of the seed to the purchaser's nearest warehouse, and the partial cost of insurance against hail for the crop.

The purchaser, in addition to the share of hail insurance paid by the Formente, pays four and six tenths cruzeiros[2] or approximately twenty-five cents in American money per bag of seed for the hail protection. In case hail destroys the crop, the Formente then supplies new seed for replanting, or if replanting is impossible it pays seventy-seven cruzeiros per acre to the farmer for the damaged crop.

The Formente holds the remaining seed which may not be sold until the year's crop is assured. If germination tests are successful, the remaining seed may be held for additional planting or for the next year's crop. If the tests are not satisfactory, the seed are sold to the oil

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[2]One cruzeiro equals five and four tenths cents in American money.

mills.[3]

Botannically cotton belongs to the malvaceae or mallow family. Its generic name is gossypium. The plant is indigenons to the islands and maritime regions of the tropics, but in its cultivated form it extends to some forty degrees north and south of the equator. The São Paulo variety was developed from the Empress and Texas Big Boll varieties which developed in the United States. São Paulo agronomists at Campinas first grew these plants in the 1920's. From them came the modern cotton grown in the state.

The cotton plant is tap-rooted with long branching side roots. The branches of the cotton plant may be terete, erect, or spreading. The leaves are alternate, petioled, cordate, three, seven, or nine-lobed, and usually three to seven veined. The fruit of the plant is called the boll and is usually the size of a hen's egg.[4]

The growing season in São Paulo ranges from the end of December to the end of March. Cotton is planted from six weeks to two months later here than in other areas of southern Brazil in order to control the root borer which is a serious menace locally to cotton production.

Planting is still largely by hand or semi-mechanical means. Only about five per cent of the cotton is planted, cultivated, and harvested by a fully mechanized method. First crops are usually cultivated entirely by hoe until the stumps and other debris from clearing new land have decayed. Later crops are cultivated by hand or by horse and mule-drawn plows depending upon the size of the cotton acreage and the wealth of

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[3]Omer W. Herrmann, op. cit., pp. 16-22.

[4]J. Merritt Matthews, Textile Fibers, Their Physical, Microscopical and Chemical Properties, pp. 188-189.

its owner. Rolling land of 1,000 to 2,000 feet above sea level and of terra arenosa and terra roxa soils are used. Valleys are not used because of air drainage and in some cases, malaria, and swampiness.

The seeds are purchased from the Formento and planted by hand or by a mechanical planter in the field. The field may or may not have been plowed depending upon the recency of its being placed in cultivation. On some of the farms mechanical means are being used to prepare the seed bed and for planting the seeds.[5]

The plants come up in about eight days or two weeks. They first appear with two peculiarly shaped seed leaves which later drop off. Between these seed leaves grows the main stalk of the cotton plant. Cotton takes approximately three weeks to develop the first leaves that are normal.

Extra plants are "chopped out" by hoe, leaving plants from eight to twenty-four inches apart depending upon the various areas or locations of the acreage. Closer spacing down to twelve inches gives a greater percentage of cotton on the first picking. Two plants are left to each hill as more cotton is supposedly yielded by this method.[6]

The first flower buds, which are called squares, develop in about seven or eight weeks and take approximately two or three weeks to nature into flowers. The flowers--which have five petals-yellowish at the base but shading to white at the edges-are self pollinating and last only a-

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[5]Benjamin J. Hunnicutt, Brazil World Frontiers, pp. 126-127.

[6]Gilbert R. Merrill, The American Cotton Handbook, p. 119.

bout twenty-four hours.[7]

After the flower fades and drops from the plant, a green pod, which is also called a square, appears. This pod develops into the cotton boll which is one to one and a half inches long and one inch in diameter at its formation. The boll matures in forty-five to sixty days after its formation. When it ripens it splits into from three to five compartments with each showing a large fluff of fiber called cotton.

The boll shrinks somewhat, and the seeds are revealed. Each compartment contains from seven to ten seeds to which the cotton fibers are attached. Rain at this season may dull the cotton or stain it green, yellow brown, or gray from the plant stalks. Even heavy dews may lightly discolor the cotton. Excessive wind may dirty it or blow the cotton from the bolls. Warm weather-both day and night-is best during the growing season. Excessive rain allows the development of plant diseases, spread of insects, and the retardation of development of the fiber and excessive foliation of the plant.[8]

The government and farmers use various methods to control the insect pests and diseases which attack the cotton. The boll weevil has not yet appeared. Five pests which attack the cotton crop are the Alabama leaf worm, the pink boll worm, the suava ant, the stink bug, and the root borer.[9] The names of the insects, with the exception of the suava ant and the stink bug, explain the parts of the plant upon which they feed. These latter two attack the leaves and stalks of the plant. To control

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[7]J. Merritt Matthews. op. cit., pp. 192-193.

[8]Gilbert R. Merrill, op. cit., p. 19.

[9]Elsie Noble Caldwell, In a Changing Brazil, p. 163.

the pink boll worm, all cotton seed sold by the state-under the decree of the Federal Government-must be fumigated.[10] To control the root borer, the state and Federal Government require the burning of the infested stalk fields although much damage is often done to the soil. The other pests are controlled by the use of insecticides. Leaf wilt, the most important disease in the area, is caused by protozoa that enter the plant roots through the root pores, grow in the root water, and develop. Thus they cut off the water supply by blocking the capillary channels and causing the plant to wilt and die.[11]

The people pick the cotton by hand and pack it into burlap bags for shipment to the gins. The bags used are made in Brazil, probably in São Paulo, from some of its own cotton or jute. Hand-picking rather than machine-picking is customary. The average adult can pick 300 pounds of seed cotton a day from which 100 pounds of lint cotton can be ginned. The bags of cotton are weighed and the weights credited to the individual pickers. Pickers are paid according to the number of hundreds of pounds of seed cotton which they pick in a day.[12]

Local ginners often advance production credit to the farmers from which they buy seed cotton. All cotton is sold to the ginner as seed cotton, and the ginner pays for both the seed and the lint. Cotton is weighed at the gin, and sorted into three grades. It is then dumped into the tulhas or bins for immediate ginning or piled on floors in the yard and covered with tarpaulins until the plant is able to gin it. The

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[10] Vera Kelsey, Seven Keys to Brazil, pp. 121-122.

[11] Omer W. Herrmann, op. cit., pp. 30-31.

[12] Ibid., pp. 31-33.

law requires that cotton be protected from the weather during its ginning so the tarpaulins are used for covering it. The farmer is paid immediately for the entire amount of seed cotton that he has brought to the gin, less the cost of ginning. The average number of bales per plant per season in São Paulo is 3,000 to 5,000 Brazilian net weight bales.[13]

Gins usually operate on a twenty-four hour basis for six to ten months depending upon the length of the picking season in various parts of the state. Because of the great overhead costs of cotton ginning, help in financing the crop is often secured from the exporter. Forty to fifty men are used per plant. Plants usually have a manager, an assistant manager, a ginner, an assistant ginner and for each shift -- three or four men to tie and weigh bales, two suction men for guiding the suction hose from the gin, and from three to five men to sack and weigh the cotton. During the day these men also load and weigh the bags of cotton upon arrival. Another eight men carry the bags from the warehouse yard to the tulhas for ginning. A bookkeeper and cashier complete the complement of the average three stand - eighty saw gin plant. An average United States gin with five eighty saw stands, would employ twelve to fifteen men on the same twenty-four hour basis.

Common labor is cheap in Brazil as the average pay for such labor at gins is four and one half cents per hour. The average pay of the ginner is thirty dollars a month on a twelve month basis. The manager of such a plant would earn a hundred dollars a month on a similar basis. The assistant manager, assistant ginner, cashier, and bookkeeper would receive twenty to fifty dollars a month on a twelve month basis.

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[13]Brazilian bales weight 400 pounds net at the present time.

Most gins are less than five years old and usually average three stands of eighty saws a stand. In a few cases the gins have four and five stands with eighty saws per stand. The gins are in modern buildings in towns which are centrally located for doing the work. Gins usually have storage space for 200 to 1800 bales of seed or unginned cotton.[14]

All gins are required to have a license before operating so that ginning practices will be uniform. A government fiscal agent or inspector is stationed at each gin to supervise the ginning of cotton, to prevent the ginning of wet raw material, to take samples of the bales, to see that cotton is graded before ginning, and to ascertain that all cotton is kept under cover during the process.

This agent takes a four ounce sample from each side of the bale, and places the sample in a paper sack with the number of the bale and the name of the ginner. Forty to fifty samples are placed in a canvas bag and sealed with an official lead and wire seal. The canvas bag contains the invoice for the samples. The invoice lists the name of the ginner, his registered trade mark, the number of bales represented by the enclosed samples, the weight of each bale, and a blank space for the insertion of grade and staple information. These bags are shipped each night to the Formente at São Paulo. When the samples arrive at the Formente the invoice is replaced by a blind form with a code number.

Samples are then turned over to the São Paulo Bolsa or merchandise exchange and its cotton section for classification. On the blind form is listed the class and staple information for the examined samples.

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[14] Omer W. Herrmann, op. cit., pp. 31-33.

This class certificate is mailed to the fiscal agent by the Formente and attached by him to the bill of lading for the bales thus classified. If any of the cotton has been improperly ginned, the Formente has the power to require changes to be made in the gin which did the work.

The gins are required to keep all grades of cotton seed separate. Three regular grades are recognized by the agriculture department and the fourth grade is inferior unclassified seed. All baled cotton must be wrapped in new cotton cloth with the national colors of Brazil woven into it longitudinally. The registered brand of the gin must be placed on the side of each bale. This brand or trademark must show the name and location of the ginning plant which bailed the cotton. The brand must be registered and approved by the São Paulo Department of Agriculture. New steel bands must be used in wrapping the cotton. From nine to eleven bands are used for this purpose. The cotton during and after the baling process must be kept under a shelter of the approved type. Bales must be weighed on platform scales only, and the use of hooks in transporting bales is prohibited. All sales are on the basis of the net weight of 400 pounds per bale.[15]

Cotton is classified by the Bolsa according to nine grades. For staple classification only three or four bales out of each hundred are checked. Staple length is measured in millimeters. The final classification of a cotton lot cannot be certified until it has been revieved by the head supervisor or assistant supervisor of the classing service.

An original and four carbon copies are made of the classification certificate. The original copy is sent to the ginner or to his broker

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[15] Ibid., pp. 16-22.

if the ginner so designates. One carbon copy is kept by the São Paulo Department of Agriculture. One copy is sent to the Federal Department of Agriculture. The two remaining carbon copies are kept on file at the Bolsa or merchandise exchange. The samples for which the certificates were issued are kept on file at the Bolsa for eighteen months in case any argument should develop over the class of cotton of a sample.

The Federal Government reviews the state classification of all export cotton at Santos where it maintains five classers for this work. The purpose of the federal check on export cotton is to form the basis of evaluation of the cotton for collecting the one and one-fourth per cent sales tax collected by the Federal Government on all export sales of cotton.[16]

Imperfect ginning can cause the development of damaged lint. These forms of damaged lint may be of three types. Gin cut cotton contains damaged or cut fibers as a result of dull gin saws, damp cotton fed into the gin, or a too tight seed roll. Neps are very small tangled masses of fibers resulting from damp cotton fed into the gin in small amounts or from dull gin saws. Long, tangled ropes of fiber or naps develop when faulty methods of removing fibers from the gin saws are used or wet cotton is ginned.

Numerous other products in addition to lint cotton are produced from the seed cotton. Cotton linters, once a waste product, are now quite important. The estimate for 1943 for example, was for 70,000 tons

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[16] Ibid., pp. 22-28.

