INTERNATIONAL BUREAU OF AMERICAN REPUBLICS
JOHN BARRETT, DIRECTOR
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RUBBER AND ITS RELATIVES

(Reprint of an article from the Monthly Bulletin of the International Bureau of American Republics, December, 1908)

WASHINGTON, D. C.
GOVERNMENT PRINTING OFFICE
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RUBBER AND ITS RELATIVES

RUBBER is one of the great essentials of modern industrial life. With iron or steel, with copper, and with glass it may be compared in the diversity of its use; it has the advantage over these, and may be compared in this latter respect to corn, wheat, and the necessary foods, in that it is capable of eternal reproduction if mankind will but apply to its cultivation his experience and scientific knowledge.

There is scarcely a device of daily commerce into which rubber does not enter as a necessity, and yet in the annual statistical publication of the Department of Commerce and Labor—Commerce and Navigation of the United States—the student will look in vain for the word "rubber," and not until he examines the word or the phrase "indiarubber," "India rubber," or "India-rubber" will he be able to see how vast and important is the subject before him. This conservatism—if the term may be here applied—is traceable throughout all the literature of all the libraries of the English-speaking world. The aboriginal native word describing the substance first discovered by the early Europeans was *cahuchu*, probably pronounced but surely corrupted into *caoutchouc*. This latter word has spread into the languages of Europe. In French it is the same word; in German the only modification is to substitute a *k* for the *c*, and in Russian nearly the same change takes place. To be sure the Spanish uses frequently the word *goma*, equivalent to our gum, and this is made more specific by adding the adjective *elastica*, and the Portuguese has the word *borracha*, but *caucho* is commercially well understood, as might be supposed from the first association with the source of supply. Rubber, or india rubber, however, is undoubtedly the term which will continue to be employed in English to distinguish this indispensable product of the Tropics.

Caoutchouc directly explains the descent of the gum and its adoption into the arts, but india rubber embraces not only this history but conceals one of the romances of the industries. Travelers—and it is said Columbus himself was one of them—noticed that the Indian inhabitants of America, thought then to be an unknown portion of the Indies, played ball with a curious substance grown in the primitive forests and prepared according to native ways. This substance was also made into shoes; it formed a protective coating for garments, and from it were made bottles which could be squeezed to-

gether so as to eject the liquid contents. This substance was called caucho in some parts of America and the gatherers were *caucheros;* in other parts the gatherers were called, because of the shape of their

A RUBBER TREE OF THE CASTILLOA SPECIES.

This tree, like its relatives, the fig, breadfruit, and the trumpet tree, has a general appearance and habit of growth which render it easy of recognition. The tree, with its rather smooth light-gray bark, has no striking peculiarities, but the slender, simple branches, with their large oval leaves, pendent in two rows, are similar to those of very few other trees. The Castilloa is native of Mexico and Central America, and thus far it has been supposed that its climatic and cultural requirements were quite different from those of the Para rubber tree, but it now appears that these differences have been greatly overestimated.

bottles and the uses to which the Portuguese saw them put, *seringueiros*, syringe men. From this origin the *india* prefix of the word

is derived. At first the gum, *goma elastica*, according to the Spanish, was merely a curiosity: it was imported into Europe and studied chemically with great interest: it was made into tubes and put to practical use in the laboratory. But in 1770 the English chemist PRIESTLEY recommended the use of the gum for effacing the marks of the lead pencil. It rubbed out these marks and was therefore a rubber. It became more widely known as experiment showed its value, and in 1823 MACINTOSH discovered the method of waterproof-

A RUBBER GATHERER IN TROPICAL MEXICO.

The "Ulero," or rubber gatherer, is provided with a sharp wedge-pointed ax for tapping the tree, and gourds for conveying the milk to be coagulated. He is generally assigned a given territory. A good collector will gather from 15 to 20 pounds of rubber per day.

ing garments, and added another word to the vocabulary. From this date india rubber was more and more an article of commerce; it served many purposes, but it also balked the inventors in many directions in which they had hoped it might be applied. Experiments were constantly being made; even the incorporation of sulphur had been tried, but it was not until 1839 that NELSON GOODYEAR, in the United States, hit upon a practical method of combining rubber with

sulphur so as to retain all its good, unique properties, while losing those that had made it hitherto unsuitable. This process was called vulcanization.

