SUGAR SUPPLY OF THE UNITED STATES.

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SUGAR CONSUMPTION in the United States for the five years ending with 1915 amounted annually to 8,000,000,000 pounds, in round numbers. This includes sugar used not only in the household as sugar, but also in the manufacture of confectionery, preserved fruits, condensed milk, cakes, and similar products. This total consumption divided by the number of people in the United States gives a yearly average of about 84 pounds for each person, or 378 pounds for an average family (4.5 persons). Computing in like manner, the number of pounds of flour consumed per family in one year would amount to about 1,039 pounds, while potatoes would amount to about 1,000 pounds. On this basis of comparison, taking the country as a whole, the average family consumes more than one-third as much sugar as potatoes or as flour. In other words, for every pound of sugar consumed in one form or other, 2.7 pounds of flour and nearly as many pounds of potatoes are consumed.

When cost is considered, sugar occupies a still more important position. Taking the average retail price of sugar for the five years 1911–1915, 6 cents a pound, of flour 3½ cents, and of potatoes 2 cents, the retail cost of a year’s supply for a family of average size would be about $23 for sugar, $36 for flour, and $20 for potatoes. In estimating the retail value of potatoes, however, for the country as a whole, the retail city price would be too high, because approximately one-half of the population is at or very near the source of production. An average between farm value and city retail value of potatoes gives an average of about 1½ cents per pound. This average applied to the family consumption would give about $15 per family as the household value of potatoes consumed. With this modified reckoning, therefore, flour would be valued at $36, sugar $23, and potatoes $15 in a year’s consumption in an average household. In like manner, a year’s consumption of butter is estimated
(for 1909) as about $23, and eggs at $18. The meat used by an average family may be estimated as slightly over 800 pounds a year (1914), and the retail cost at possibly $200. Milk is consumed in somewhat larger quantities than is sugar, but the yearly cost is probably less.

The figures just quoted emphasize the well-known fact that sugar is a principal item of food both as to quantity and cost. It is so thoroughly recognized that frequent comments are made comparing the present status of sugar as a staple food with its status of a few generations ago as a material for flavoring. A century ago the people of this country consumed less than one-tenth as much sugar as they do now. In 1821-1825 the average per capita consumption was 8.3 pounds, and was practically the same 20 years earlier. In 1791-1795 the estimated consumption was only 7.5 pounds per capita.

INCREASE IN CONSUMPTION OF SUGAR.

A great change occurred in the consumption of sugar between 1825 and 1850. In the five-year period 1851-1855 per capita consumption of sugar had reached 30 pounds, or nearly four times the figure of 1821-1825. The home production in the later period was more than ten times that of the former, and imports were more than seven times as large. These figures do not include maple sugar, which furnished a large fraction of the supply no doubt in the Northern States. The first census of agriculture, that for 1839, reports 31,000,000 pounds of sugar made on farms in the Northern States; this may be assumed to be maple sugar. The total population of the United States in 1840 was 17,000,000, hence the maple-sugar consumption at that time was about 1.8 pounds per capita. During 1851-1855 the home production of sugar nearly equaled the net imports. Great changes were taking place in the economic conditions in this country in that period. Steam was rapidly coming into use as an important factor. The old horsepower mills in Louisiana were being replaced rapidly by steam-driven mills and by other improvements in machinery. In 1845 there were reported 630 sugar mills operated by steam power and 610 by horsepower. In 1850 there were 907 steam mills and 588 with horsepower, and in 1855 the steam mills numbered 938
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and the horsepower mills only 361. This period also marked a high point in the river traffic of the Mississippi Valley. Steamboat trade, of which sugar was an important article carried, had not yet been affected seriously by railroad competition. Railroads themselves were just beginning to be connected so as to form through lines of traffic. Heretofore they had been chiefly local, whereas the great river system was the principal route for freight in the Middle West. In 1851–1855 ocean steam navigation had reached a high point of efficiency compared with earlier years. This development meant larger cargoes, quicker service, and, above all, lower freights. The small vessels of a century ago had to charge relatively high rates compared with the large carriers of later times. Since much of our sugar is carried by water from foreign countries, this lowering of the ocean freights helps to make possible our large supply of sugar and its relatively low cost. These are but examples of a general and rather radical change in economic life in this country, and one of the incidents of this change was that of adding another important food to the diet list of the Nation. Just as cotton became common in household use through the invention of the cotton gin, so sugar was transferred from the list of flavoring materials to that of staple foods by means of improvements in mechanical, commercial, and transport facilities.