[17] Gilbert R. Merrill, op. cit., p. 168.

of linters according to the São Paulo Department of Agriculture. This was a sixteen per cent increase over the 1914 production which had previously been the peak year.

Linters are the short fibers that cling to the seed after the long lint has been cleaned from them. These fibers are useful in making gun cotton, cotton batting and acetate rayon. Three cuttings of linters are made at São Paulo's oil mills. The first cutting secures one-fourth of the total production, the second three-fourths, and the third cutting a negligible amount.[18]

Other additional materials secured are cotton seed kernels and hulls. From 2,000 pounds of seeds come twenty-seven pounds of linters, 841 pounds of hulls, and 1,012 pounds of kernels. The other materials are waste stems, etc. The hulls supply bran for cattle feed, fiber for making high grade paper, and fuel ashes for fertilizer. The kernels yield 732 pounds of cotton seed cake for livestock feed and fertilizer. The kernels also provide 280 pounds of crude oil which is made into soap stock and summer yellow. The summer yellow portion supplies winter yellow, salad oil, cotton lard, cotolene, miners' oil, and soap. These are a few items developed in the ginning of São Paulo's cotton.[19]

The proportions of lint to by-products are quite small. For each five hundred pounds of lint produced, 140 pounds of edible oil, eighty pounds of linters, and 640 pounds of livestock feed in the form of meal

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[18] "Increased Production of Cotton Linters", Foreign Commerce Weekly, XII (September 18, 1943), 34.

[19] J. Merritt Matthews, Textile Fibers, Their Physical, Microscopical and Chemical Properties, pp. 197-200.

and hulls are obtained.

The lint, linters, and oil are composed of carbon, nitrogen, and oxygen which are taken from the air by the cotton plant. The stalk, leaves, meal, and hulls contain nitrogen, phosphoric acid, and potash, which come largely from the soil.[20] If the farmer plows these under the soil will not lose these valuable plant foods. Unfortunately, in most cases, these materials are fed to cattle and other stock, in some cases they are burned.

The development of São Paulo as a one variety producer is largely due to the work of two men--José Gerabaldi Dantas and Raymundo Cruz Martins. Senhor Dantas is chief of the Federal Cotton Grading Commission in São Paulo. He graduated at Lavras Agricultural College in the state of Minas Geraís and then came to the United States on a government scholarship to study cotton growing. While in the United States he took a special course in cotton grading at the University of Georgia. Returning to São Paulo and working as chief of the Federal Cotton Grading Commission, he has helped to establish the confidence of the world in São Paulo cotton.

Senhor Cruz Martins studied cotton growing in the various institutions of the southern United States. He became chief agronomist of the São Paulo State Experiment Station at Compinas in 1924. Cruz Martins chose the two types of Texas cotton from which were developed the present São Paulo cotton. It was sheer coincidence that this new strain was developed just at the proper time to make São Paulo and Brazil great

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[20] John F. Maloney, Cotton in Peace and War, pp. 120-121.

producers of cotton. The work of these two men has helped to make Sao Paulo one of the world's great cotton producing areas.[21]

In the 1930's and early 1940's São Paulo and Brazil were dependent upon the United States for much of their cotton machinery. The following table proves several things about the machinery situation as it stands today.

TABLE II

AGRICULTURAL MACHINERY IMPORTS INTO BRAZIL IN 1945[22]

1945	Metric Tons		Thousands of Cruzeiros	
Item	Total	United States	Total	United States
Plows and Accessories	697	487	4,047	2,971
Threshers	12	5	208	89
Seed Drills	18	13	155	118
Tractors	847	817	9,569	9,519
Other Agricultural Implements	357	303	2,685	2,280
Totals	1,931	1,625	16,664	14,977

The United States still seems to be getting a large share of Brazil's agricultural machinery imports. The demand for tractors dominates the imports, with almost half of all imports being devoted to this item. A large share of all this machinery went to São Paulo. It is remarkable that there are no mentioned imports of cotton ginning equipment. A

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[21] Benjamin J. Hunnicutt, Brazil, World Frontier, pp. 120-121.

[22] "Imports of Agricultural Machinery into Brazil, 1945, Foreign Commerce Weekly, XXIV (July 13, 1946), 42.

large share of this type of equipment used in São Paulo is either made in the state or in some other part of Brazil. Volta Redonda, the huge new steel plant recently completed in the country, is furnishing the steel from which most of this equipment is made. Plows and other similar machinery are also largely made in São Paulo, thus helping to partially meet the needs for these items. If figures for 1950 were available, the total imports would probably be much lower as more and more of the machinery used in planting, picking and ginning São Paulo's cotton is now made within the state or in neighboring states.[23]

São Paulo compares rather well with the country as a whole in the number of gins and saws. Table III shows the relationship for these items. Evidently São Paulo dominates the field in both the number of gins and of gin saws.

TABLE III

COTTON GINS OPERATING IN SÃO PAULO IN 1945[24]

Number of Gins	1,204
Percentage of Brazilian Total	46.5%
Number of Gin Saws	98,650
Percentage of Brazilian Total	56.2%

As indicated in Chapter III in the production of Brazilian ginned

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[23] José Jobim, Brazil in the Making, p. 202.

[24] "Industrial Brazil", Commercial Pan America, XIV (August, September, 1945), 93.

cotton, São Paulo has dominated the field since 1934. The rank of São Paulo in the production of cottonseed is shown in Table IV. The latest data available were from 1936 and from 1939 to 1942. From Table IV it is evident that São Paulo dominates the cottonseed market much as it does that of cotton lint. Although more recent data were not available for cottonseed production it is evident by observation of Table I, page 48, Chapter IV, that if São Paulo's cotton production rose or remained high during these years her production of cottonseed would be comparable.

TABLE IV

COTTONSEED PRODUCTION IN METRIC TONS[25]

Year	São Paulo	Brazil
1936	416,500	820,368
1939	637,616	999,982
1940	717,212	1,093,612
1941	889,000	1,173,673
1942	659,552	879,559

From August 1, 1944, to July 31, 1945, São Paulo produced 73,866 metric tons of linters. In the period from August 1, 1945, to July 31, 1946, the state produced 42,064 metric tons of linters. Domestic consumption of linters averages 8,000 to 10,000 metric tons per year. The 1945-46 export was 43,184 metric tons. Part of this export was from crops

[25] Ibid., p. 92.

held over from previous seasons. The United States and Great Britain were the state's best customers. The United States took sixty-three per cent of the linters or 27,294 metric tons. Great Britain imported 13,265 metric tons.[26] Most of these linters were used for making rayon, paper, or gun cotton.

Ginning machinery varies in price depending upon where the machinery is made. Most machinery now used is made in São Paulo or in the neighboring states. The gins are of semi-high density type and are made to put cotton to a density of twenty-six to thirty pounds of cotton per cubic foot. Gins vary from $4,000 to $6,000 in price depending upon the weight and power of the equipment.[27]

São Paulo's lint cotton compares well with cotton of the United States. The proportionate staple lengths in 1940 were: ten per cent of seven-eights inches or under, seventy per cent of fifteen-sixteenths to one inch in length, and twenty per cent of one inch or better in length.[28] The lower grade groups have rapidly diminished over the years. Most of her fibers now run between three-fourths and one and one-sixteenth inches. These fiber lengths are rather standardized over the entire state as a result of the use of standardized seed.[29] Most of São Paulo's cotton in the last few years has been Type 5 or better. American middling cotton ranks just above São Paulo Type 5. Therefore, São Paulo's cotton com-

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[26] "Linter Output, Consumption and Exports, São Paulo", Foreign Commerce Weekly, XXV (December 21, 1946), 47.

[27] Proceedings of the First Cotton Research Congress, pp. 190-191.

[28] Ibid., pp. 191-193.

[29] Benjamin J. Hunnicutt, Brazil World Frontier, p. 122.

pares well with that of the United States in staple length and grade.[30]

In summary, cotton production developed largely as a result of the lower demand for coffee at the same time the world demand for cotton increased. Cotton production is largely a hand-produced crop because of the lack of machinery. The first few crops are produced entirely by means of the hoe due to the large amount of tree roots and stumps in the freshly cleared lands. Cotton tends to be more uniform in fiber length than it is in the United States because of the government control of seed development and ginning practices. Growing seasons are reversed in São Paulo as compared to those in the United States because of its location in the Southern Hemisphere. Lengths of growing season are similar. Cotton pests are similar to those of the United States with the exception that the cotton boll weevil has not yet been introduced into São Paulo.

Ginning methods are more closely supervised in São Paulo than in the United States in order to prevent non-uniformity in ginning. In general, Paulista gins employ more workmen than do America gins of comparable or larger size. This practice occurs because of the cheaper labor available in São Paulo as compared to the United States.

The practice of licensing gins in São Paulo is in marked contrast to the unlicensed gins of the United States. Grading practices are somewhat similar but appear to be more closely supervised in São Paulo than in the United States. Imperfect ginning is prevented by forcing ginners to regin any cotton that has been badly ginned and if necessary, revoking licenses of ginners who continue to do shoddy work.

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[30] "Cotton Grading, São Paulo", Foreign Commerce Weekly, XII (July 31, 1943), 28.

A large share of the by-products of cotton are used or exported from the state. São Paulo's development as a one-variety state was largely due to the work of Senhor José Gerabaldi Dantas, the chief of the Federal Cotton Grading Commission, and Senhor Raymundo Cruz Martins, chief agronomist of the São Paulo State Experiment Station at Campinas. São Paulo, once dependent upon the United States for much of the agricultural machinery used in producing and ginning its cotton, now makes much of its own or buys it from neighboring states.

São Paulo's domination of the cotton industry of Brazil is proved by its control of forty-six and five-tenths per cent of the gins, fifty-six and two-tenths per cent of the gin saws, and the production of over half of the cottonseed ginned from 1936 to 1942. São Paulo also exported a large share of the cotton linters shipped from the country. This control of ginning machinery is very apparent. Price of gins vary according to the power of the machines. Cotton grades in São Paulo are very similar to the United States middling grade, in strength, length of fiber, and value of fiber for textile uses.

CHAPTER VI

ECONOMIC, SOCIAL AND POLITICAL FACTORS IN COTTON PRODUCTION

People form one of the most important elements in cotton production. São Paulo's people arrived from many countries and by several different routes. São Paulo, like the remainder of Brazil, is a land of mixtures. Upon the native stock has been grafted the Portuguese and Negro. To this mixture has been added Italians, Portuguese of recent origin, Spaniards, Japanese, Germans, Russians, Poles, United States citizens, and numerous other groups. Out of this mixture has developed a hybrid people who have made the name Paulista synonomous with an energetic and daring person.

The Federal census uses various terms to refer to divers racial mixtures that developed in São Paulo as well as elsewhere in Brazil. A branco is a person of pure white ancestry. Petos or crioulos are of black or negro ancestry. Amerelos are Orientals. Any dark mixtures which cannot be identified are called morenos. Indio is the term applied to full-blooded Indians who are very rare in São Paulo. Mestiço applies to a person of mixed blood and usually to a cross between white and Indian stock. The term mulato has an identical meaning with the English term mulatto. Caboclos and mamelucos refer to mixtures of Indian and Negro.[1] São Paulo has some of all of these mixtures as there is no color line between the various races in the marriages or social life of its people. São Paulo's population is whiter, however, than is that of any other

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[1] T. Lynn Smith, Brazil: People and Institutions, p. 179.

Brazilian state because since 1875 there has been a great influx of white Europeans into the population.[2] These hybrid people comprised the energetic groups that have helped to raise the state's crops, including its cotton.