Rubber—india rubber—is a definite chemical combination of carbon and hydrogen, expressed by the (proportionate) formula $C_5 H_8$, or $C_{10}H_{16}$. It is a whitish solid, opaque, scarcely reacted upon by the ordinary solvents, but forming fluid or gelatinous masses with the ethers and the coal-tar oils. All this refers, of course, to the chemically pure rubber. It will also melt and burn. Physically, rubber will stretch, and when tension is released its mass returns to the original position and form. Unfortunately, however, rubber in the pure state has three awkward qualities: It loses this distensibility at cer-

RUBBER BOOTS—THE PRINCIPAL BUT BY NO MEANS THE ONLY SOURCE OF "RECLAIMED RUBBER."

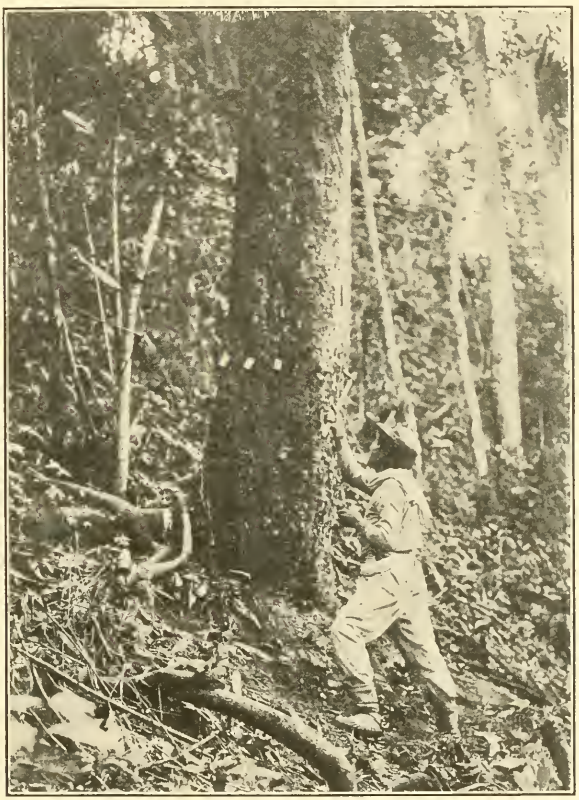
NOTE.—Russia is not included in Europe, because it is attempted to show how great is the amount of rubber (from boots and shoes) reclaimed in Russia alone, as contrasted with the remaining portion of Europe. The cut illustrates the amount of old rubber shoes now held in various parts of the world, waiting to be turned into "reclaimed rubber."

tain degrees of heat and cold, it softens under heat, and has a great tendency to stick to itself or to other masses of rubber with which it is brought in contact. Now, these three qualities of rubber as refined after entering the market from the tropical forests are overcome when it is mixed with sulphur—that is, vulcanized. It can then be molded into various shapes and still remain distensible. The degrees of temperature between which it retains these good qualities are very much wider apart, so that climatic changes are less felt by the manufactured product, and consequently rubber articles of an infinitely more varied type can be turned out from the factories. Vulcanized rubber is therefore the substance really implied ordinarily by the word alone.

COPY OF THE ORIGINAL ENGRAVING OF THE CASTILLOA ELASTICA, SOMEWHAT REDUCED.

The rubber trees of Mexico received a botanical description and name in a paper read by Cervantes before the Royal Botanic Garden Association of the City of Mexico in 1794, and was printed on an engraved plate, a copy of which is in the Library of Congress, Washington. The tree was named Castilla in honor of Castilla, a Spanish botanist, who died in 1793, while engaged in the preparation of a work on the flora of Mexico.