Thirty years later than the period just discussed—that is, in 1881–1885—the per capita consumption of sugar had risen to 46 pounds, and the imports had increased from an average of about 420,000,000 pounds in 1851–1855 to nearly 2,500,000,000 pounds in 1881–1885. During this period, however, the domestic production had fallen off; our sugar consumption was largely dependent upon foreign supplies.

After another 30 years, in 1911–1915, an average of 8,150,000,000 pounds of sugar a year were required in this country, or about 84 pounds per capita.

MAJOR SOURCES OF SUPPLY.

The principal sources of supply for the sugar consumed in the United States at present may be classified as foreign, insular, and continental. The foreign sources supply approximately one-half of the sugar we use; our island possessions,
about one-fourth; and our domestic cane and beets, the remaining one-fourth. These fractions are only roughly approximate, as the proportion from each source varies from year to year. During the five years ending June 30, 1915, the domestic sugar production amounted to about 1,873,-000,000 pounds; Hawaii, Porto Rico, and the Philippines shipped in 2,130,000,000 pounds; while the imports from foreign countries, after subtracting exports, amounted to 4,147,000,000 pounds, making a total supply of 8,150,000,000 pounds. According to these figures the domestic cane and beet fields supplied 23 per cent of the sugar we used in 1911–1915, the planters of Hawaii, Porto Rico, and the Philippines furnished 26 per cent, while Cuba, supplemented by small amounts from other foreign countries, furnished 51 per cent.

During the five years ending with the season of 1915–16 the sugar consumption of the United States averaged almost 160,000,000 pounds per week. The supply for 27 weeks came from foreign countries, our island possessions furnished supplies for 13 weeks' consumption, while the product of the United States proper was equivalent to 12 weeks' average consumption. The Cuban crop, all but a small fraction of which goes to the United States, has increased greatly in recent years. The crop of 1915–16 was estimated at 6,738,-000,000 pounds and was the largest on record for the island. A still larger output was expected for 1916–17, but an uprising took place which interfered to some extent with sugar making, and the crop, according to early estimates, was from 6,300,000,000 to 6,700,000,000 pounds, the second largest ever made in Cuba. The sugar season, beginning in December, 1911, and ending the following summer, resulted in about 4,300,000,000 pounds, the largest on record to that date; and the fourth largest crop was made in 1906–7, amounting to 3,200,000,000 pounds, or less than half the crop of 10 years later. The long grinding season, large cane area, and the efficient transportation facilities make Cuba a natural source of our sugar supply. Not only is there steamship service, but the car ferry between Key West and Habana has established a railway connection over which a car may pass carrying raw sugar from a Cuban factory to a United States refinery without unloading. This route has been found
advantageous in recent times, especially owing to the scarcity of ships and high freight rates on the water.

**HAWAII A GOOD PRODUCER.**

Of our island possessions Hawaii has the most highly developed sugar industry. There are some 50 mills, practically all of which are large or medium sized, the annual production of a mill ranging from about 4,000,000 to 100,000,000 pounds. The season in Hawaii is long, beginning nominally about October 1 and continuing for a large part of the following 12 months. An average of the running time of all mills is from 180 to 200 days. Nearly all the crop consists of raw sugar and is shipped for refining to San Francisco and to north Atlantic ports. The shipments of Hawaiian sugar to the United States in 1911–1915 were somewhat less than 1,200,000,000 pounds a year. The area of cane in Hawaii, according to the census for 1909, was 183,230 acres, and the total of reports made to the Bureau of Crop Estimates for the season ending September 30, 1916, was 246,332 acres—an increase of about 63,000 acres, or 34 per cent. Owing to the long growing season for cane in Hawaii only about one-half of the growing acreage is cut each year. The harvested area in the season 1915–16 was 115,419 acres, or 47 per cent of the total. The yield of cane is heavy in these islands, ranging from 39 tons per acre in 1912–13 to 46 tons in 1914–15, and the cane is high in sugar content, yielding an average of 245 pounds of sugar per ton of cane in the five seasons ending with 1915–16. The average yield of sugar per harvested acre of cane was 10,495 pounds during these five seasons; and the average sugar yield based upon total acreage—harvested and not harvested—was about 5,400 pounds per acre in 1914–15 and 4,800 in 1915–16, or 5,100 as an average for both years together. Hence an acre of growing cane in Hawaii represents, on an average, a year’s supply of sugar for 13½ families. Cane is by far the most important crop of Hawaii, constituting in 1909 over 92 per cent of the total value of all crops. Also in manufactures sugar took the lead; its value was equal to 76 per cent of the value of all manufactures, and was about 16 times the value of the manufacture which was second in rank, namely, rice cleaning and polishing.
PORTO RICO'S LEADING INDUSTRY.

