COTTON GROWING IN SOUTH AMERICA

By GEORGE McCUTCHEON McBRIDE

As the most largely used textile, the greatest staple of international trade, cotton has a prime geographical interest from the mere magnitude of its place in human affairs.[1] The peculiar features of its distribution add greatly to that interest. The cotton plant is of very ancient cultivation, but only during the last century has it attained its great relative importance. Although cotton in its natural state is widely distributed, commercial cotton is produced in restricted areas. Of the world's production three-fifths comes from the United States, nine-tenths of the remainder from China, India, Egypt, and Russia (Turkestan and Transcaucasia). But only the United States, India, and Egypt produce for export. The supply for the world's market is thus virtually an Anglo-American monopoly.

Concerning the distribution of cotton as a commercial crop two questions arise. How can the area devoted to cotton be increased to keep pace with the ever-increasing demand for cotton? How can the distribution be extended that the dangers of dependence on so restricted sources of supply may be avoided? Since the American Civil War the industrial countries of Europe have been concerned with these questions, more especially in recent years, as the activities of the British Cotton Growing Association (founded in 1902) and the similar organizations of France (1903) and Germany (1900) bear witness.[2]

Cotton, in the wild state, is a plant of the tropics and subtropics—of the warm regions with summer rains and a succeeding dry season. Under cultivation the range is extended, in particular under irrigation. At present cultivation is largely limited to the regions near the northerly climatic limit in North America and Asia. In the search for new fields Africa and South America, presenting the bulk of the land surface within the tropics and subtropics, naturally invite attention. Both continents offer hopes for the future extension of the cultivation. In Africa interest concentrates on the Sudan. The various railroad schemes for tapping the heretofore inaccessible resources of this naturally productive region point to extensive possibilities of cotton growing. The irrigable lands of the Niger bend, for instance, are compared with Egypt. Such expansion will be chiefly to the profit of France and Britain. In contrast South America offers possibilities in countries politically independent, a circumstance that has already awakened wide interest. Efforts to increase production here are

[1] See the article "Cotton and Human Affairs" by Mr. McBride in the March, 1920, number of the *Journal of Geography*.—EDIT. NOTE.

[2] Alfred Renouard: L'évolution cotonnière américane et ses conséquences pour l'Europe, *La Nature*, No. 2372, 1919, Sept. 13, pp. 170-174.

FIG. 1. (For sources, see bottom of opposite page.)

being made in earnest, and it seems opportune to present a study of the situation as it now appears.

Cotton is grown in every South American country, yet only two—Brazil and Peru—produce it on a commercial scale; and their output is almost negligible in the world's total. In 1915 Brazil produced 1.3 per cent of the world's supply of commercial cotton, Peru little more than one-third of this amount. Obviously this is not the limit of possibilities, which we now proceed to examine in detail.

Cotton in Peru: A Desert Crop

A particular geographical interest is attached to cotton production in Peru. Long before the arrival of the Spaniards, cotton was an important cultivation. It had given rise, in fact, to the highest expression of indigenous culture, the textile art, in which, as numerous specimens show, the ancient Peruvians excelled. Today this art has been lost; but cotton cultivation, long fallen into serious neglect, has lately had a notable revival.

In Peru, as in Egypt, cotton is a desert crop. The Andean highlands are too cold, the eastern slopes of the mountains in general too humid for the plant to thrive.[3] But in the third physiographic region of the country, that of the arid coastal belt, it finds its suitable sunny habitat.

To the traveler along the Pacific steamer routes the west coast appears an unbroken, brown desert, impossible of cultivation. On landing at some desolate little port whose corrugated iron structures seem but the temporary shelter of nomadic prospectors or engineers, it is with great surprise that he finds the wharves piled high with bales of cotton or bags of sugar and rice. The town itself is barren. The hills at the back are treeless. Water is peddled in the streets and sold by the pailful. A narrow-gage railway running up along a valley seems to lead only deeper into the desert. Following such a railway line for a few leagues from any port one comes into a flat-bottomed gorge where fields are green with growing crops. Clustered huts of workmen, hamlets of small tradesmen, even little cities, lie hidden in these oases, seldom, however, encroaching upon the irrigable soil of the valley floor but strung out along the sharply defined edge of the desert at the foot of the bordering slopes.