It might be thought that rubber would grow old after being once used in a manufactured article. So it does, but, almost like the metals, it has a new life when restored to its earlier condition. Reclaimed rubber does not sell for as high a price as fresh rubber just imported, but it has a substantial value, and no discarded bit of rubber goods seems too old or worn-out for reclamation and repeated use in the arts. Up to a short time ago old rubber shoes seemed to be the only



A RUBBER GATHERER IN BOLIVIA.

The tapping of the tree marks the beginning of the rubber gatherer's work. He attaches a small cup to the tree, and with a wedge-shaped ax makes a gash in the bark, being careful not to penetrate the wood. This operation is repeated at intervals of about a foot in a line around the tree, until 5 or 6 cups have been placed, into which the milk flows slowly. The next day a row of incisions is made just below the first, and so on until the ground is reached. A good tree will yield to a height of 20 feet or more. An expert gatherer can tap a hundred trees per day, provided they are close together.

or principal source of supply for reclaimed rubber, but to-day, thanks to modern ingenuity in devising chemical processes by which separation is accomplished, rubber is extracted from belts, from hose, or from the scrap of the trade, devulcanized as far as possible, and returned to the manufacturer for further use, although in this state it is never so generally serviceable as fresh rubber. The departments of government, the railway companies, and large users of rubber

make a business of selling discarded articles, and rubber gatherers of the stuff vie with the *caucheros* in supplying the market with the results of their labor.

To one whose attention has not been carefully directed to the matter the multiplicity of the uses and combinations of rubber will be astonishing. All know how common are rubber bands, lead-pencil eraser tips, stamps, and fountain pens on a writing desk; every minute we see a wheeled vehicle fly past, its peace-destroying noise of yesterday obliterated by the rubber tire: but the use of rubber for these purposes, however enormous it is in the aggregate, by no means exhausts or even illustrates the demands for rubber in modern industry. The devices into which rubber enters can no more be enumerated than can those of iron or copper, but among them may be mentioned the various appliances for insulation in electricity; without rubber an entirely new method of telegraphing and telephoning would have to be invented. The air brake of the railroad must have rubber for its proper equipment; our fire service would be essentially crippled without rubber in the hose, and, in fact, hose of any kind can scarcely be conceived without rubber. Packing, belting, and tubing imply the use of rubber. Then there are boots, rubber heels, and overshoes; coats and gloves for clothing; the many pharmaceutical, dental, and surgical rubber goods, such as blankets, stoppers, combs, sheeting, bandages, water bottles, and syringes. In domestic life there are carpets, mats, toys, and cushions; rubber paint and pavement have special advantages in selected places; roller skating would be a torment, and English tennis, Scotch golf, and American baseball would be decidedly tamer without rubber.

COAGULATING RUBBER BY THE USE OF MOON VINE JUICE IN MEXICO.

The milk is emptied into this preparation, the impurities remaining in solution, and the clean rubber collecting in a solid mass, which can be lifted off the top.

It is evident that there are two distinct phases to the study of this commercial commodity. The one is industrial, the other botanical.

Before crude rubber becomes the finished product, it must be treated both mechanically and chemically to make it pliant for its multiform purposes. These processes are complicated, but necessary in transforming the raw material into an article ready for manipulation into any of the shapes mentioned above. First the rubber must be washed and cut into bits, then it is squeezed between rollers in order to remove the water and to prepare it in sheets; then it is dried and made ready for compounding. Very few articles as employed today are made of the pure gum; some compound is necessary in many cases: in others it is adopted in order to cheapen the price of the goods, which varies according to the quantity of compounded substance used. The consumer can, however, if he wishes to pay the cost, get the best possible article, the judgment of the manufacturer alone determining how much rubber to use.

BASE OF TREE INJURED BY TAPPING.