The number of Brazilian immigrants has varied from year to year with the province of São Paulo getting the largest share of them. This immigrant horde was greatly reduced in 1937 when the new Federal constitution of that year limited the immigration to Brazil to two per cent of the number of immigrants entering the country in the past fifty years. This had a detrimental effect on the labor supply of São Paulo as many of the immigrants were used to supply the cotton planters and pickers of the state. The peak need for labor is from March to June for both coffee and cotton, thus making it difficult to supply the needs of the cotton farmer for labor.[3]

The population of São Paulo has grown rapidly because of that immigration. It is still inadequate to meet all needs for labor, however, as Sao Paulo has large areas of unused lands in the western and northwestern areas which could be used for cotton and other crops. The following table gives the population of São Paulo at each census from 1890 to 1940 and estimates of the population in 1942, 1943, 1944 and 1945. This table has been compiled from several sources, but it shows the rapid growth in São Paulo's population not only from overseas immigration but also from the other states. While São Paulo's population from 1890

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[2] See Appendix H, page 113.

[3] P. K. Norris, Cotton Production in Southern Brazil, F.S. 63, Office of Foreign Agricultural Relations, United States Department of Agriculture, (1935), p. 2.

increased approximately six hundred per cent from 1890 to 1940, that of Brazil as a whole increased approximately three hundred per cent.[4] When the area of São Paulo - 247,239 square kilometers or 95,845.4 square miles[5] - is considered in relation to its population, it is not too crowded, however. Population density, using the 1945 figures, would be about eighty-four per square mile. With the population of the capital subtracted the density would be even less. In spite of this immigration, one of the greatest needs in São Paulo is a labor supply.

TABLE V

POPULATION OF SÃO PAULO FROM 1890 to 1945[6]

Year	Population
1890	1,383,753
1900	2,282,279
1920	4,592,188
1940	7,239,711
1942	7,576,700
1943	7,733,500
1944	7,890,200
1945	8,077,010

[4] See Appendix H, page 113.

[5] One square mile equals 2.59 square kilometers.

[6] T. Lynn Smith, Brazil: People and Institutions, p. 138; and Benjamin J. Hunnicutt, Brazil World Frontiers, p. 16.

From 1935 to 1940 and in previous years this labor need was met by immigration and migration from other states.[7] In this five year period 30,038 immigrants entered São Paulo and were sent to work on the farms. Of this number, seventy-eight and four tenths per cent or 23,554 were Japanese. The Japanese began coming in 1926 when numerous agricultural colonies were begun and settled through the work of private organizations and the state and federal governments. Up until that time the immigration had been largely of Spanish, Portuguese, and Italian origin.

Between 1884 and 1939, 1,412,263 Italians, 185,795 Japanese, 581,718 Spanish, and 1,204,394 Portuguese entered the country. Of these, the Japanese and Italians went largely to São Paulo. The Spanish settled in the states of São Paulo, Rio de Janeiro, Minas Gerais, and Rio Grande do Sul. Most of the Portuguese gravitated to the cities. It appears, then, that the Japanese and Italians furnished much of São Paulo's agricultural laborers and owners who came from abroad during this period.[8] This applies particularly to the cotton area.

In addition to the immigrants from abroad, many people have come to the state from other parts of Brazil. The number of migrants from other states to São Paulo has varied from approximately 18,000 in 1903 to 119,000 in 1913 which was the peak for such migrations. In 1939, 112,346 people from other states entered São Paulo. Droughts in northern Brazil particularly in the São Francisco Valley drove people from that area to the state. Higher farm wages in São Paulo probably attracted labor from

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[7] T. Lynn Smith, op. cit., p. 136.

[8] George Wythe, Brazil, an Expanding Economy, p. 26.

the other states to the western part of São Paulo.[9] The state has sent more and more of these migrants to work on the cotton farms of the West. The number sent to this area in 1939 was over 93,000.[10]

Thus labor supply is still a great problem in São Paulo today. It is estimated that the state needs 300,000 laborers largely for working the cotton plantations and coffee fazendas.[11] It takes 640 man hours of labor to produce a bale of cotton in São Paulo as compared to 262 man hours per bale in the United States.[12]

Several reasons have caused migration into São Paulo and other parts of Brazil to be slow. Systematic land surveys were lacking making it difficult to establish where land boundary lines lay. Land titles were often clouded due to early land speculations and fraudulent sales in the area. The tendency, until recent years, to concentrate land ownership in the hands of a few has been prevalent. Maintenance of slavery made it difficult for white labor of any type to compete.[13] Today these problems are being overcome as rapidly as possible. The most outstanding attempt to solve such problems has been the establishment of agricultural colonies which in many cases have grown into thriving towns. The purpose of such colonies, which were provided by the Federal law of February 14, 1941, was to establish Brazilian farmers of limited means on small individual holdings.

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[9] Benjamin J. Hunnicutt, op. cit., p. 19.

[10] T. Lynn Smith, op. cit., p. 319.

[11] Ibid., p. 119.

[12] Henry W. Spiegel, The Brazilian Economy, p. 183.

[13] T. Lynn Smith, op. cit. , p. 267.

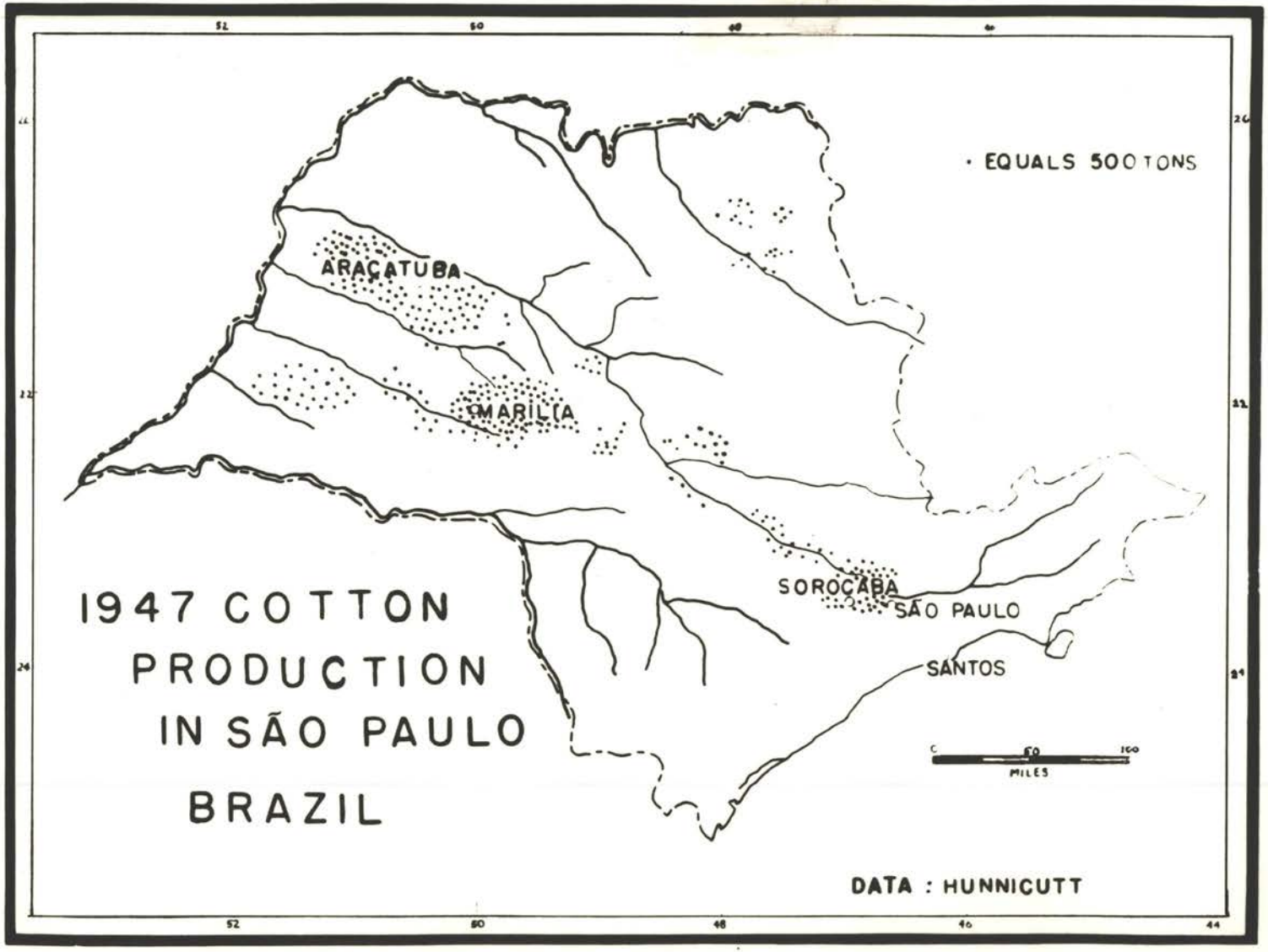
· EQUALS 500 TONS
ARAÇATUBA
MARILIA
SOROCABA
SÃO PAULO
SANTOS
1947 COTTON
PRODUCTION
IN SÃO PAULO
BRAZIL
MILES
DATA : HUNNICUTT

FIGURE IX

Lots, under this law, may range in size from twenty to fifty hectares,[14] and twenty-five per cent must be left in forest by the owner of each plot. Each colony must provide a rural crafts school and a primary school for all children. Breeding stations for improving livestock and plants must be provided. Co-operative buying, production, and marketing must be practiced.

Lots, seeds, and most tools are free of charge. The lots which are, at first, for use only, later became the colonists own property. Candidates, who live in the areas where colonies are being established and have five or more children, are to have preference over other prospective colonists.

The Federal Government pays wages for work done the first year, provides free medical services and medicines until the "emancipation" of the colony, lends agricultural machinery and instruments during the first year, pays the transportation of the colonist to the seat of the colony from the station or part nearest to the colony, and give freedom from state and local taxes until the colony is emancipated. Colonists must clean all drainage channels to a width of two meters and maintain roads to a width of seven meters through their property.[15] Colonists may be expelled if they fail to cultivate the land during the trial period which may vary depending upon the colony. Colonists may also be expelled if they disturb the residents.[16]

Many colonies have been established under this new land and several

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[14] One hectare equals 2.47 acres.

[15] One meter equals 39.37 inches.

[16] T. Lynn Smith, op. cit., p. 367.

are located in the state of São Paulo. Most of them have been founded in the terra arenosa area of the cotton belt. These colonies have absorbed many migrants from other states as the soil is rich and the land is free.

The most recent Brazilian immigration rules admit chiefly farmers, farm laborers, and technicians. Farmers and other agricultural or pastoral specialists are given preference in admittance and special preference within this group is given to families of at least three persons who are able to work and are between the ages of fifteen and fifty.[17] This helps supply additional cotton laborers.

By these methods, São Paulo has tried to meet her labor shortage which is greatest from March to June when the cotton and coffee harvests of the state are both demanding laborers.

One of the problems in getting labor into São Paulo is lack of transportation. Although the state has 6,920.54 kilometers of the 31,915.35 kilometers of Brazilian railroad total, there are still large areas which lack both railroads and highways as Americans know them.[18]

The immigrants from overseas and other states usually arrive by sea or land depending upon the region from which they come. Most immigrants from overseas come by sea to Santos and by rail to the city of São Paulo at state and Federal expense. In a few cases the immigrants come by sea to Rio de Janeiro and to the city of São Paulo by rail at either government or private expense. National migrants from Baiá, Alagoas, and Pernambuco usually come by one of these sea routes.

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[17] George Wythe, Brazil, an Expanding Economy, pp. 30 and 32.

[18] One kilometer equals .621370 miles.