In Porto Rico in 1916 there were 65 establishments for making sugar, of which 37 each produced 4,000,000 pounds or over, 7 produced less than 4,000,000 pounds each, but at least 1,000,000 pounds, while 21 had each a crop of under 1,000,000 pounds. There were 4 large factories or centrals which made in 1916 more than 40,000,000 pounds each, and their total production was 350,000,000 pounds, or 36 per cent of the entire crop. Porto Rico's shipments to the United States, which, like Hawaii's, consist almost wholly of raw sugar, furnished in 1911-1915 over 680,000,000 pounds a year. Since the outbreak of the war (1914) the Porto Rican crops have increased greatly. The crop of the season ending in the summer of 1916 was reported officially at 967,000,000 pounds, while the 1916-17 crop exceeded 1,000,000,000 pounds. Porto Rico's average production during the five years ending in the summer of 1915 was 727,000,000 pounds, or considerably more than double the five-year period 1901-1905, and more than five times the average production of 1891-1895. The acreage of cane in Porto Rico increased 40 per cent from 1909 to 1915; the Federal Census reported 145,000 acres in 1909, and the treasurer of the island accounted for 203,000 in 1915. This gain corresponded to a gain ranging from 260,000,000 to 275,000,000 pounds in the sugar crop. An acre of cane in Porto Rico yields on an average about 4,500 to 4,800 pounds of sugar. The reported acreage divided into the sugar production for 1916 gives an average of 4,750 pounds per acre; while figures for 1913-14, in reports of 21 factories, give an average of 4,537 pounds of sugar per acre of cane. Hence an acre of cane in Porto Rico represents a year's supply of sugar for eleven or twelve families in the United States. Cane is the principal crop of Porto Rico, the acreage (1915) of 203,000 being 36,000 more than coffee, which is the second crop in area, and 87,000 more than the total for fruits and coconuts.

Sugar holds first place in the manufactures as well as in the agriculture of Porto Rico. That industry had, in 1910, a capital of $20,700,000, or four-fifths of the total capital for all manufacturing industries of the island; and the products (sugar and molasses) were valued at $20,600,000, or nearly three-fifths of all manufactured products.
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PRODUCTION ON THE INCREASE IN THE PHILIPPINE ISLANDS.

Until within the last several years Philippine sugar production was confined almost wholly to the small mills of the natives, and the product was crude sugar of a primitive type. The Philippine Government estimates the sugar production of the islands in 1915-16 as 825,000,000 pounds, while the census for 1902 reported a total of about 397,000,000 pounds. Philippine shipments to the United States during the five years 1911-15 averaged about 280,000,000 pounds a year, or about 400,000,000 pounds less than the Porto Rican shipments.

LOUISIANA INCREASING ITS SUGAR-CANE ACREAGE.

The oldest source of our domestic sugar is a section of Louisiana beginning a few miles east of the left bank of the Mississippi River and extending roughly for 100 miles westward, and on the north, from an east and west line passing not far above Baton Rouge, the sugar belt extends southward to the Gulf coast. Outside of this region cane is grown generally throughout the Gulf States, but is there used almost exclusively to make sirup and not sugar. Practically the only other cane sugar from our Southern States, outside of this Louisiana region, is made in a few scattered localities in Texas. Cane is said to have been introduced into Louisiana about 1751, and an attempt was made to make sugar eight years later but without success. It was not until 1795 that the first successful sugar mill was erected in Louisiana. The industry was originally part of farming, and the equipment was rather simple, consisting of a set of rollers for crushing the cane and some kettles for boiling the juice. The introduction of improved machinery was followed by a decline in the number of plantations having their own mills.