Irrigation is made possible here by the streams that flow from the Andes for at least a part of the year. Many of these streams never reach the sea. Other rivers—even intermittent brooks are indiscriminately styled

[3] Cotton is grown on the sheltered floors of some of the valleys of the *montaña*, but as regards commercial production they are impossibly remote.

SOURCES FOR THE MAP, FIG. 1—For Brazil, the state products maps published by the Secção de Geographia Agricola of the Sociedade Nacional de Agricultura, 1908; for Argentina, Estadística Agrícola, 1916-1917, Minist. de Agric., Buenos Aires, 1918, p. 22; Agricultural and Pastoral Census of Argentina in 1908, Buenos Aires, 1909, Vol. 2, pp. 435-436, Vol. 3, pp. 400-402; The Argentine Year Book, 1915-1916, Buenos Aires, pp. 232-234; for Peru, the references cited in footnotes 4 and 6; for the other countries, scattered information.

ríos in this parched land—empty into the ocean during a few months of the year. Very few are perennial. Irrigation can be carried on along narrow strips that border the channels, but only at certain seasons, though the soil is a deep alluvium and yields well where water is available. The near-by deposits of guano supply a cheap and abundant fertilizer. It is in such spots that the important cotton-producing areas of Peru are located.[4]

Varieties Grown

The native plant grown before the Spanish conquest is still widely cultivated. The fiber of this native species, of which two main subvarieties are cultivated, is rough and long and is highly prized for mixing with wool or for use in imitation woolen fabrics. Native Peruvian cotton is not planted anew each season but lives for several seasons, even attaining a life of twenty years. In the warmer valleys, where the plants reach the greatest age, stalks sometimes grow to be from 10 to 15 feet high. The best fiber comes from plants not more than four or five years old. Another native variety grows wild in some parts of the country but is not cultivated. Foreign cotton has also been introduced and forms more than 50 per cent of the present production. The so-called "Egyptian" cotton from the United States is the most popular. It grows more rapidly but does not live so long and cannot stand drought so well, hence it is cultivated chiefly in the valleys best supplied with water. The price it commands is not so high as that of the native fiber and is subject to greater fluctuations, but its yield per acre is considerably greater than that of the Peruvian plant.

Distribution

Eighteen of the Peruvian coast valleys produce cotton for export, but the following seven stand out above the others: Piura and Chira in the north; Chancay and Cañete in the department of Lima; Ica, Chincha, and Pisco in the department of Ica in the south. The principal factor that controls the time of planting, and consequently of picking, is neither the seasonal variation of temperature, which, in fact, is very slight, nor local rainfall—as we have remarked, entirely lacking in most of these valleys—but the arrival of water in the dry stream beds.

In the far north of Peru, in the valley of Piura, equatorial rains occasionally cross the sharply defined northern border of the desert. The inhabitants expect a wet season about every seven years. The rain then falls continuously for several days at a time. These years are the "good years," *años buenos,* for cotton then may be grown on land long unused. Plants put in the ground at that time yield several crops without further rain and without irrigation.[5] The exports at Paita, the chief port of this

[4] A detailed description of how the textile is grown may be found in the official Peruvian publication, *Boletín del Ministerio de Fomento*, Vol. 14, No. 1, pp. 25-94.

[5] A. F. Sears: The Coast Desert of Peru, *Bull. Amer. Geogr. Soc.*, Vol. 27, 1895, pp. 256-271.

region, are considerably increased during these "good years." Cotton raised thus is called *algodón de lluvia* (rain cotton) to distinguish it from that cultivated with irrigation.

In the usual dry years in the valley of Piura the ground must be ready for planting before water arrives in the river channels. The soil is well soaked then and the cotton planted. Water generally reaches the valley at Piura in January or February when the equatorial rains are falling in the interior and the mountain snows are melting fast. A limited amount of water is then available during some three months, after which none can be had until the following year. Picking time comes during June, July, and August. Newly planted fields yield their first crop after about eight months' growth. A second crop may be gathered shortly after Christmas, but growers usually find it more profitable not to endanger the plants by interrupting the process of irrigation at that time and so pick but once a year. Some cotton is being picked, however, during almost the entire year in valleys where the native plant is grown.