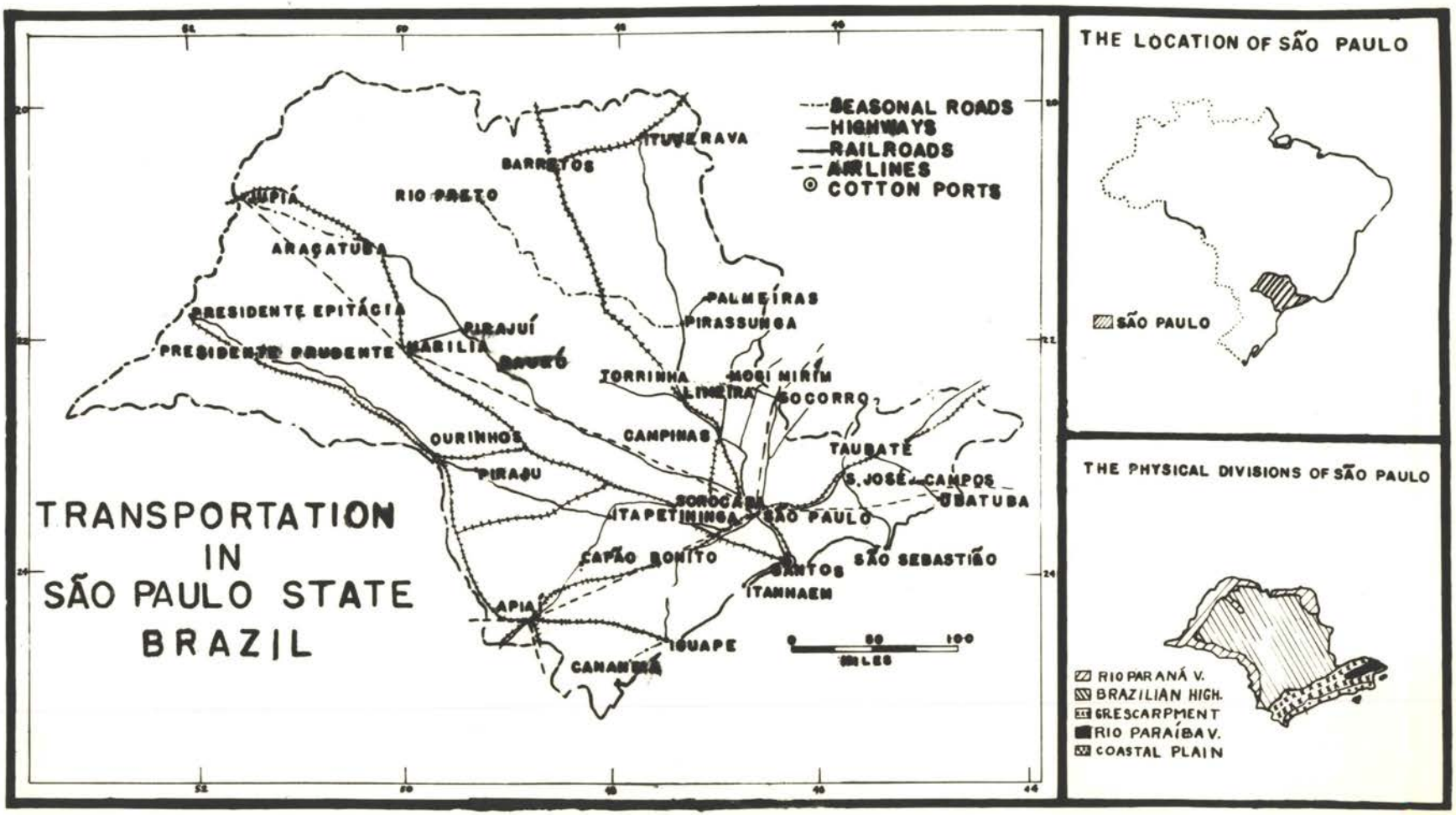
TRANSPORTATION
IN
SÃO PAULO STATE
BRAZIL
SEASONAL ROADS
HIGHWAYS
RAILROADS
AIRLINES
COTTON PORTS
ITUVERAVA
BARRETOS
JUPIÁ
RIO PRETO
ARAÇATUBA
PRESIDENTE EPITÁCIO
PRESIDENTE PRUDENTE
PIRAJUÍ
MARILIA
BAURU
PALMEIRAS
PIRASSUNGA
TORRINHA
MOGI MIRIM
LIMEIRA
SOCORRO
OURINHOS
CAMPINAS
TAUBATÉ
PIRAJU
S. JOSÉ CAMPOS
SOROCABA
UBATUBA
ITAPETININGA
SÃO PAULO
CAPÃO BONITO
SÃO SEBASTIÃO
SANTOS
ITANHAEM
APIAI
IGUAPE
CANANÉIA
0 50 100
MILES
THE LOCATION OF SÃO PAULO
SÃO PAULO
THE PHYSICAL DIVISIONS OF SÃO PAULO
RIO PARANÁ V.
BRAZILIAN HIGH.
ESCARPMENT
RIO PARAÍBA V.
COASTAL PLAIN

FIGURE X

Most national settlers come south from Ceará to Juazeiro on the Rio São Francisco in northern Baiá. Then the migrants travel by river boat up the São Francisco for 850 miles to Pirapora in northern Minas Gerais. This part of the trip usually takes ten days to three weeks. At Pirapora migrants board the train for the hospedaria[19] of São Paulo, a trip of 800 miles to the border. The train trip takes a minimum of two days and nights. The migrants forming this group who came from areas that are equidistant from the Rio São Francisco and the seacoast converge on Monte Claros in Minas Gerais. Monte Claros is another rail head from which the rail trip to São Paulo may start.[20]

There has also been a migration from east to west within the state. Ghost towns and decaying fazendas are prevalent in this area because of a desire for a healthier climate, because of transportation change, and because of exhaustion of the soil for cotton in the eastern areas.[21] This movement to the west has been especially true of the foreign population. In 1934, the latest figures available, placed the rural population as 88.4 per cent Brazilian and eleven and five tenth per cent foreign born, with a one tenth per cent unknown. Urban ratios were eighty and three tenths per cent Brazilians and nineteen and six tenths per cent foreign born with a one tenth per cent unknown.[22]

In 1934, Brazilian held sixty-two and three tenths per cent of the cotton acreage. By 1937-38 the cotton acreage in control of Brazilians

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[19] Hospedaria are dormitories maintained by the state for migrants.

[20] T. Lynn Smith, op. cit., pp. 324-325.

[21] George Wythe, op. cit., p. 17.

[22] Henry W. Spiegel, op. cit., pp. 167-168.

had dropped to fifty-four per cent. By naturalization of a large percentage of the Italians who held thirty-seven and seven tenths per cent of the cotton land in 1934 the control by Brazilians has risen to seventy-two per cent at the present time. Japanese still hold fourteen per cent and Italians four per cent of the cotton acreage.[23]

The average cotton farms in 1938-the most recent data-were from thirty to one hundred fifty acres in area. Few farms produced a large amount of cotton, however. Very few farmers produce as much as 1,000 bales today, and the fourth largest farm in São Paulo State produces only 3,000 bales a year.[24]

Over forty-five per cent of the cotton farmers were still tenants in 1945. Farm owners of cotton areas increased a slight two per cent in 1945 in spite of the huge number of tenants.[25] This is still true in spite of the fact that the cultivated acreage in São Paulo has increased from 3,800,581 acres in 1905 to 9,702,167 acres in 1939-1940. One other noticeable factor is that in the state as a whole the number of landowners increased from 1905 with 56,981 to 1933-1934 with 274,740 and then declined in 1939-1940 to 170,462. Most of this decrease is not due to the absorption of these small cotton farms but to the growth of the coffee fazendas although some consolidation of cotton farms has occurred.[26]

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[23]Henry W. Spiegel, op. cit., pp. 167-168.

[24]Benjamin J. Hunnicutt, Brazil World Frontier, pp. 126-127.

[25]"Cotton Acreage, São Paulo, Brazil", Foreign Commerce Weekly, XX (September 1, 1945), 30.

[26]"Agricultural Evaluation of the State of São Paulo", Bulletin of the Pan American Union, LXXXI (January 1, 1947), 52.

Most of the farms are still hand-tilled as they were in 1920 when the number of people engaged in agriculture per plow in São Paulo were thirty. This was much better than in Brazil as a whole as there were 435 per plow on a national basis. Approximately fifteen per cent of the people used plows in São Paulo at that time and the ratio has not increased greatly today.[27] Usually at least the first crop or two of cotton raised on a new land area is grown by means of hoe agriculture even at the present time. In 1939-1940, seventy-one and three tenths per cent of the farms and fifteen and eight tenths per cent of the farm land were in farms under 120 acres. Cotton was usually raised alone but sometimes with coffee, corn, and manioc on the same farm. This shows the influence of cotton at the present time on the land which was once covered by huge fazendas for coffee and cattle before cotton became an important crop.[28]

Tenancy seems to be most prevalent in Brazil on the cotton plantations of São Paulo. The usual tenancy system prevails among the share croppers of São Paulo that is found among those of the United States. A certain percentage-usually fifty-of the cotton is given for use of the land. In cases where the Japanese use the land, they usually prefer to pay cash rent to giving a share of the crop. In some cases, the entire crop for the first year or two is given to the cropper for clearing the land. Tenants are often in debt to the ginner or supply merchant for money or materials used in raising the crop. Private owners of land

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[27] T. Lynn Smith, op. cit., p. 53.

[28] Henry W. Spiegel, op. cit., p. 53.

usually retain their ownership in the crop until they sell it to the ginner.

Cotton pickers form another class interested in cotton in São Paulo. Many of these people are hired as contract labor. The first Japanese were hired, not on the cotton plantations but on the coffee fazendas. They later bought land to the westward and moved on.[29] Cotton land needs a huge labor supply at harvest time, but it uses very little at other times. The agricultural laborers such as cotton pickers were considered as below the social level of the tenants.

To protect all laborers including the cotton pickers, much Federal labor legislation has been passed since the 1930 Revolution. All over São Paulo and the remainder of Brazil, social security funds have been used to raise the standards of living of the worker; to buy land for workers' communities, to open popularly priced restaurants, and to advance short term loans to insured laborers. The law requires that two-thirds of all help of any type employed must be Brazilians, but the insurance is open to both natives and foreigners regardless of race and color.

Trade unions and the right to organization among all laborers are recognized. This includes agricultural laborers such as the cotton pickers of São Paulo. Farm laborers are guaranteed protected, minimum wages, an eight hour day, and fifteen days of paid vacation each year. No one under fourteen may be employed, no one under sixteen may be employed in night work, and no one under eighteen may be employed in hazardous occupations. The Federal Government provides free medicinal aid, protection for maternity, and old-age, disability, and life insurance. Special courts

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[29]Lawrence W. Hill (editor), Brazil, pp. 138-139.

are provided to settle labor disputes. Although these laws are more strictly enforced in the cities, they are becoming better enforced in the thickly populated regions of São Paulo and on the cotton lands.[30] The cotton grower already pays to his farm labor the highest wages in all of Brazil.[31]

Numerous other government attempts have been made to raise the standards of living of all Brazilian labor. Although São Paulo's labor is better paid, it still needs assistance. In 1934, Getulio Vargas, then President of Brazil, signed a decree voting $10,000,000 to create a rural bank. The purpose of the bank was to foster agriculture through loans to farmers, to work jointly with the Economic Adjustment Administration of Brazil, to finance a department of agriculture to campaign for diversified farming and a soil survey, and to strongly urge the planting of wheat all over Brazil, with reference to the areas of São Paulo and Rio Grande do Sul where it grows best.[32] In general, cotton remains the main crop for many small farms although attempts at diversification have been made.