As early as 1845 over 45 per cent of the sugar planters in Louisiana were without sugar mills and their cane was sent to neighboring plantations for grinding. Steam power was rapidly being introduced at this time and the making of sugar increased also. About 1849 there were 1,536 sugar houses in Louisiana, or about 300 more than in 1845. The increase was largely due to steam mills, there being 235 more in 1849 than in 1845, but the horsepower mills had increased also from 610 in the earlier year to 671 in 1849. With the
increase in machinery and its consequent cost and larger efficiency, the number of mills decreased and a still larger number of planters sent their cane to neighbors' mills for sugar making. One of the most important improvements in the mill was the vacuum pan, the purpose of which is to boil the cane juice in a vacuum or under low pressure. The older mills or open-kettle concerns boiled the juice in open kettles of a few feet in diameter at the top and tapering downward, of a shape similar to half an egg. The kettles were superseded to a limited extent by open pans, which are more efficient than the kettles, but not so good as the vacuum pans. The open pans are used now largely for making cane sirup. The vacuum-pan process extracts more sugar than does the open kettle, and accordingly leaves a smaller amount of sugar in the residual molasses. This improvement has changed the quality of molasses to such an extent that molasses has come to mean not the sirup for table use but a by-product from sugar making, weak in sugar content, and usually of a more unpleasant taste than is desirable for table use. In 1849, out of 1,536 sugar houses, only 11 were reported as having vacuum pans, while in 1916, out of 150 operating sugar factories, 141 were vacuum-pan houses. Numerous other improvements were introduced. Better methods for crushing the cane and extracting the juice were used, improved systems for boiling the juice, and labor-saving devices for handling materials about the factory were adopted, and these improvements have been followed by larger and still larger outputs per factory.

In 1849 the factories averaged each about 150,000 to 175,000 pounds of sugar for the season; in 1916 the average exceeded 4,000,000 pounds. The factories had increased in size and efficiency, not only producing more sugar but getting more in proportion to the quantity of cane used. Within the Louisiana sugar belt cane is by far the most important commercial crop. In the 23 sugar parishes the cane area in 1909 amounted to 16.4 per cent of the total area of the improved land in farms. The 10 leading sugar parishes showed an area in cane equal to 35 per cent of the total improved land, and in corn 33.1 per cent of the total. The large number of mules required in the cane fields makes corn an important product for farm consumption rather than for sale. In the
parishes of St. Mary, Lafourche, and Terrebonne cane occupied 41.6 per cent of the total area in improved land, corn 30 per cent, while hay and forage occupied 16.1 per cent. Hence, practically 87 per cent of all improved farm lands in those parishes may be regarded as devoted directly or indirectly to the sugar-cane industry. Of the total amount of sugar made in Louisiana in 1916, amounting to 607,800,000 pounds, 238,000,000 pounds, or 39.2 per cent, was produced in the three parishes just mentioned. These parishes contained also 51 of the State's 150 operating factories.

The sugar belt is well served with transportation facilities. A number of railroads with branch lines and spurs deliver cane to the mills and haul sugar to market. Water transportation facilities also are good. A network of bayous and canals extends from the western side of the sugar belt to the Mississippi River. Steamboats and barges traverse these waterways carrying cane to the mills and taking sugar to New Orleans.

A large fraction of the sugar made in Louisiana is raw sugar, which is sent to the refineries to be refined and granulated; while the rest of the Louisiana product consists of high-grade sugar fit for immediate consumption.

In 1912 the sugar classed as "raw" amounted to 72 per cent of the total output, and the better grades made 28 per cent, according to the Louisiana Sugar Planters' Association. Two years later, in 1914, the higher grades constituted 59 per cent of the total, but they declined to 47 per cent in 1915 and to 35 per cent in 1916. These higher grades of sugar are not all white granulated, but include light yellow sugar.