Anxiety to obtain the largest yield of rubber, with slight regard for the protection of the trees and for future production, has resulted in the permanent injury of many young trees

Sulphur is the principal ingredient employed in compounding rubber, and serves two purposes; it reduces the amount of pure rubber engaged for any article—in itself a valuable item—and it is the most efficient vulcanizer known. It transforms pure rubber into two distinct commercial substances, according to the amount of sulphur used, but chiefly according to the intensity of heat applied to effect the combination, for in all probability a chemical change occurs here, in addition to the undoubted physical union of rubber with sulphur. The one substance is soft rubber in the protean elastic condition familiar to all; this is produced by combining pure rubber with sulphur at a low temperature. The other substance is hard rubber, ebonite, or vulcanite, in which all elasticity is lost, and the shape into which this is molded is permanently and rigidly retained, within natural temperature limits. Nevertheless, compounded and vulcanized rubber will not last forever: it grows brittle and dull with age, the gritty scales on the surface of combs, etc., being the crystals of

unabsorbed sulphur coming to the surface, so that vulcanized rubber must finally be desulphurized and returned to the trade as reclaimed rubber.

Millions have dreamed of the possibilities and fortunes have been premised as the result of a process producing a rubber substitute. Artificial or synthetic rubber would seem so easy; take only ten atoms of carbon and combine them with only sixteen atoms of hydrogen and you have rubber. But the little trick of adding life to this inert molecule has not yet been learned. The fortune is still there for the lucky inventor who can accomplish it, because carbon and hydrogen

1 2

COAGULATING THE LATEX IN MEXICO.

1. Spreading the latex on Calathaea leaves. 2. Pressing the two coated leaves together to unite the sheets of rubber.

are cheap, inexhaustible even, while rubber may get costlier year by year. The discussion of artificial rubber may therefore be dismissed with a phrase—there is no such thing. Either the exploited article is a humbug, or it contains some proportion of real rubber mixed with substitute ingredients. Rubber substitutes are often of value in the trade because the article manufactured from them only needs that small proportion of rubber they contain.

The botanical aspects of rubber are, however, the more fascinating to the investigator, and touch very much more intimately the field in which the International Bureau of the American Republics is

interested. The plant from which the product comes is peculiarly a part of tropical flora, and although there are rubber-producing plants outside of tropical forests, the bulk of the staple is derived from a narrow belt on both sides of the equator, and decidedly better adapted in Latin America to rubber growth than corresponding regions elsewhere.

Rubber is the cream from the juice, the milk, or the *latex*, of several varieties of tree or shrub. This latex is not the same as the sap, and it runs in different channels and performs different functions. As this latex flows from the cut in the tree, it has the appearance of milk and acts much in the same way. If left to itself, the latex separates into a lower fluid and a surface mass, like cream, which is india rubber. A latex possessing from 15 to 40 per cent of rubber (cream) is of value and will pay for working, but a proportion below this is poor and thin, and only in exceptional circumstances will it return any profit. Various ways have been developed or devised for obtaining this rubber from the latex, the process being intrinsically coagulation. The aboriginal method seems to have been, in Brazil, by smoking heat; elsewhere natural heat is applied, or mineral or chemical additions are made to the milk to separate the rubber. Recently the suggestion has been carried into practice of using the separator apparatus so efficient in the dairy industry. It can not be doubted but that the coagulation process adopted has a noticeable influence on the character and market price of crude rubber, although the kind of tree from which the latex flows, as well as the soil in which it grows, are substantial factors in the result. Having been, up to within recent times, largely a matter of native habit, left altogether in unscientific hands by the buyers of rubber, the coagulation showed remarkable differences, and in some instances has even impressed a name upon the product; nigger heads, bisquits, and scraps are among the terms applied, but the shape of the crude rubber usually indicates the place from which it is shipped. It will take years to uniformize the various native plans adopted for coagulation. Perhaps this will never be accomplished, but on plantations where careful study can be given to the matter it has been determined that heating by smoke produces the cleanest and purest rubber for commercial export.

Rubber is rubber, whether from a tree on the Amazon, in the uplands of Ceara, the mountains of Bolivia, the jungles of Nicaragua, the fastnesses of the Congo, the cultivated plantations of Ceylon, or the northern regions of Mexico; the important question is, however, whether the plant has an abundant yield of latex. Therefore the source of supply has been the subject of great study for the botanist ever since the first American discoverers saw the curious balls and bottles of the natives.