Better homes are of brick or masonry. They may be plastered and have either a roof which is gabled and covered with pitch or one with four slopes and covered with tile. Some of the poorer type are thatched

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[30] Sidney Greenbie, The Fertile Land, Brazil, pp. 70-72.

[31] Benjamin J. Hunnicutt, "A Study in Brazilian Cotton", Bulletin of the Pan American Union, LXXII (May 2, 1938), 305.

[32] "Brazil Starts Farm Loan Bank", New York Times, (June 28, 1934), p. 3.

and as the traveler goes farther inland he sees wooden homes with shingled roofs. This is especially true where wood is avilable but the shingled roof for the home applies only to the poorer classes. The wooden residences are of the poorest type. The homes for the poorer classes are rather crude in the cotton area. The wooden homes developed because the altitude made better protection necessary on the plateau.[33]

Usual diets especially among the poorer classes consist largely of beans, corn meal, beef, pork, coffee, rice, and a few vegetables. There is a remarkable lack of green vegetables, fruits, and milk among the poorer classes in all areas of the state. The food expenditure per person in São Paulo, which has the highest expenditure for food in all Brazil, is $2.55 per month in the capital, and $2.05 per month in the interior. Fifty-four and nine tenths per cent of the average income of people in the capital and sixty-one and four tenths per cent of the average income of the people in the interior of São Paulo is spent for food.[34]

Education and health standards in the state are low. In 1920 only about thirty-seven and eight tenths per cent of the people over seven years of age were literate. In the lowlands bordering the Paraná and Rio Grande Rivers malaria is so prevalent that lands below 1,000 feet which would grow cotton are unusable. Houses are often located near malarial areas. Almost ninety per cent of the rural population are subject to hook worm. Many other diseases are prevalent. Tetanus is said to be present in certain areas of the state. Health and diet have been improved through certain areas by the founding of clinics and workers'

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[33] T. Lynn Smith, op. cit., p. 88.

[34] Ibid., pp. 354-358.

restaurants which have been provided by the Federal Government.[35]

The homes in the cotton district are scattered on individual holdings. The homes of the parceiros[36] are scattered among the cotton fields as they are in the United States.[37]

Government assistance to cotton growers and pickers as well as shippers has taken several forms. Federal Decree No. 20211, of July 14, 1931, provided that all cotton destined for export must be classified before being shipped. According to Federal Decree No. 22929 passed on July 12, 1933, all cotton sales must be based upon the quality of the cotton as determined by official cotton classification certificates. Decree No. 22982 of July 25, 1933, set up a Federal Textile Plant Bureau to distribute good cottonseed and whose duties might be transferred to state governments.[38]

The purpose of these three decrees was to establish the production of a type of cotton staple that would be uniform in tensile strength, length of fiber, and grade of fiber. Government encouragement to cotton exporters has often taken the form of reducing the amount of foreign exchange that must be sold at official rates rather than upon the open market.

The Federal Government maintains a protective tariff of .178 cents per pound on yarn and finished cloth which are imported into Brazil thus

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[35] Ibid., pp. 354-358.

[36] A tenant farmer of São Paulo.

[37] T. Lynn Smith, Brazil: People and Institutions, p. 405.

[38] "Cotton in Brazil," Bulletin of the Pan American Union, LXIX, (October, 1935), 746-762.

helping the textile industry of São Paulo. Federal Decree No. 24049 of March 27, 1934, required the annual registration and licensing of all gins and gave ginners eighteen months in which to conform to standard practices. All of these decrees and other aid tended to help the cotton industry of São Paulo and Brazil grow in strength and importance on a world basis.[39] Even the price of cotton has been maintained in recent years by the Federal Government.

General Waldomira Linia, Federal Military Governor of São Paulo, advocated free schools in a proposal to President Vargas of Brazil in 1932. This proposal would have given free education at Government expense for the children of farmers and laborers of São Paulo. This plan would have eventually raised the living standard of the state and particularly of cotton areas.[40]

Cotton is largely raised on a share cropper or small farmer basis. Foreign-born people still control approximately twenty-eight per cent of São Paulo's cotton lands. Over forty-five per cent of the states cotton farmers were still tenants in 1945. Most acreages planted to cotton varied from thirty to one hundred fifty acres and usually grow less than 1,000 bales of cotton per farm. The cotton pickers of São Paulo are the best paid of Brazil's farm laborers.

All classes, rich and poor alike, in the state are under-nourished and need the assistance which the Federal and state governments are now extending. Living standards as a whole are low among all of São Paulo's

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[39] Ibid., pp. 746-762.

[40] "Free Schools Urged in Brazil as War Reconstruction Step", New York Times, (October 13, 1932), p. 5.

people and especially among the tenants and cotton pickers of the cotton areas. Crop ownership depends upon the status of the producer, but the crop is usually mortgaged before it is sold in the case of the sharecropper.

Cotton is usually raised as the only money crop, but it may be produced in conjunction with other crops such as coffee and manioc.

Lack of education and poor health tend to keep the standard of living low in São Paulo's cotton belt. Government attempts at stabalizing prices, raising living standards, and standardizing the product for better overseas sales have partially succeeded but much further work on the second problem is still needed.

These then are some of the problems connected with cotton production in São Paulo. Some have been solved. Others must be solved if cotton is to be a blessing to the state and not a curse.

CHAPTER VII

TRANSPORTATION AND MARKETING OF SÃO PAULO'S COTTON

There are several types of buyers and ginners who may handle the purchase of the seed cotton from the farmers in São Paulo. In remote regions the commonest type of buyer is the local independent buyer who is located at points where no gin is available. This buyer, or scalper as he is called, usually handles approximately twenty-five per cent of the state's seed cotton before it is ginned. Another type of buyer is the independent ginner. This man purchases seed cotton from the farmer, gins it, and then sells it to the cotton export merchant.

Line ginners may own or control gins at many strategic points. They also buy cotton from the farmer and gin it as does the independent ginner. The line ginner protects himself from extreme loses by buying cotton futures on the word market--a thing that the independent ginner does not do. Line ginners may be independent, or they may be subsidiaries of export merchants. In addition to these types of buyers, cotton export merchants maintain commission buyers who purchase ginned cotton from the small independent ginners.[1]

When the cotton leaves the gin, it has been checked by the fiscal agent stationed at the gin who sampled each bale, sent the samples to the Formento to be classified, and attached the classification certificate for each bale to the final bill of lading. The bale leaves the gin

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[1] Omer W. Herrmann, "South Brazil, New Land of Cotton", Circular No. C-117, Farm Credit Administration, United States Department of Agriculture, Washington, D. C. (May, 1940), pp. 36-39.

wrapped in new cotton cloth and steel bands. The cloth wrapping or tare carries the official brand of the ginner and the national colors of Brazil.

The cotton is usually purchased by a commission man of some export firm and is shipped by rail to the city of São Paulo for repressing and warehousing. If the cotton has not been sold by the ginner as yet it is shipped to the city of São Paulo for the same purpose. Shipment is usually by rail as highways are lacking entirely or are seasonal in nature. Gasoline and trucks are still expensive in the state so that it is cheaper to ship by rail. The product which is comparatively bulky can also be more easily handled by this method. Rail transportation is approximately two cents a mile in the state of São Paulo because of cheap labor for maintenance and electrification of many routes.[2]

The Sorocabana Railway, one of the roads over which much of the cotton is hauled to the city of São Paulo, began electrical operation from Sorocaba to São Paulo in January, 1945. Another stretch from Sorocaba to Santo Antonio was to be completed by March of the same year.[3] The São Paulo Railway was authorized in June, 1945 to electrify its route from the city of São Paulo to Jundiaí which is located between Campinas and the capital. At Jundiaí, the São Paulo Railway connects with the Paulista Railway to Barretos which serves the cotton and coffee areas of the northeast. This will allow through traffic to the north-

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[2]Bertita Harding, Southern Empire: Brazil, pp. 18-19.

[3]"Electric Operation on Sorocabana Railway", Foreign Commerce Weekly, XVIII (February 3, 1945), 19.

east and will save a large amount of coal.[4]

Cotton from the northwest comes by rail from Jupia, Araçatuba, Marilia, and Sorocaba to the city of São Paulo. Another route is from Presidente Epatacia to Presidente Prudente to Ourinhos and connects with the main line through Marilia and several miles to the southeast of that city.[5]

Most cotton is hauled over the Sorocabana Railroad after it reaches Sorocaba either to the capital or directly to Santos to save freight and avoid cable sections from the city of São Paulo to Santos.[6] If the cotton has been pressed, shipment is always through Sorocaba directly to Santos.

Many roads converge on the capital with loads of cotton as it is the great spot market for the state. The most vital of these railways for cotton transportation is the São Paulo Railway which connects the capital with Santos. In its fifty miles are sixteen viaducts and thirteen tunnels. This section of railroad plus two different railroad guages complicate the transportation routes of the state.[7]

When the cotton reaches the city of São Paulo it is repressed, if necessary, to the standard forty pounds to the cubic foot, forming the 400 pound net bales required by law. Approximately seventy-five per cent

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[4]"Railway Electrification between São Paulo and Jundiaí", Foreign Commerce Weekly, XVIII (February 17, 1945), 16.

[5]To trace these routes check the transportation map on page 77.

[6]"New Railroad Branch in Brazil", Bulletin of Pan American Union, LXXII (April, 1938), 251.

[7]Benjamin H. Namm, "São Paulo, the Fastest Growing City in the World", Bulletin of the Pan American Union, LXXVII (October, 1943), 741-750.

of the bales which are exported from São Paulo State are repressed at the capital. Repressing is necessary as actual cargo space must be purchased on Brazilian ships rather than shipping by weight as is done in the United States. Compressing must be done at the city of São Paulo rather than at Santos as no compressers and very little storage space are available at the port.

Some authorities say repressing adversely affects the spinning qualities of cotton. Compressed cotton has a ten to eleven pound tare or cover per each 400 pound bale. Compressing costs approximately sixty cents per bale. Repressed bales do not look good as approximately eighty-five bales per hour are repressed at the average compress.

After repressing, bales are stored in warehouses until they can be shipped to local users or to Santos. Gins, presses, and warehouses are on railroads because of the ease of transportation. Warehouse receipts are for a definite number of bales without identification, thus making it impossible to withdraw a few bales at a time.[8]

The city of São Paulo is the site of the state's largest cotton market. Cotton is sold from this point to the domestic trade or to the export merchants for foreign shipments. Government control is quite marked over the sale of export cotton. The mercantile exchange or Bolsa de Mercadorias must grant permission to the export merchant to have the specific bales included on a list released for shipment. The Bolsa issues five copies of a certificate showing the number of bales intended for export, their weights, and their classification.

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[8] Omer W. Herrmann, op. cit., pp. 42-47.

Three copies of this certificate are made out for the exporter who sends one copy to the foreign buyer, sends one copy to the Bank of Brazil for checking foreign money sent to Brazil in payment for the cotton, and keeps the third copy in his files for future reference. The fourth copy of the certificate goes to the Federal Department of Agriculture at Rio de Janeiro for the maintenance of export statistics. The fifth copy of the certificate goes to the São Paulo Department of Agriculture at the city of São Paulo.

The exporter's three copies are released to him when he has paid the one and one-fourth per cent sales tax charged by the Federal Government on all sales. If the country to which the cotton is being sold is a barter country, the exporter must clear the cotton through an export firm designated by the government for such allocatees. When these steps have been followed, the cotton may be shipped by rail from São Paulo, the capital, to Santos and loaded on the ship which is to carry the cotton to the foreign customer.[9]

Cotton in the domestic market serves the factories of the state as a raw material. Probably the largest of local users are the Matarazzos, an Italian family, who have built an industrial empire based on textiles, cement, electrical equipment, and chemicals.[10] Brazil consumes approximately 600,000 to 800,000 bales of cotton per year in its cotton textile mills at the present time.[11] Cotton manufacturing ranks first among

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[9] Ibid., pp. 29-30.