One of the characteristics of the Louisiana sugar industry is its uncertainties. Cane does not mature there, for the growing season is too short. Cane is harvested before it is fully ripe, and the cutting season is limited to the few weeks beginning about the latter part of October and ending shortly after the cane is killed by frost. Working immature cane results in a lighter tonnage per acre than is obtained in Cuba or other tropical countries, and it also results in a smaller sugar content in Louisiana than in the Tropics. In spite of these limitations, this State is producing a considerable part of the Nation's supply of sugar. The harvested area increased from 183,000 acres in 1915 to 221,000 in 1916,
and a further increase was made in 1917. At this rate of increase the area would soon equal that of 1911 (310,000 acres), and the total output of Louisiana would be expected to range from 500,000,000 pounds in a very unfavorable year to nearly 900,000,000 pounds under the best of crop conditions.

DOMESTIC PRODUCTION OF BEET SUGAR.

The beet-sugar production of the United States is comparatively new, amounting to an inconsiderable total only a generation ago. The industry being new, the equipment is modern, and instead of turning out a crude product, as many European mills do, our beet factories make white granulated sugar. Accordingly figures for United States production are in terms of "refined" (pure) sugar. Up to 1891–1895 the average production was slightly below 39,000,000 pounds. Five years later the average annual production (1896–1900) was about 117,000,000 pounds; the next five-year period showed an average exceeding 479,000,000 pounds, and in 1911–1915 beet sugar averaged 1,449,000,000 pounds, or more than three times the yearly average of 1901–1905. This large output in 1911–1915, however, was equal to only about nine weeks' average consumption for the United States. The crop of 1915, the largest beet-sugar crop ever made in the United States, was slightly more than 1,748,000,000 pounds, equivalent to about 11 weeks' consumption. Had the same crop conditions prevailed in 1916 as in the preceding year, the crop of 1916 would have been about 2,000,000,000 pounds instead of the actual yield of 1,641,000,000 pounds. Unfavorable weather early in the season followed by further damage resulted in a loss of 103,000 acres between planting and harvesting. The remaining 665,000 acres yielded a poor return, especially in the East, the average yield per acre in Michigan being about 5½ tons in 1916, whereas in 1915 the average in that State was 9 tons per acre. The beet-sugar factories are distributed over a wide territory, extending from northern Ohio to the Pacific coast, and from Montana almost to the Mexican border. East of the Missouri River the principal beet-sugar State is Michigan, where two-thirds of the beet acreage east of the Missouri River was located in 1916. This eastern region pro-
duced in 1916 about 108,000 tons of sugar, while the region west of the Missouri River produced 712,000 tons. The principal beet-sugar States in the West are Colorado and California, but the industry is also important in Utah, Idaho, Nebraska, and Montana. One of the western regions begins on the east with the factory at Grand Island, Nebr., on the Platte River, and follows that river and its branches, including at its western end factories and fields as far north as Billings, Mont.; on the Yellowstone River, and on the south reaching almost to Denver. Another region between the crest of the Rocky Mountains and the Missouri River includes the valley of the Arkansas River from Garden City, Kans., to the Royal Gorge in Colorado, and extends southward into New Mexico. West of the Rocky Mountains the factory at Grand Junction works the beets raised in the irrigated fields along the Grand and Gunnison Rivers; a large industry is carried on in northern Utah and southern Idaho; and new fields are being developed in western Montana. In the Pacific northwest are two new factories, one that opened at Grants Pass, Oreg., in 1916, and the other at North Yakima, Wash., in 1917. The California factories are located along the coast south of San Francisco, also in the valleys of the Sacramento and San Joaquin Rivers.

There were 17 more beet-sugar factories operating in 1917 than in 1916, of which 14 were new. These new concerns were located at Tracy, Cal.; North Yakima, Wash.; Paul and Shelly, Idaho; Cornish, Delta, Moroni, and Smithfield, Utah; Missoula and Hamilton, Mont.; Worland, Wyo.; Brighton, Colo.; Bayard, Nebr.; and Mason City, Iowa. The factories idle in 1916 which resumed work in 1917 were at Corcoran and Hamilton City, Cal.; Janesville, Wis.; and Ottawa, Ohio. One factory which operated in 1916 was idle in 1917.