In the series of valleys near Lima, those of Chillón, Rímac, Chancay, Huacho, Pativilca, Santa, Lurín, Mala, Cañete, Chincha, and Pisco, Egyptian (upland) cotton is grown more largely than the native species. Of these valleys, Chincha is the most productive. Here the heat is modified by winds from the sea. The soil is deep. So porous is the sandy ground, however, that it is difficult to secure sufficient water for irrigation. Consequently after the soil has been well soaked in February and March the surface is pulverized to prevent escape of the precious liquid. Planting then comes in May or June, and the crop is picked about the first of the following May. In the upper part of the valley, where water arrives earlier, planting at times is done in October. Even if planting is done during December and January a good crop may be harvested in July and August.

Pisco valley is more fortunate in having a permanent water supply. Beginning with October there is an abundance throughout the entire summer. There is even enough in this river to allow some to be "lost in the ocean." Here planting takes place in October or November, considered by all the most favorable season, since the plants become large enough by February to shade the ground from the extreme heat of that month. Egyptian cotton is here the favorite variety. The stalks, cut close to the ground after each crop, bear for four or five years before dying. The native plant is not cut but continues to bear on the same stalk for several seasons.

In the valley of Ica, farther south, where water is extremely scarce, native cotton is grown almost exclusively. At times several years pass without enough water for irrigation in the lower valley, and one watering a year is sufficient for a good crop. The soil is sandy, the water sinks deep into the ground, and many schemes are resorted to in order to secure the underground supply.

FIG. 2

FIG. 3

FIG. 2—A typical cotton field in Minas Geraes, Brazil. The depressions between hills or mountains, the lower part of mountain sides, and the land along the banks of small rivers are the places most frequently utilized. (Courtesy of Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce.)

FIG. 3—Picking cotton at the Piracicaba Agricultural School, São Paulo, Brazil. (Courtesy of the Pan American Union.)

FIG. 4

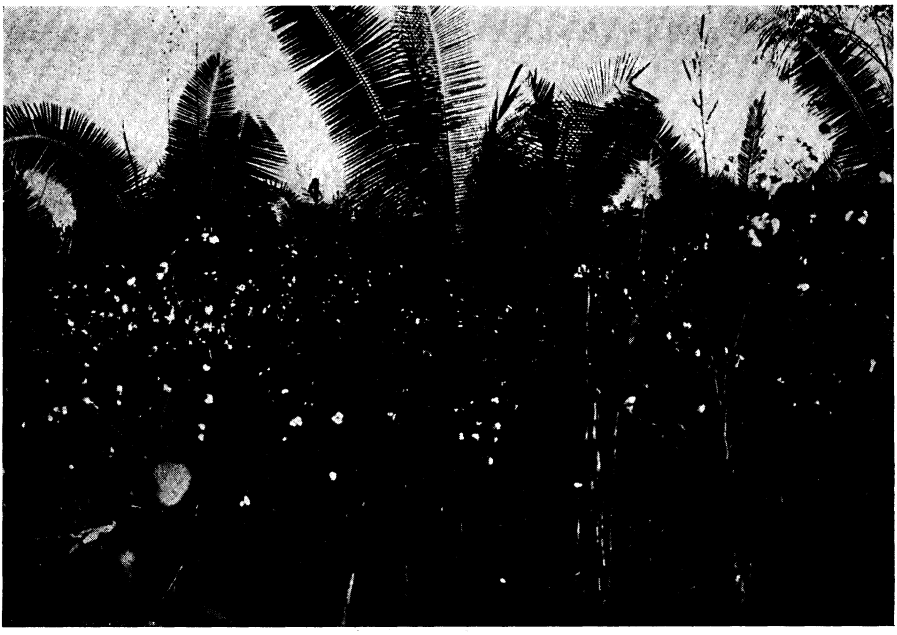

FIG. 5

FIG. 4—Cotton trees at São Joaquim (Santa Catharina?), thirty-five years old and still producing. They were cut back every other year.

FIG. 5—A cotton farm near Coroatá on the Rio Itapicurú, Maranhão, Brazil, showing the appearance of a field in October. The condition seen explains, in part, the reason for poor grades in Maranhão cotton. (Figs. 4 and 5 courtesy of Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce.)