[10] Hermane Tavares De Sá, The Brazilians, People of Tomorrow, p. 96.

[11] Benjamin J. Hunnicutt, Brazil World Frontier, p. 22.

Brazil's textile industries with the control of the industry in the hands of São Paulo State.[12] São Paulo in 1944 dominated the control of the mills for Brazil as a whole with 215 mills, 96,000 operatives, 31,085 looms, and 1,102,228 spindles as compared to the total for the whole country with 411 mills, 254,000 operatives, 97,000 looms, and 3,000,000 spindles. Twenty-five per cent of all factory workers in Brazil are in the cotton mills, and São Paulo employs over one-third of them in her mills. Most of São Paulo's spinning mills are now on a double shift to allow them to keep up with her looms.[13] São Paulo's industry is still expanding as in 1946 it had 1,109,776 spindles.[14]

In an attempt to meet the needs of various markets for Brazilian cloth, an agreement was signed in June, 1943, by the chief organizations of the industry with the Co-ordinator of Economic Mobilization of the country. This agreement required each manufacturer to deliver to the Brazilian trade ten per cent of his output in low-priced goods with the prices marked on the selvage. Generally these prices are marked at fifty per cent of costs. Goods which were reserved to meet the 150,000,000 yard quota of Brazil for the United Nations Relief and Rehabilitation Association were to take another ten per cent of the manufacturers' production. Sixty per cent of the production under this agreement is of high-priced goods for sale in Brazil with at least a twenty-five per cent net profit.

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[12] "Cotton in Brazil", Bulletin of the Pan American Union, LXIX (October, 1935), 746-762.

[13] "Brazilian Textile Industry", Bulletin of the Pan American Union, LXXX (October, 1946), 588-590.

[14] "Expansion in Industry, São Paulo", Foreign Commerce Weekly, XXV (December 21, 1946), 47.

The remaining twenty per cent is exported at thirty per cent net profit. Most of São Paulo's large mills signed this agreement.[15]

Thus São Paulo, with one third of Brazil's cotton spindles, dominates the textile industry which produces nearly half of the total value of the industrial output of the country and leads other industries in the number of people it employs. The industry of São Paulo and all Brazil has expanded rapidly because of the market for finished goods in South America, the lack of competition at home from other countries, a high tariff on cotton textile imports, and because cotton forms the basic clothing for Brazil's people. São Paulo could expand still more if the standard of living and wages were higher and if more mill labor were available.[16] This is possible as São Paulo produces much more cotton than she uses at the present time.

This domination of the industry is quite marked as Sao Paulo State controlled sixty-two per cent of the total textile production of all types in 1938. This domination is in part due to the cheap electric power, the large local supply of cotton, the large immigration of people from the world's industrial nations to the state, and the early development of the dyeing and printing industry in connection with cotton cloth.

The mores were changed by the large number of immigrants so that São Paulo's women today feel little compunction against working in the mills. The state's other industries also require large numbers of men, leaving few workers other than the women for the cotton mills. São Paulo today leads Brazil in the production of towels, napkins, pajamas, gloves,

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[15] "Brazilian Textile Industry", Bulletin of the Pan American Union, LXXX (October, 1946), pp. 588-590.

[16] Morris Llewellyn Cook, Brazil on the March, pp. 211 and 218.

underwear, shirts, socks, stockings, handkerchief, scarfs, shawls, sheets, blankets, cotton textile goods, and ready-made clothing.[17]

In addition to finished products, São Paulo produced 69,945 metric tons of cotton yarns in 1949. The consumption of the yarn was as follows: forty per cent in making piece goods; twenty per cent for knitted goods, thread, and ribbons; ten per cent in sheets; ten per cent in bedspreads, towels, fancy goods, etc; seven per cent in tire fabric; five per cent in canvas and belting; five per cent in bagging; and three per cent in cordage. The yarn producers use eighty per cent of the yarn spun within the state. São Paulo State also exported 290 tons of cotton yarn in 1949.[18]

At the end of 1949, Brazil had 3,500,000 spindles of all types operating. This is less than one-eighth the number of spindles in the United States. As additions to, or replacements for, these spindles and for other machinery, Brazil had ordered $28,000,000 worth of textile machinery but needs a total of $80,000,000 including that already ordered. Over one-third of this order was from the United States, but only a small portion of it was to go to the cotton mills of São Paulo with most of it destined for the wool and rayon industries of that and other states.[19] Estimates for 1949-50 consumption in São Paulo and other Brazilian cotton mills show the necessity of using 875,000 bales of cotton in order

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[17] José Jobim, Brazil in the Making, pp. 142, 161-168.

[18] "Cotton Yarn Consumption", Foreign Commerce Weekly, XXXIX (May 15, 1950), 41.

[19] "Brazilian Textile Machinery Situation", Foreign Commerce Weekly, XXXIX, (May 8, 1950), 36.

to produce over 1,200,000,000 meters of cloth domestic and foreign market.[20] The Federal Government controls the types of textile machinery of all types which are imported into the country and prohibits the admittance of the undesirable types.[21]

Cotton use in São Paulo's textile mills has risen steadily since the 1940's. The state used 55,715 metric tons of cotton in 1941, 74,059 metric tons in 1942; 79,361 metric tons in 1943; and 80,707 metric tons in 1944.[22]

The most recent mills in operation in the state are two new ones at Sorocaba and Ribeirão Preto. The Sorocabo mill has been in operation for some time. The mill at Ribeirão Preto has been in the process of completion. When completed, it is to have 80,000 spindles and looms, which should be enough to use the yarn produced. Approximately 2,000 spindles have already been installed. It is predicted that it will be the largest textile mill in South America when completed.[23]

Production of piece goods for São Paulo has increased rapidly over the years. Brazil production in 1936 was 1,475,000,000 linear meters and that of Sao Paulo alone in 1946 was 342,552,293 linear meters. This production was for cotton only and did not include other textiles.[24] Cotton

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[20] "São Paulo Cotton", Foreign Crops and Markets, XXVI (December 26, 1940), 685.

[21] Henry W. Spiegel, The Brazilian Economy, pp. 214-215.

[22] "Cotton Consumption, State of São Paulo, Brazil", Foreign Commerce Weekly, XIX (April 14, 1945), 36.

[23] "New Spinning and Weaving Mill, São Paulo Brazil," Foreign Commerce Weekly, XXVI (March 1, 1947), 29.

[24] "Brazil's Production and Exports", Foreign Commerce Weekly, XXVIII (August 23, 1947), 28.

piece goods exports from Brazil from January to September of 1949 was 2,164 metric tons. Largest exports were to Argentina with 1,295 metric tons, Paraguay with 355 metric tons, 248 metric tons to Pakestan, and 161 metric tons to Iraq.

The largest amount of exports were bleached piece goods, dyed fabrics, unbleached piece goods, printed fabrics, and cotton duck. Bleached and unbleached piece goods went largely to Argentina, Paraguay, and Chile. Printed fabrics were shipped chiefly to Argentina, Paraguay, Pakestan, and Uruguay. Dyed fabrics went chiefly to Argentina and Paraguay, and cotton duck also went to these markets. These figures applied chiefly to cotton goods, and although applying to Brazil as a whole give some idea of various types of goods and the proportionate amount exported from São Paulo's cotton mills which control Brazilian textile production.

During 1948 and the first half of 1949 the export trade with Argentina was greatly reduced by blocked Brazilian balances in Argentina and other Argentine trade restrictions. These barriers were removed in the first part of 1949.[25] A reciprocal trade treaty, signed between the Argentine and Brazilian governments calls for Brazilian sales, at prevailing market prices, to Argentina, of 16,000,000 yards of cotton textiles in 1947; 22,000,000 yards in 1948; and 27,000,000 yards in 1949, 1950 and 1951.

In addition, Brazil is to supply Argentina with 2,000,000 pounds of cotton yarn a year from 1947 to 1951. All goods under this agreement

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[25] This data is from a report by David de Lima, American Commercial Attache at Rio de Janeiro which was loaned to the author by Mr. Rollo S. Smith, Acting Chief, American Republic Branch, Office of International Trade, Department of Commerce, Washington, D.C.

are to be carried in the ships of the signers to the pact. If either has an opportunity to buy or sell under more advantageous circumstances, that country must ask the other party to the pact to adjust its prices before buying elsewhere.[26] This treaty will mean additional expansion for São Paulo's cotton mills which already produce such a large share of Brazil's textiles.

Table VI shows the distribution of raw cotton in the state of São Paulo from 1937 to 1945. The drop in local consumption in 1945 was largely due to reduced cotton yields in 1944. In 1947 the export of cotton from São Paulo through the part of Santos reached an all time high.[27] In marked contrast to the 1870's when cotton textiles were the leading imports, only some fifty-two metric tons of clothing and thirty-two tons of cotton oil cloth were imported in 1947. These came largely from the United States.[28] Brazilian cotton has taken many of the markets that were once exclusively American. Japan, which once bought much American cotton, began purchasing Brazilian cotton in 1934 when an official delegation visited Brazil and proposed to buy all the cotton Brazil produced. In return Japan would ship cotton goods to Brazil and undersell local producers.[29]

Japanese raw cotton imports in the first six months of 1935 were 73

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[26]"Reciprocal Trade Agreement between Argentina and Brazil", Bulletin of the Pan American Union, LXXXI (March, 1947), 160.

[27]"Cotton Exports, Brazil", Foreign Commerce Weekly, XXVII (April 26, 1947), 32.

[28]"Brazilian Imports of Wearing Apparel and Textiles", Foreign Commerce Weekly, XXXII (September 11, 1948), 31.

[29]"Japan After Brazil's Cotton", New York Times, June 17, 1934, p. 8.

TABLE V I

COTTON DISTRIBUTION, STATE OF SÃO PAULO[30]
(In metric tons)

Year	Export to Foreign Countries	Shipment to Overland	Other States Coastwise	Consumption by local mills
1937	152,324	5,000	1,408	47,269
1938	200,117	5,000	283	47,481
1939	258,536	8,299	200	47,845
1940	185,525	6,768	106	49,991
1941	254,012	15,797	893	55,715
1942	147,510	23,089	3,216	74,058
1943	79,131	19,263	2,698	79,361
1944	105,045	20,151	9,744	80,707
1945	53,525	7,834	1,544	39,229

metric tons, 1936 were 23,205 metric tons, 1937 were 26,738 metric tons, and of 1938 were 20,722 metric tons.[31] The value of cotton exports from Brazil from 1941 to 1945 varied from fifteen per cent of total exports in 1941 to eight and seven tenths in 1945.[32] São Paulo supplied the largest share of these cotton exports. From 1934 to 1938 the chief users

[30] "Cotton Supply, State of São Paulo", Foreign Commerce Weekly, (January 5, 1946), 36.

[31] Raul Bopp and José Jobim, Sol e Banana, p. 32.