The classification of rubber-bearing trees carries the number well toward one hundred, and if many latex-producting shrubs and vines

TAPPING A RUBBER TREE IN CHIAPAS, MEXICO.

The object in rubber tapping is not merely to avoid the destruction of trees, but to secure the maximum quantity of gum with the least injury to future productiveness. The gatherer (ulero) makes, with his machete, diagonal lines or gashes which form channels in which the milk can flow until it is all brought to one side of the tree, whence it is let down to a cavity hollowed in the ground and lined with large tough leaves. These are dexterously lifted up, and the milk poured into a calabash or other vessel and carried away to be coagulated.

are included, the tale might be made threefold, but for practical purposes only four great species are recognized. The Euphorbiaceæ contain the *Hevea* and the *Manihot;* the Ulmaceæ, the *Castilloa* and the *Ficus;* the Apocynaceæ, the *Hancornia* and the *Landolphia;* the Asclepiadeæ, *Cynanchum*. The six important trees are those under the first three varieties.

Hevea is the rubber tree par excellence. It is indigenous to the region of the river Amazon, and is therefore found throughout that immense watershed in the tributary areas of Peru, Bolivia, Ecuador, Colombia, and Venezuela. *Hevea* is a large tree, of comparatively

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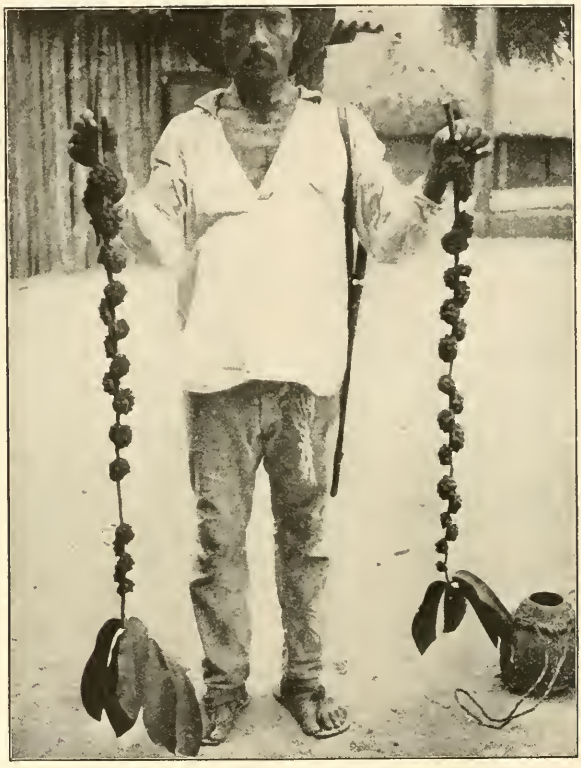
COAGULATING THE LATEX IN MEXICO.

3. Stripping the leaves from the rubber. 4. A finished sample of rubber, marked by the veins of the leaves.

slow growth, but on that account of long life. From the fourth year on it will yield its milk, and may be systematically tapped for twenty years or longer. It is often found 12 feet in circumference, and the scattered trees in the tropic jungle will constitute a forest by themselves. The *Hevea* requires a low-lying, rich, deep soil, with such abundant moisture as only the equatorial neighborhood can give. *Hevea* does not need to be overflowed; in fact, those trees that are subjected to periodic floods near the great rivers are not necessarily the best stock or the largest producers. *Hevea* also is well adapted to cultivation wherever the soil and climate are suitable, and the consensus of opinion is that in the ultimate future this tree, modified

perhaps by scientific horticulture, will be the chief rubber bearer of commerce. This is the tree that has made Brazilian rubber famous, and for generations to come Brazil is assured of a steady source of revenue from the supply furnished by this native of her fluvial forests.

The *Manihot* tree produces the Ceara rubber of commerce. Its native locality is a high, stony, arid, and in places semidesert country. Its latex yields a rubber remarkable for strength and tenacity,



BRANCHES OF CASTILLOA ELASTICA WITH RIPE FRUIT.