Production and Destination of Peruvian Cotton

While the greater portion of the Peruvian cotton is shipped to England and the United States, there are several textile factories in the country that handle a part of the crop. Most of these mills are located at or near Lima. They produce the coarser fabrics in demand at the local markets. A quite modern mill, partly operated by electricity, has been opened recently in Arequipa, and here some of the cotton from the southern valleys is made into cloth, largely for the homely needs of the Bolivian and Peruvian highland populations. The cotton produced in Peru is usually ginned near where it is grown, and, because of the scarcity of wood and coal, cottonseed is used for fuel in the gin engines.

Labor

Labor is an old problem in the Peruvian coast valleys. In colonial days it was solved in part by the importation of negroes. When the negro slaves were freed in the middle of the last century dependence was placed on Chinese laborers, and many coolies were introduced. Later Chinese immigration was stopped, and its place has not been filled, though a number of Japanese have entered the country. As most of the colonizable land of the coast valleys pertains to large estates there is little hope of attracting European labor, and chief dependence must still be placed on the Indian population. Peons are attached to most of the large estates. The peons, who are virtually serfs, are not free to hire out on other farms. As no estate can support a very large number of peons there is frequently a scarcity of labor at the short season during which irrigation is possible. There are few towns or cities or even densely populated rural districts from which labor can be recruited. In places a transfer of workmen between upland vineyard and coastal cotton lands has been possible. When, as often happens, the vintage season coincides with the arrival of the water in the late summer, a double shortage of labor is experienced. Indians from the high sierras descend to some of the valleys for the planting or picking season, returning immediately thereafter to their cool mountain homes. Some landowners have been forced to adopt a plan of renting on shares, either to their own peons or to free laborers whom such offers would attract. This, however, is not so profitable to the landlord as the favorite Latin-American peon system inherited from colonial times.

Transportation

In the isolated Peruvian valleys the problem of reaching a market is often a vexing one. Miles of desert separate centers of production from the towns. The lower parts of the valleys are in some cases absolutely barren, affording no sites suitable for the location of settlements. Railroads, however, have now tapped all of the principal valleys, and tiny ports line

the Peruvian coast to handle the produce of the valley oases. Human carriers, mules, and donkeys move the cotton in small bales to railway points. Cheaply constructed coastwise steamers (*caleteras*) touch at the various ports, collecting produce and carrying it to the more important points where ocean liners load it for export.

Official estimates place the cotton yield of the entire republic for the 1915-1916 season at 27,600 metric tons.[6] This is not an impressive amount—it leaves Peru tenth among the cotton-growing countries of the world[7]—but it shows good and hopeful progress.

Possibilities of Increased Production

At present there are about 140,000 acres planted in cotton. This amount is being increased steadily and is capable of a still greater extension. The districts of Chira and Pisco offer the greatest possibilities, since they are well supplied with water. Besides the valley floors, to which the present cultivation is almost entirely limited, there are considerable areas of interfluvial grounds that will produce when water is brought to them. Foreign capital is needed for this enterprise. Given modern systems of irrigation and some solution of the labor problem, perhaps by increased use of mechanical aids, this desert coast of Peru, with its ideal climatic conditions, should easily multiply its yield many times and contribute an appreciable part of the world's cotton, though it offers no such possibilities as do the extensive uplands of Brazil or the plains of northern Argentina.

Brazil

Cotton was used in Brazil before the arrival of the Portuguese (1500), though it was not under cultivation, as in Peru. The Indians employed its fiber to make cords for their bows, to weave sleeping nets (*hamacas*), and even to make the scanty clothing which the climate required. During colonial times the Portuguese developed the industry, cultivating cotton and establishing textile factories. In the absence of coin, cotton thread and cloth were circulated as money in some parts of the colony. As negro slavery became more general the cultivation of cotton grew, and, by the end of the eighteenth century, Brazil ranked as one of the foremost cotton-producing countries of the world. Maranhão, Pernambuco, Bahia, Rio de Janeiro, and Pará all figured prominently among the ports from which the raw material was shipped. Brazilian cotton, at this period, formed about 8 per cent of the amount used in English mills and supplied the principal stock of the finer qualities. So profitable was the production that cotton was transported from far inland on the backs of mules, the journey

[6] C. R. Paz: Estadística de la industria algodonera en el Perú, año 1915-1916, abstracted in the *West Coast Leader*, May 5, 1917, Lima.