A large fraction of the beets used is produced by farmers who sell to factories. The industry is not, as in Louisiana, the outgrowth of home sugar making, but, on the other hand, is primarily a factory industry. Contracts are made between the factory operators and the beet growers before planting, and these contracts fix the basis of payment for the beets. In some cases the exact price per ton is specified, in other
contracts a minimum price is specified for beets containing a certain percentage of sugar, and a fixed amount is paid for each additional percentage of sugar in the beets above the minimum. A third modification, which has become quite general, is to offer the farmer an additional amount per ton of beets for every increase in the price of sugar of a certain fraction of a cent over a specified minimum price. This latter is a form of profit sharing by which the grower shares with the factory an increase in sugar prices. A large acreage, however, is planted and harvested by the sugar companies themselves, especially in the region west of the Missouri River.

AMERICAN REFINERIES.

Nearly all the beet sugar made in the United States comes out of the factory granulated and ready for household use, but imported sugar, the insular crop, and more than one-half of the Louisiana product are sent to refineries before being sold for consumption. There were 18 of these refineries in the United States in 1914, and their combined product was 6,666,000,000 pounds of sugar, or about four-fifths of a year's supply for the nation. The refinery differs from other sugar factories in that it does not handle cane or beets, but merely takes the lower grades of sugar and converts them into higher grades. The working season of a cane-sugar factory is limited by the length of the harvest period and the keeping qualities of harvested cane; and beet-sugar factories, for like reasons, are unable to work more than a few months in a year. A refinery, on the other hand, is not prevented by natural causes from operating throughout the year. The refineries are much larger than the mills that work beets or cane. The average output of a refinery in 1914 was 370,000,000 pounds, or 17 times the average output of a beet-sugar factory in 1916, and more than 90 times the average product of a Louisiana factory the same year. Practically all the refineries are located near the seaboard, for a large part of their raw material comes by sea. Of the 18 refineries reported in the Census of 1914, 12 were near the Atlantic coast, 4 near the Gulf of Mexico, and 2 on the Pacific coast.
MINOR SOURCES OF SUPPLY.

All but a small fraction of the sugar used in the United States is made from cane or beets. Other products contributing to our supply of sweet foodstuffs, however, are worth noting. They include maple sugar and sirup, honey, cane sirup, sorghum sirup, and such cane molasses as is fit for household use. The total yearly production of these articles may be estimated roughly as about 500,000,000 or 600,000,000 pounds. To this total should be added, if figures were available, the net imports of edible molasses and the net domestic supply of glucose and grape sugar, including corn sirup.

The maple-sugar crop, according to the last census, 1909, was about 14,000,000 pounds; and maple-sirup production equaled 4,000,000 gallons, which is equivalent to about 32,000,000 pounds of sugar; making the total maple products equivalent to 46,000,000 pounds of sugar. While these figures refer to 1909, it is probable that the annual production has not changed much since then.

The honey crop of 1909 was 55,000,000 pounds, which, added to the sugar equivalent of the maple products, makes a total of 101,000,000 pounds of sweet foodstuffs.

Our domestic production of table sirup made from sugar cane was 23,000,000 gallons in 1909, while molasses, a residual product from sugar making, equaled 25,000,000 gallons. At that time the imports of foreign and insular molasses were averaging about 32,000,000 gallons a year, and exports of molasses averaged about one-tenth that amount. The present supply of molasses is probably larger, owing to recent large increases in the importation of low-grade molasses, much of which was probably for use as a raw material in manufacture. In the fiscal year ending June 30, 1917, imports of foreign and insular molasses amounted to 140,000,000 gallons, and our exports of molasses were about 3,000,000 gallons.

No official figures for the total quantity of glucose and grape sugar made in this country are available, but the census for 1914 gives the value of glucose production as $18,541,000 and grape sugar as $3,766,000. No estimate of
quantity is given for the former item, but grape-sugar produc-
tion amounted to 174,000,000 pounds. The glucose and
grape-sugar production not only goes to meet a general de-
mand in this country, but is exported in large quantities.
In the fiscal year ending June 30, 1917, exports of glucose,
or corn sirup, were 170,000,000 pounds, and of grape sugar,
about 45,000,000 pounds.