[32] Henry W. Spiegel, op. cit., p. 123.

of Brazilian cotton were the United Kingdom, Germany, and Japan. From 1939 to 1943 the chief users were the United Kingdom, Japan, Canada, Spain, Sweden, and China. In 1947, the positions of chief users were held by the United Kingdom, Belgium, Spain, and Italy. In 1947 the leading users of Brazilian cotton were the United Kingdom, Spain, Poland, France, and Sweden in that order.[33] Cottonseed oil went chiefly to the United States, Sweden, and Canada from 1941 to 1944.[34] The largest users of cotton yarn during this same period were Argentina and Uruguay. Cotton linters went largely to the United Kingdom, the United States and Japan in 1941 and to the United Kingdom and the United States from 1942 through 1944. Cotton residue from 1941 through 1944 was shipped chiefly to the United Kingdom and the United States.[35]

São Paulo produced a large share of these items. Thus the United States has lost many customers to the Brazilians. A recent trade and payments agreement signed between the United Kingdom and Brazil provides that Brazil will ship approximately 60,000 tons of raw cotton and 4,000 tons of cottonseed oil to Britain. Among items that the British will send to Brazil are textile machines of various types to the value of 2,5000,000 pounds sterling.[36] Brazil's commitments for European relief during 1945 called for the provision of 300,000,000 additional yards

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[33]"Cotton Exports by Countries of Destination", Foreign Crops and Markets, LIX, (December 26, 1949), 686.

[34]This was the latest available data.

[35]Foreign Commerce of Brazil, 1940-1946, "Foreign Trade Series No. 2070", Pan American Union, Washington, D. C. (1947), p. 13.

[36]"Tariff and Trade Controls", Foreign Commerce Weekly, XXXII (July 10, 1948), 13.

of cotton textiles for various international organizations in addition to 200,000,000 yards already called for up to that time.[37] A large share of these commitments were met largely by São Paulo's production.

Raw cotton ranked third in exports in 1945, while cotton textiles ranked second.[38] By official estimates the cotton crop of Brazil plus its exportable by-products is now more valuable than the coffee crop.[39] Most of these products leave Brazil and the state of São Paulo through Santos which has a depth at the docks ranging from seven to ten meters,[40] or twenty-two and nine tenths feet to thirty-two and seven tenths feet right at the quays. 138 cranes are available here for loading ships with São Paulo's cotton textiles and fibers.[41]

Principal local markets of São Paulo's textile industry and raw cotton production are located in Rio de Janeiro, Rio Grande do Sul, the Federal District, Baia, and Pernambuco and are reached by rail or coastal steamer from São Paulo.[42] Anderson and Clayton, an American company and the largest cotton merchant in Brazil, buys much of the state's cotton but exports it chiefly through Brazilian firms.[43] Thirteen to twenty-

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[37] "Brazilian Cotton Textiles for the United Nations", Bulletin of the Pan American Union, LXXIX (August, 1945), 477.

[38] "Brazil's Foreign Trade in 1945", Bulletin of the Pan American Union, LXXX (September, 1946), 528-529.

[39] Benjamin J. Hunnicutt, Brazil World Frontier, p. 15.

[40] One meter equals 3.27 feet.

[41] John W. Brunk and Hugo Franklin, Editors, Brazil Yearbook and Manual, p. 60.

[42] "São Paulo in Brazilian Coastwise Shipping", Bulletin of the Pan American Union, LXX (April, 1936), 361-362.

[43] Benjamin J. Hunnicutt, op. cit., p. 22.

five per cent of the Santos' cotton exports belong to this company although the exports are largely through Brazilian firms. Seven firms controlled seventy-five per cent of the Santos' cotton exports in 1940-1941.[44]

Brazil, through the production of cotton in São Paulo and the manufactures of this state, now is a serious competitor of the United States in both raw cotton and cotton textiles. In raw cotton production Brazil ranks fourth and its textiles have become serious American competitors in the Argentine, Uruguayan, and Paraguayan markets and in Europe in the English, Swedish, French, and Spanish markets. Even Canada, once an American stronghold, now buys a great deal of cotton from Brazil.

Brazil has won a place for herself in the world market through the excellence of the textiles and raw cotton of São Paulo. Brazil is in the market to stay because of the huge investment in cotton equipment, the excessive and extensive work done in crop improvement, the marketing machinery and export facilities available throughout the year, the determination of her people to diversify, and because both Europe and Asia desired a competitor for the United States in cotton exportation.[45]

One million two hundred thousand bales of cotton in good seasons, largely from São Paulo, cannot be ignored in the export trade of the world. Production at five cents a pound and delivery in these world markets is possible for Sao Paulo cotton according to L. A. Wheeler, Director of the Department of Foreign Agricultural Relations of Washington,

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[44]Henry W. Spiegel, op. cit., p. 181.

[45]Benjamin J. Hunnicutt, "A Study in Brazilian Cotton", Bulletin of the Pan American Union, LXXII (May, 1938), 300-301.

D. C.[46] So Brazil is in the world market to stay regardless of the fact that the cotton growers and manufacturers of other parts of the world feel her competition. The only method of overcoming that competition is to meet it with better products from American mills and fields at the same price or at a lower price than Brazilian goods and products are produced.

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[46] Benjamin J. Hunnicutt, op. cit., p. 125.

CHAPTER VIII

THE OUTLOOK FOR COTTON PRODUCTION IN SÃO PAULO STATE

The future of São Paulo's cotton production depends upon the markets for the state's cotton and the textiles made from it. These markets are local, national, and international.

Local markets include the use of the fiber and its by-products in the factories of the state. With a population which includes approximately twenty per cent of the total of the nation, it is possible that the use of cotton will continue to expand. This seems likely if the living standards of the state continue to rise. Cotton has always been the most comfortable fabric for wearing within São Paulo. The kinds of cotton fabrics worn will improve if the standards of living within the state can be raised. The program for the raising of these standards includes the conquest of malaria and hookworms over much of the state and especially in the valuable cotton land below the 1,000 foot contour along the Rio Grande and Rio Paraná and their tributaries. Educational standards, housing standards, and wage standards also must rise to increase the demand for high-priced cotton goods. When these things are done the local markets for the province's textile products and other by-products of cotton will expand.

National markets include the sales of finished textiles, yarn, raw cotton, and cotton by-products within the states of Rio Grande do Sul, Rio de Janeiro, Pernambuco, Paraná, the Federal District, Minas Gerais, and Baiá. To expand the sale of high-class cotton textiles within these markets, it is also necessary to raise health, housing, and wage standards even more than would be necessary in São Paulo where living standards are

higher than in all other states except the Federal District and Rio de Janeiro. Markets for raw cotton in the Federal District and Rio de Janeiro will increase with the further industrialization of these areas.

International markets include the United Kingdom, Argentina, Paraguay, Uruguay, Sweden, France, Spain, Pakestan, North Africa, Canada, and many other less important customers. These markets are likely to continue to improve in the future because of the excellence of both textiles and raw materials shipped from São Paulo to them. As long as the state's cotton and cotton textiles continue to improve, Brazil's market for cotton and cotton textiles will continue to expand and to compete with products from the United States, India, and Egypt, unless production costs in these areas can be decreased.

Brazil, because of the good physical, climatic, and soil conditions for cotton production in São Paulo, is in the world market to stay. Her people have learned to grow cotton and have invested too much money and time in equipment, land, and buildings to stop producing now.

Although cotton growing depletes the soil, São Paulo alone has large amounts of unused cotton soil which can be planted to replace worn out areas. Apparently the only social problem which has developed because of cotton production with the state is the problem of tenancy which is being attacked by allotting new lands to former tenants on low-rate-long-term payment plans.

The possibility of cotton being replaced by some other crop apparently will not occur within the forseeable future. As long as prices for the crop are high and the demand is great, São Paulo's prosperity based upon cotton and coffee will continue in spite of world competition.

APPENDIX

APPENDIX A

MEAN MONTHLY TEMPERATURES (°F. and °C.)[1]

Station	Alt. Feet		Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.
Apiaí	3.050	°C.	15.6	16.6	18.6	20.0	20.6	20.6	19.7	18.1	15.4	14.3	13.8	14.9
		°F.	60.1	61.7	65.5	68.0	69.1	69.1	67.5	64.6	59.7	57.7	56.8	58.2
Barretos	1738.4	°C.	21.9	23.1	23.8	23.5	24.1	23.8	23.7	22.0	19.4	18.0	18.3	19.1
		°F.	71.4	73.6	74.8	74.3	75.4	74.8	74.7	71.6	66.9	64.4	64.9	66.4
Campinas	2197.6	°C.	19.0	20.3	22.0	22.3	22.6	22.6	22.3	20.6	18.1	16.5	16.3	17.5
		°F.	66.2	68.5	71.6	71.9	72.7	72.7	72.1	69.1	64.6	61.7	61.3	63.5
Cunha	2,525	°C.	16.6	17.4	18.5	19.2	19.8	20.2	19.5	18.1	15.7	14.6	14.4	15.6
		°F.	61.9	63.3	65.3	66.6	67.8	68.4	67.1	67.4	60.3	58.3	57.9	60.1
Itanhaem	16.4	°C.	18.9	20.4	22.0	23.8	25.0	25.0	24.4	22.3	19.9	18.7	17.9	18.1
		°F.	66.0	68.7	71.6	74.8	77.0	77.0	75.9	72.1	67.4	65.7	64.2	64.6
Itapetininga	2.132	°C.	17.2	19.2	20.8	22.1	22.3	22.1	21.6	19.7	17.0	15.2	15.0	15.9
		°F.	63.0	66.6	69.4	71.8	71.9	71.8	70.9	67.5	63.0	59.4	59.0	60.6
Itararé	2.378	°C.	16.9	18.8	20.3	21.4	21.8	21.7	20.8	19.5	16.4	15.1	14.9	16.0
		°F.	62.4	65.8	68.5	70.5	71.2	71.1	69.4	67.1	61.5	59.2	58.8	60.8
Rio Preto	1.574.4	°C.	21.5	22.6	23.9	24.4	25.0	24.8	23.8	22.5	19.9	18.7	17.5	18.4
		°F.	68.7	72.7	75.0	75.9	77.0	76.6	74.8	72.5	67.8	65.7	63.5	65.1
São José dos Campos	1.869	°C.	18.5	19.7	20.6	22.0	22.6	22.8	22.3	20.8	18.0	16.7	15.6	17.0
		°F.	65.3	67.5	69.1	71.6	72.7	73.0	72.1	69.4	64.4	62.1	60.1	63.0
São Paulo	2.460	°C.	16.9	18.0	19.4	20.8	21.3	21.5	20.7	18.6	16.5	15.0	14.7	15.8
		°F.	62.4	64.4	66.9	69.4	70.3	70.7	69.3	65.5	61.7	59.0	58.5	60.4
Sorocaba	1,804	°C.	19.3	21.0	22.2	23.0	23.4	23.6	23.2	21.4	18.5	17.1	16.6	17.3
		°F.	66.7	70.0	72.0	73.0	74.1	74.5	73.8	70.5	65.3	62.8	61.9	63.1

(1) José Setzer, Contribuição para o Estudo do Clima do Estado de São Paulo, pp. 9, 11, 43, 73, 112, 113, 149, 172, and 201.