[7] Cotton Production and Distribution, Season of 1915-16, *U. S. Bur. of the Census Bull. 134*, Washington, D. C., 1916.

sometimes requiring several months. The invention of the gin in 1793 made North American competition too keen for less progressive Brazil, and her proportion of the world's trade gradually diminished, though the production for home consumption continued to be considerable. When the Southern ports were blockaded during the Civil War, Brazil again came to the front as a source of supply for European mills, but the boom was short-lived. Since that time Brazilian cotton has been consumed largely by local factories. Little of it enters European trade, though probably more is raised now than at any previous time in the history of the country.

Distribution

The cotton plant grows wild or cultivated over the entire republic. Branner reported in 1885 that he had seen it growing in nearly every province and cites authorities to show that it is raised, at least on a small scale, from the Araguary in Brazilian Guiana to Porto Alegre in Rio Grande do Sul, along the Amazon, the Tapajoz, the Madeira, the Rio Negro, in the Matto Grosso region, and along the upper waters of the Paraguay.[8] Production for commercial purposes, however, is limited almost entirely to the states along the northeastern coast, a small district west of the city of São Paulo, and a few localities among the hills of Minas Geraes. In the northeastern angle of Brazil the coastal plain, though often very narrow, at places attains a width of 100 miles or more. The cultivated areas of this strip, as also of the lowest river valleys, are devoted chiefly to the production of sugar. They are too moist for cotton culture.

Back of this coastal belt, at a distance which varies from 30 to 200 miles, the land rises to a height of several hundred feet. A greatly broken surface, some 500 feet or more in elevation, interrupted in places by higher remnants of ancient mountain ranges, extends far inland toward the low basin of the Amazon and Paraguay river systems. This upland is known by various names in Brazil, according to the amount and character of its vegetation. The plateau consists for the most part of open woodland in the better-watered sections, great areas of bush country, and vast stretches of prairie. Few dense forests are found. Over the entire high interior there are marked rainy and dry seasons, most of the precipitation taking place in the summer months, while the winter is clear and dry. During the dry winters trees lose their leaves and grass dries up except in the more favored regions; but there is little change of temperature from month to month.

It is on the seaward margin of the plateau that both coffee and cotton have been extensively cultivated. Coffee production has centered in the states of São Paulo, Rio de Janeiro, and the southern part of Minas Geraes. Cotton growing is distributed chiefly on the highlands that border the

[8] J. C. Branner: Cotton in the Empire of Brazil, *U. S. Dept. of Agric. (Miscellaneous) Special Report No. 8*, Washington, D. C., 1885.

coastal belt farther north in the states of Bahia, Sergipe, Alagoas, Pernambuco, Parahyba, Rio Grande do Norte, Piauhy, Ceará, and Maranhão. It is seldom found below the 500-foot contour, or above the 2,000-foot line.

While the coastal belt, with the exception of that part lying between latitude 3° and 5° S., has abundant rain (40 to 60 inches), the interior, where the bulk of the cotton is grown, falls within the climatic division of the semi-arid northeast. Here large areas have a rainful averaging 15 inches or less, marked furthermore by irregularity from year to year. The droughts of Ceará are notorious for the wholesale depopulation occasioned through famine and migration. The drought of 1877-1879 was the most disastrous, as it came after years of prosperity during which the acreage devoted to cotton was greatly increased. In the region liable to drought a sure basis for increased cultivation must depend on irrigation by storage, work which is now under progress. Droughts apart, the climate is excellently suited for cotton cultivation.

The landward limit of the cotton belt of northeastern Brazil is fixed more by accessibility to markets than by climate, since general meteorological conditions vary but little over the Brazilian plateau.[9] In the São Paulo region, where coffee and cotton enter into competition, meteorological factors are influential. The frosts of the winter of 1918, for instance, worked serious havoc in the coffee plantations. To replace their loss planters have been tempted to turn to cotton as a crop yielding a quick return.