The fruit of the rubber tree has a faintly sweetish taste, but is without appreciable flavor. It contains considerable milk, though not in commercial quantities.

and promises to react successfully to cultivation if proper soil is selected for it, but as yet no efforts on a scale large enough for a thorough test have been attempted.

The *Castilloa*, next to the *Hevea*, is the best-known rubber producer in the tropic belt. Its native habitat is Central America and southern Mexico, and it is found in Ecuador, Colombia, and Peru, having been acclimatized also in the West Indies. The tree has at-

PLANTED CASTILLOA ELASTICA TREES, ABOUT 14 YEARS OLD.

This is a portion of a cultivated grove at La Zacualpa Plantation, Chiapas, Mexico. The scarred trunks show that they have been tapped many times. The trees average about a foot in diameter and stand about 12 feet apart in the rows. They were originally planted alternately with cacao, but this has mostly disappeared.

tracted considerable attention since the exploitation of rubber plantations in the zones north of the equator, and is very adaptable to cultivation if carefully treated. It is not so large as the *Hevea*, nor is the latex the same, needing therefore quite different treatment in its coagulation; but that is a matter of science and art, which will be regulated as its characteristics become better known. This is the rubber tree that has been so butchered to supply the growing demands of a consuming world. The natives, in their primitive zeal to extract the greatest possible amount of juice in the shortest possible time, simply felled—killed—the tree and bled it to the last drop. Whole forests have been laid waste in the unrestrained search for rubber, but nowadays the principle of conservation has become firmly rooted and the tree must be well treated wherever it is still alive, while cultivation is restoring it to areas originally favorable to its propagation. The *Ficus*, the rubber tree of urban conservatories, is of the same genus with the *Castilloa*, but its native habitat is the jungle of the eastern Tropics. In Assam, New Guinea, and the Malay Islands it is at home, but seems not to be of great profit when cultivated. It is likewise a tree of age, not coming to substantial yield until after many years of life, and therefore unpromising to the proprietors of a rubber plantation,

Hancornia is almost a shrub. It grows south of the Amazon Valley, and is found also in Venezuela and Peru; in fact, it is one of the best-known sources of Peruvian rubber. It has, however, one fatal defect when considered as a plant for future usefulness: in order to get the latex the tree must be cut down. Although more intimate acquaintance may determine that *Hancornia* can be cultivated, and, acknowledging that its rubber product ranks well up in the scale, it is probable that the area in which the tree now grows, if the culture be continued, will be planted with *Hevea* or *Castilloa*, according to the soil.

Landolphia (Lianas) is a rubber-yielding vine growing in the jungles of the Far East, of New Guinea, and especially of Africa in the basin of the Congo. Its product is commercially of decided value, but the fear that it may depress the native industry of Latin America or the cultivated plantations of Ceylon is groundless, because, however extensive may be the territory over which the vine is found, it must be destroyed in order to extract the latex; and cultivation is out of the question, since the vine requires the support of forest trees for its growth, and no plantation can first cultivate a sunless jungle before introducing a commercial staple. When the indigenous vine becomes exhausted the land on which it appeared must be diverted to other crops.