APPENDIX B

MEAN SEASONAL AND YEARLY TEMPERATURES[1]

Station	Alt. Feet		Spring	Summer	Fall	Winter	Year	Period of Observation
Apiaí	3,050	°C.	16.9	20.4	17.7	14.3	17.3	1902-1923
		°F.	62.4	68.7	63.9	57.7	63.2	
Barretos	1738.4	°C.	22.9	23.8	21.7	18.5	21.7	1912-1923
		°F.	73.2	74.8	71.1	65.3	71.1	
Campinas	2197.6	°C.	20.4	22.5	20.3	16.7	20.0	1889-1943
		°F.	68.7	72.5	68.5	62.1	68.0	
Cunha	2,525	°C.	17.5	19.7	17.8	14.7	17.4	1894-1923, 1926-1929
		°F.	63.5	67.5	64.0	54.5	63.3	1931-1941
Itanhaem	16.4	°C.	20.4	24.6	22.2	18.2	21.4	1926-1938
		°F.	68.7	76.3	72.0	64.6	70.5	
Itapetininga	2,132	°C.	19.1	22.2	19.4	15.4	19.0	1927-1941
		°F.	66.4	72.0	66.9	59.7	66.2	
Itararé	2,378	°C.	18.7	21.6	18.9	15.3	18.7	1909-1924, 1926-1931
		°F.	65.7	70.9	66.0	59.5	65.6	
Rio Preto	1,574	°C.	22.7	24.7	22.1	17.9	21.9	1911-1919
		°F.	73.1	76.5	71.8	64.2	71.4	
São José dos Campos	1,869	°C.	19.6	22.5	20.4	16.4	19.7	1914-1923, 1926-1927,
		°F.	67.3	72.5	68.7	61.5	67.5	1940-1941.
São Paulo	2,460	°C.	18.1	21.2	18.6	15.2	18.3	1887-1922,
		°F.	64.6	70.2	65.5	59.4	64.9	
Sorocaba	1,804	°C.	20.8	23.3	21.0	17.0	20.5	1917-1923, 1927-1937
		°F.	69.4	73.9	70.0	63.0	69.0	1940-1941

[1] José Setzer, Contribuição para o Estudo do Clima do Estado de São Paulo, pp. 9, 11, 43, 73, 112, 113, 149, 172, and 201.

APPENDIX C

MEAN MONTHLY RAINFALL (INCHES AND MILLIMETERS)[1]

Station	Alt. Feet		Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.
Apiai	3,050	In.	3.7	4.4	5.4	6.4	7.4	6.9	4.8	2.3	3.3	3.1	2.2	2.3
		MM.	93	113	138	164	188	174	123	60	84	80	58	60
Barretos	1738.4	In.	1.9	3.3	6.3	9.0	9.0	7.6	6.1	3.9	1.5	1.1	.7	.8
		Mm.	47	85	160	228	228	192	156	100	39	29	17	21
Campinas	2,197.6	In.	3.0	4.9	6.2	9.3	9.7	8.2	5.1	2.4	2.2	1.9	1.1	1.5
		Mm.	77	124	158	236	247	208	151	62	55	49	28	38
Cunha	2,525	In.	2.8	4.8	5.1	6.6	9.1	7.5	6.7	2.4	1.5	1.9	1.1	1.3
		Mm.	70	121	129	167	231	191	171	61	39	48	27	33
Itanhaem	16.4	In.	5.8	6.0	5.7	7.5	8.6	9.4	8.5	6.4	5.2	4.6	3.7	4.2
		Mm.	148	152	145	190	218	239	216	162	131	118	95	107
Itapetininga	2132	In.	3.4	4.1	4.6	8.4	8.6	7.1	3.6	2.4	1.8	1.9	1.3	1.5
		Mm.	86	105	118	213	219	180	91	62	45	48	32	39
Itarare	2,378	In.	3.1	3.5	5.0	6.9	7.5	5.8	3.9	2.1	2.6	2.9	1.9	2.3
		Mm.	78	90	127	175	191	147	99	54	67	74	45	59
Rio Preto	1,5784.4	In.	1.7	4.3	6.1	8.2	8.7	8.5	5.1	2.5	1.1	.7	.3	.9
		Mm.	42	108	156	208	220	216	129	63	28	18	7	22
Sao Jose dos Campos	1,869	In.	2.0	3.9	4.6	6.8	7.9	7.5	5.3	2.5	1.2	1.4	.6	.9
		Mm.	50	93	118	173	201	191	135	63	30	36	16	22
Sao Paulo	2,460	In.	3.1	4.2	5.2	6.8	8.2	7.6	5.6	2.5	2.6	2.4	1.2	2.0
		Mm.	78	106	132	172	208	192	143	63	67	62	30	51
Sorocaba	1,804	In.	2.8	3.6	4.2	6.5	7.9	5.5	3.5	1.9	1.6	1.9	1.1	1.7
		Mm.	70	92	106	164	200	140	88	48	41	47	29	42

[1] José Setzer, Contribuição para o Estudo do Clima do Estado de São Paulo, pp. 9, 11, 43, 73, 112, 113, 149, 172, and 201.

APPENDIX D

MEAN SEASONAL AND YEARLY RAINFALL[1]

Station	Alt. Feet		Spring	Summer	Fall	Winter	Year	Period of Observation
Apiaí	3,050	In.	13.5	20.7	10.4	7.6	52.2	1902-1924, 1941-1944
		Mm.	344	526	267	198	1335	
Barretos	1738.4	In.	11.5	25.6	11.5	2.6	51.2	1912-1924, 1926, 1935-1943.
		Mm.	292	648	295	67	1302	
Campinas	2197.6	In.	14.1	27.2	10.7	4.5	56.5	1889-1943
		Mm.	359	691	268	115	1433	
Cunha	2,525	In.	12.7	24.0	10.6	4.3	51.6	1893-1931, 1940-1943
		Mm.	320	589	271	108	1288	
Itanhaem	16.4	In.	17.5	25.5	20.1	12.5	75.6	1909-1924, 1926-1943
		Mm.	445	647	509	320	1921	
Itapetininga	2,132	In.	12.1	24.1	7.8	4.7	48.7	1924, 1926-1931, 1933-1944
		Mm.	309	612	198	119	1238	
Itararé	2,378	In.	11.6	20.2	8.6	7.1	47.5	1909-1924, 1926-1931, 1940-1944.
		Mm.	295	513	220	178	1206	
Rio Preto	1,574	In.	12.1	25.4	8.7	1.9	48.1	1911-1919, 1938-1941, 1943-1944.
		Mm.	306	654	220	47	1227	
São José dos Campos	1,869	In.	10.5	22.2	9.0	2.9	44.6	1914-1924, 1939-1945
		Mm.	266	565	228	74	1133	
São Paulo	2,460	In.	12.5	22.6	10.7	5.6	41.4	1889-1923
		Mm.	316	572	273	143	1304	
Sorocaba	1,804	In.	10.6	19.9	7.0	4.7	42.2	1917-1924, 1926-1935 1937-1944.
		Mm.	268	504	177	118	1067	

(1) José Setzer, Contribuição para o Estudo do Clima do Estado de São Paulo, pp. 9, 11, 43, 73, 112, 113, 149, 172, and 201.

APPENDIX B

Rainfall of Marilia Based on Data from 1939-1945[1]

Month	Millimeters	Inches
September	62	2.4
October	96	3.8
November	215	8.5
Spring	373	14.7
December	198	7.8
January	188	7.4
February	172	6.8
Summer	558	22.0
March	109	4.3
April	49	1.9
May	47	1.9
Fall	205	8.1
June	71	2.8
July	35	1.4
August	7	.13
Winter	113	4.5
Year	1249	49.3

(1) José Setzer, Contribuição para o Estudo do Clima do Estado de São Paulo, p. 53.

APPENDIX F

The Average Normal Rainfall and Temperature of Santos[1]

Months	Temperature[2]		Rainfall[3]	
	°C.	°F.	Millimeters	Inches
September	19.6	67.3	140	5.5
October	20.7	69.3	165	6.5
November	22.8	73.0	190	7.4
Spring	21.0	69.8	495	19.4
December	24.4	75.8	196	7.7
January	25.0	77.0	268	10.6
February	25.2	77.4	269	10.6
Summer	24.9	76.8	733	28.9
March	24.7	76.5	298	11.7
April	22.9	73.2	197	7.7
May	20.8	69.4	152	6.0
Fall	22.8	73.0	647	25.4
June	19.3	66.7	146	5.7
July	18.6	65.5	103	4.1
August	18.8	65.8	108	4.3
Winter	18.9	66.0	357	4.1
Year	21.9	71.4	2232	87.8

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(1) José Setzer, Contribuição para o Estudo do Clima do Estado de São Paulo, p. 201.

(2) Temperature averages are for the period 1888-1941.

(3) Rainfall averages are for the period 1888-1945.

TABLE G

Maximum and Minimum Temperature Averages for Santos[1]

Months	Maximum Temperatures[2]		Minimum Temperatures[2]	
	°C.	°F.	°C.	°F.
September	23.8	74.8	16.9	62.4
October	24.5	76.1	17.8	64.0
November	26.7	80.1	19.2	66.6
Spring	25.0	77.0	18.0	64.4
December	28.5	83.3	20.8	69.4
January	29.7	85.5	22.2	72.0
February	29.4	84.9	22.3	72.1
Summer	29.2	84.6	21.8	71.2
March	29.2	84.6	21.7	71.6
April	27.7	81.9	19.8	27.6
May	25.5	77.9	17.3	63.1
Fall	27.5	81.5	19.6	67.3
June	24.4	75.9	15.8	60.4
July	23.3	73.9	14.7	58.5
August	23.5	74.3	15.3	59.5
Winter	23.7	74.7	15.3	59.5
Year	26.4	79.5	18.6	65.5

(1) José Setzer, Contribuição para o Estudo do Clima do Estado de São Paulo, p. 127.

(2) Maximum and minimum temperatures are for the years 1910-1924, 1926-1935.

APPENDIX H

Annual Immigration to Brazil and to São Paulo from 1874 to 1939[1]

Year	To Brazil	To São Paulo	
	Number	Number	Per cent of Total
1874	19,942	120	.6
1875	11,001	1,389	29.9
1876	30,567	1,303	4.3
1877	29,029	2,832	9.8
1878	22,432	1,678	7.5
1879	22,189	953	4.3
1880	29,729	613	2.1
1881	11,054	2,705	24.5
1882	27,197	2,743	10.1
1883	28,662	4,912	17.1
1884	24,890	4,868	20.0
1885	35,440	6,500	18.3
1886	33,486	9,534	28.5
1887	55,963	32,110	57.4
1888	133,253	91,826	68.1
1889	65,946	27,694	42.0
1890	107,474	38,291	35.6
1891	216,760	108,688	50.1
1892	86,203	42,061	48.8
1893	134,805	81,745	60.6
1894	60,984	48,947	80.3
1895	167,618	139,998	83.5
1896	158,132	99,010	62.6
1897	146,362	98,134	67.0
1898	78,109	46,939	60.1
1899	54,629	31,172	57.1
1900	40,300	22,802	56.6
1901	85,306	70,348	82.5
1902	52,204	37,831	72.5
1903	34,062	16,553	48.6
1904	46,164	23,761	51.5
1905	70,295	45,839	65.2
1906	73,672	46,214	62.7
1907	58,552	28,900	49.4
1908	94,695	37,278	39.4
1909	85,410	38,308	44.9
1910	88,564	39,486	44.6
1911	135,967	61,508	45.2
1912	108,182	98,640	54.7
1913	192,683	116,640	60.5
1914	82,572	46,624	56.5
1915	32,206	15,614	48.5
1916	34,003	17,011	50.0

APPENDIX H (continued)

Year	To Brazil	To São Paulo	
	Number	Number	Per cent of Total
1917	31,192	23,407	75.0
1918	20,501	11,447	55.8
1919	37,898	16,205	42.8
1920	71,027	32,028	45.1
1921	60,844	32,678	53.7
1922	66,967	31,281	46.7
1923	86,679	45,240	52.2
1924	98,125	56,085	57.2
1925	84,883	57,429	67.7
1926	121,569	76,796	63.2
1927	101,568	61,607	60.7
1928	82,061	40,847	49.8
1929	100,424	53,262	53.0
1930	74,420	30,924	41.6
1931	24,056	16,216	67.4
1932	34,683	17,420	50.2
1933	48,812	33,680	69.0
1934	50,368	30,757	61.1
1935	35,913	21,131	58.8
1936	(2)	14,854	(2)
1937	34,677	12,384	35.7
1938	19,388	(2)	(2)
1939	22,668	(2)	(2)

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(1) T. Lynn, Smith, Brazil: People and Institutions, p. 269.

(2) Data for these years were unavailable.

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