The character of the soil is also a factor determining the division of the cultivated areas on the higher lands between coffee and cotton. In the coffee district the soil is a dark red diabase, rich in iron, and when rains set in everything becomes covered with sticky red earth. The soil is said to be peculiarly suited to coffee production. On the other hand, cotton is generally grown on the soils formed from the great sandstone and limestone deposits which characterize a large part of the northeastern uplands and the valley of the São Francisco.

Methods of Cultivation and Varieties Grown

Modern methods of cultivation are practically unknown over most of Brazil. Cotton is grown chiefly on small farms and in about the same manner as it was two hundred years ago. The timber or bush is cut and allowed to lie until thoroughly dried; then it is burned, and the cotton is planted among the stumps and charred logs, with almost no effort to break the ground. Planting takes place when the first rains come and hence varies from December to April or May, being earliest in the north and on the higher grounds. The crop is picked as it matures. Picking sometimes extends throughout the dry season. This circumstance has given

[9] The best descriptions of the climate of Brazil are contained in C. M. D. de Carvalho's "Climatologie du Brésil," London, 1916, and in his "Météorologie du Brésil," London, 1917 (reviewed in *Geogr. Rev.*, Vol. 4, 1917, p. 411).

the impression that there is more than one crop a year; but Branner, after investigation, asserts that such is not the case in any part of the country.[10]

As in other South American countries the tree cotton, mostly indigenous, is cultivated extensively, especially upon the drier regions of the uplands. This hardy plant grows for many years, though it seldom yields well for more than two or three. Its fiber is long and silky. The annual herbaceous varieties require more moisture and more careful cultivation but produce a larger quantity of fiber. Sea Island plants have also been introduced with good results in a few regions where the water supply is more abundant. The *arboreo* is of slow growth, bearing a crop only after from nine to twelve months, while the *herbaceo* requires but six to mature.

Production

Export figures fail to reveal the production of cotton in Brazil because, as in China, the fiber grown has been consumed almost entirely within the country. An extremely high import duty, 7.27 cents per pound, has tended to keep out foreign raw material and has fostered home manufacture. There are now over two hundred mills manufacturing cloth. A decided stimulus to this industry has been felt since the beginning of the war, scarcity of British manufactured textiles having forced Brazil to depend more upon her own output. It is only within recent time that the by-products have been considered, but cottonseed is now being utilized by presses in São Paulo to such an extent that the importation of cottonseed oil has almost entirely ceased.

Efforts to Encourage Production

In recent years the cultivation of cotton has been encouraged through the official Servicio do Algodão (now under the direction of an American expert). Great efforts are being made not only to render Brazil independent of foreign raw material but, by stimulating the textile industry, to place the country among the world's large exporters of cotton and cotton goods.[11] During the months of May and June, 1918, an exposition of Brazilian textile industries was held in Buenos Aires for the purpose of extending the output of the country's factories in the important markets of that city. As a result of these efforts reports for 1917-1918 show an increased cultivation of cotton in Brazil, and her production was estimated to be about 400,000 bales.[12] A setback to production is the boll weevil, which in late years has become a very serious menace to the Brazilian crop. In 1918 the estimated damage amounted to over $27,000,000. Alagoas and Ceará suffered most heavily, losing two-thirds of the cotton planted. State

[10] *Op. cit.*, p. 32.

[11] *Commerce Repts.*, June 19, 1918, pp. 1078-1080.

[12] Cotton Growing in Latin America, *U. S. Dept. of Commerce, Latin-American Division, Circular No. 34*, Washington, D. C., 1918, and *Commerce Repts.*, June 22, 1918, p. 1127.

and federal governments, however, are taking precautionary measures to check this pest, and, in spite of such losses, larger areas were under cultivation in 1918 than ever before.[13]

Possibilities

In considering the future of cotton in Brazil those who have studied the situation have used extravagant terms. Branner says: "The territory in Brazil capable of yielding cotton is coextensive with the empire itself." An experienced American expert, after studying the cotton situation there recently reported that "Brazil is a natural cotton country and possesses an ideal climate for this crop. . . . . The continued supremacy of the United States in the production of cotton depends wholly upon the continued dormancy of Brazilian agriculture."[14] Others have described Brazil as "potentially the greatest cotton-producing country on earth."[15] As far as climate and soil conditions are concerned production has far from reached its limits. The whole northern section of the plateau varies little in temperature from month to month and, in most sections, receives sufficient moisture during some part of the year to insure a fairly abundant growth of cotton, while the long mild winters, with months of sunshine, few frosts, and no storms, afford favorable maturing and picking seasons. Parts of the lower Amazon basin will probably be found suitable also.