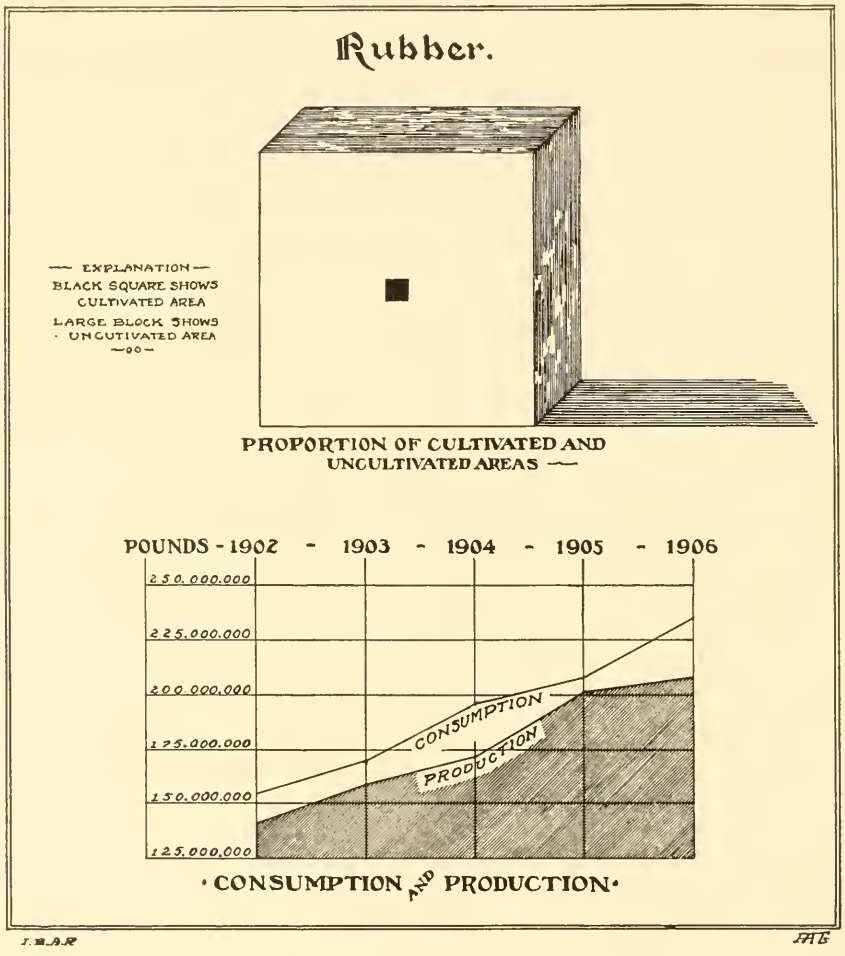
Considering the immense and increasing use of rubber in modern life, it is a fascinating problem to estimate how great may be the rubber-producing area of the world. It can be assumed that the genuine rubber tree will not repay the cost of cultivation outside of a

A RUBBER-PRODUCING MISTLETOE IN VENEZUELA.

Though not yielding a commercial rubber, this parasitical growth, like many leguminous plants and shrubs in tropical countries, produces a gummy exudation very similar to good rubber, but lacking the essential property of elasticity.

zone lying about 500 miles on either side of the equator. This includes all the Amazon basin in Brazil, the greater portion of Peru, the northern section of Bolivia, all of Ecuador, Colombia, Venezuela, Panama, Central America, and the southern section of Mexico. In

Africa it includes the Congo basin and the Sudan on the west, and the analogous portion on the east; in Asia the larger part of India, the northern tip of Australia, the intervening archipelagoes, and the Philippine Islands. No one can calculate with precision the productive extent of these regions, because the deciding factors of



NOTE.—Consumption and production are here taken as synonymous with imports and exports, because practically no producing country manufactures rubber, and no consuming country has rubber lands. It is impossible, likewise, to make imports and exports balance, and this explains the continued preponderance of consumption over production. As a matter of fact, this relationship, although actually maintained, is less than the diagram indicates, because a noticeable amount of reclaimed rubber is annually added to the new rubber just entering the market.

soil, rainfall, elevation, drainage, moisture, and temperature are not enough known; nevertheless, the area absolutely available is so well understood that any fear of a rubber famine, so far as nature's ability is concerned, is unfounded. Rubber cultivation has already extended over 150,000 acres in Ceylon; in the Federated Malay States are

130,000 acres; elsewhere in the East are at least 30,000 more; so that, even where it has been artificially introduced into an alien land, all told perhaps 600,000 acres, the tree itself is doing its duty in supplying the wants of mankind. In the western continent, Mexico and Central America are extending the cultivated territory for the plant, while experiments are making in other parts of the world. In Cuba and the Philippines there are extensive sections adapted, in all security, to the propagation of rubber. Cultivation, therefore, if con-

(Reproduced from India Rubber World.)

AN EXPANSE OF GUAYULE LAND.