Labor and transportation are the factors that limit the possibilities of largely increased production in the near future. The plateau region is very poorly supplied with navigable streams. Such rivers as the São Francisco and the upper Paraná, while navigable in long stretches of their courses, are impeded by rapids or falls where they descend from the plateau. A gradual extension of railways into the interior will ultimately provide transportation facilities.

As for labor, even the present demands cannot be supplied. Neither the far-reaching raids carried on by the early Paulistas in quest of Indian slaves, nor the importation of large numbers of Africans in colonial times, nor the phenomenal immigration of years immediately preceding the war have provided sufficient workmen for the increasing demands, even of the coffee crop. Owners of *fazendas* (plantations) find it difficult to secure permanent colonists. Each season witnesses a movement of workmen with their families from one farm to another in search of better living conditions. The establishment of factories, too, has attracted many laborers to the cities, and migration from country to town is taking place in Brazil, as everywhere else, to a remarkable extent. But with increase of population and improved means of transportation it seems probable that Brazil will become one of the very important sources from which raw cotton will be exported to the world's markets.

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[13] *Commerce Repts.*, April 4, 1918, p. 49.

[14] *Daily Consular and Trade Repts.*, Sept. 12, 1914, pp. 1391-1392.

[15] *U. S. Dept. of Commerce, Latin-American Division, Circular No. 34*, p. 3.

Argentina, Paraguay, and Lowland Bolivia, Regions Adapted to Cotton Growing

Though as yet scarcely figuring in the world's markets, northern Argentina, with the adjoining parts of Paraguay and Bolivia, has long been looked upon as offering one of the largest available areas for cotton culture. Except in the highlands of the northwest, the climate is sufficiently mild, the temperature is constantly moderate, and the rainfall, which nowhere exceeds 40 inches, occurs mostly in the spring and summer months, the winter season being dry. In this section are situated extensive sugar-cane estates, where rainfall is sufficient, or where, as about Tucumán, irrigation is possible.

So promising were these regions considered for cotton production that in the great shortage of our Civil War an effort was made by British interests to encourage cultivation there. A measure of success was met with in many places, even with the handicap of great distance from market.[16]

In 1906 the Argentine Ministry of Agriculture sent an expert to study the provinces of the north with a view to establishing so-called "cotton colonies" there. The report submitted[17] found that most of the low plains in that section of the country and the valleys not higher than 1,000 meters are suitable, in climate and soil, for cotton cultivation. Plants were found growing wild in many places, and cotton growing on a small scale was common. Little progress, however, was made in the establishment of cotton colonies. Until the stimulus of war-time prices production was practically limited to those colonies of the Chaco advantageously situated near Barranqueras, port on the Paraguay. But at present renewed efforts are meeting with greater success. Communities which had been producing textiles only for their domestic consumption have begun to extend the area under cultivation with the hopes of profiting by the high prices offered.[18] In 1916, according to the *Estadística Agrícola* (1916-1917), the area under cotton was 7,500 acres, almost all in the Chaco Territory. The following figures published by the Argentine Department of Agriculture show the area planted in cotton during the season 1918-1919 distributed according to provinces:[19]

Corrientes	927 acres
Chaco and Formosa	31,061 "
La Rioja, Jujuy, Misiones, etc	692 "
Total	32,680 acres

[16] See M. G. Mulhall: The Cotton Fields of Paraguay and Corrientes, Buenos Aires, 1864.

[17] J. B. Massé: Rapport sur la création de colonies cotonnières nationales, *République Argentine, Annales du Ministère de l'Agric., Sect. Écon., Commerc. et Indust.*, Vol. 1, No. 1, Buenos Aires, 1906.

[18] *Commerce Repts.*, March 11, 1918, p. 916.

[19] *Commerce Repts.*, April 22, 1919, p. 495.

Extension of Production

As regards climate and soil this section of northern Argentina, with the similar contiguous regions of Bolivia and Paraguay, offers an area suitable for cotton growing that far exceeds in extent the 30,000,000 acres of the cotton belt in the United States. But the problems of labor and transportation make extensive cotton growing not an immediate possibility. At present sugar is the chief cultivation, and for the sugar estates much of the labor is furnished by Indians from the Chaco of Argentina and Bolivia. This would probably never prove a satisfactory supply for the cotton fields. It is too uncertain and would be too hard to train. But Argentina's phenomenal immigration, if resumed when normal world conditions shall have been re-established, will gradually solve this problem. As for transportation, regular steamer traffic on the Paraguay River simplifies the problem in the east, and the usual South American tendency towards government-owned railroads, built not in response to production already established but rather as a means of developing promising regions, may be counted on ultimately to provide facilities for the interior districts.

Other South American Countries

In former years, when there were no great cotton countries, the Guianas furnished an important percentage of the world's production. In 1827, 16,000 bales were exported from British Guiana. Dutch Guiana at one time supplied the British mills with much of the finer quality used.[20] But the regions in which cotton cultivation is possible are very limited. The narrow coastal belt, in many places actually below the level of high tides, is too humid to favor cotton culture, though admirably suited to sugar and rice. The interior uplands, exposed to the northeast trades, receive on their Atlantic slope over 100 inches of rain distributed throughout the year. Farther inland are found extensive savanas, where, because of lighter rainfall, grasslands replace the forests of the Atlantic slope. But over all of these highlands there occur marked changes of temperature that make extensive cotton cultivation unlikely, even when settlements and railroads reach that most inaccessible region.

In Venezuela the district about Valencia is the chief center of cotton cultivation, which is still on a very small scale. The crop is consumed locally, the mills producing a coarse, inferior cloth. In the interior of the country, the great grasslands, the *llanos,* offer many thousands of square miles where cotton might possibly be grown, though the climatic conditions are not sufficiently known to warrant a positive conclusion. This region, too, possesses a scanty population, apparently less numerous now than one hundred years ago, and means of transportation are quite primi-

[20] J. A. Todd: The World's Cotton Crops, London, 1915, pp. 97, 204.

tive. It must be long before the *llanos* are anything more than a pastoral country.

Colombia's great eastern lowland territories offer similar conditions of climate, soil, and settlement. In her northern provinces, Bolívar, Atlántico, and Magdalena, she produces a small quantity of long staple cotton, some of which is exported while North American raw material is imported for use in her local mills. The lower basin of the Magdalena, to which cotton cultivation is principally limited today, is well suited in climate, soil, and location to become an important center of production.

In Ecuador, over a small area about Guayaquil and in the province of Manabi, some cotton is grown, but very little territory in this country will ever offer a field for its extensive cultivation.

The same may be said of Chile and Uruguay. Chile's northern provinces, where temperature conditions would be favorable, contain little arable soil and almost no water. Her southern sections lie beyond the latitude where cotton can become a staple product. Uruguay, like central and southern Argentina, is subject to sudden and extreme fluctuations of temperature.

Conclusion

The possibility of cotton growing over wide areas in South America has been demonstrated by the success already achieved. Commercial production on a large scale must necessarily depend upon the other factors mentioned as well as upon the suitability of climate and soil. But the problems of labor and transportation are capable of solution—are being solved at the present time in some of the most important sections. South American countries confidently expect that foreign capital will be available for the development of irrigation where that may be required. It would seem that this great, politically independent continent, lying almost entirely within the tropical and subtropical zones, in which cotton exists as an indigenous plant and in which it has been successfully grown in many places and for many centuries, offers a field that is well worth the attention of those who are interested in extending the production of this indispensable fiber. Though not an immediate possibility, it seems safe to predict that the great highlands of Brazil and the plains of northern Argentina, Paraguay, and eastern Bolivia, with the more limited coastal valleys of Peru, may eventually compete with the cotton belt of North America and vie with Egypt, India, and China in supplying the world with its most important item of international trade.