The guayule shrub is found over large areas of the chaparrales, or bush prairies, in the northern part of the Mexican highlands. The first reports concerning this plant and its value are said to have been made by a Jesuit priest, about the middle of the eighteenth century. The name is probably derived from the Spanish word *Hay* (there is), and the Indian word *Hule*, meaning india-rubber.

ducted scientifically, can furnish the supply. It is not intended to ignore the future productive possibilities of the native forests. In Mexico and Central America the rubber zone is, from the configuration of the country, within reach; but in the Amazon Valley thousands of square miles are hidden beneath the virgin forest, and however inexhaustible the growth of the tree, the acquisition of the rubber, difficult at present, will become more and more so as time goes on. That this is the natural habitat of the *Hevea* can not be doubted, but

that it will continue to remain the principal source of supply has been questioned by students and observers ever since Ceylon made a successful plantation of this tree in 1877. The Brazilian and other governments are earnestly striving to conserve the rubber forests, to rectify earlier mistakes in the way of unrestrained robbery, and to encourage not only the entrance of more capital into the industry, but to bring into cultivation and make more accessible the area already exploited. Nevertheless, it is not beyond possibility that in this in-

(Reproduced from India Rubber World.)

A BALE OF GUAYULE SHRUB.

Within the few years since the exploitation of the guayule plant began, Mexico has arisen to second place among the rubber-producing countries of the world. The United States takes 80 per cent of the annual production.

stance the same result may happen as did happen with cinchona. This is still known to the pharmacopœia as Peruvian bark, but the industry has moved thousands of miles away from its native birthplace, and the supply of quinine, as far as the commercial market is concerned, now comes from India.

Be all this as it may, Brazil—Manaos, Pará, Ceara—continues to dominate the india-rubber world. Assuming the world's last an-

nual crop to be 150,000,000 pounds, her exports in 1907 were over 80,000,000 pounds. Add to this the Peruvian and Bolivian crops coming down the Amazon, and considering that fine Pará sets the price, it will be seen that many years must pass before the predominance can be overcome. This product was sent to the United States, Great Britain, France, Germany, Uruguay, Belgium, and Argentina, in this order. It is easy to understand that Belgium ranks low in importation from Brazil, because the output from the Congo has its chief entrepôt in Antwerp. The markets for the world's crop may be arranged as follows: The United States, Great Britain, Germany, France, and Belgium.

(Reproduced from India Rubber World.)

FOUR HUNDRED TONS OF GUAYULE RUBBER.

These bales vary in weight from 70 to 1[illegible] pounds. During the calendar year 1907 guayule rubber exports from Mexico reached a total of 11,900,000 pounds, and for the first six months of 1908 nearly 7,000,000 pounds.

Guayule is a shrub containing rubber in its branches, but this rubber is pure rubber and can be used for every purpose to which the latex of the *Hevea* is applied. Guayule therefore contradicts the statement made that no rubber could be produced outside the tropic zone. Guayule is a native of Mexico, but its habitat stretches also well into Texas. The shrub must be destroyed before the juice is extracted, and coagulation must be conducted by a different method, but in the end the outcome is rubber. The business of gathering the plant has become quite successful, and it is probable that efforts to cultivate it will turn out likewise. Gutta percha is not rubber; it was at first confused with the latter, although it had no

suppleness or elasticity, and its source of origin is a tree related to the india-rubber genus, but physically it has different properties, and in the arts it has different uses. About all the gutta percha of commerce comes from the Far East. *Balata* is an American gutta percha, growing in many parts of the Tropics, but produced chiefly in Venezuela and the Guianas. A practical distinction between rubber and gutta is found in the (Latin) names, *gummicum elasticum* for rubber and *gummicum plasticum* for gutta. This substance has two important uses; one is for insulation in telegraph instruments, but particularly for covering to submarine cables, which it protects better than any known substance against the water or the animal attacks beneath the surface; the second is for forming molds of various kinds by surgeons and dentists. It plays also a part in the manufacture of golf balls. At least 1,000 tons a year of gutta percha have been used since 1858 in submarine cables, the length of which has reached over 200,000 miles.

RUBBER GATHERER'S HOME ON THE UPPER AMAZON RIVER.