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Contributors

Bannister, Richard.
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SOCIETY FOR THE ENCOURAGEMENT

OF

ARTS, MANUFACTURES, AND COMMERCE.

CANTOR LECTURES

ON

SUGAR, COFFEE, T[illegible]OA:

THEIR ORIGIN[illegible] USES.

BY

RICHARD BANNISTER, F.I.C., F.C.S.

(Deputy Principal of the Inland Revenue Laboratory.)

DELIVERED BEFORE THE SOCIETY OF ARTS, APRIL 28, MAY 5, 12, 19, 1890.

Reprinted from the "Journal of the Society of Arts," October 17, 24, 31, *November* 7, 1890.

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SYLLABUS.

LECTURE I.

Sugar, what it is—Consumption—History and origin—Sugar of commerce, raw and refined—Analysis and classification—Bounties and drawbacks—Specimens of commercial sugars.

LECTURE II.

Sugar used in brewing, distilling, and jam-making. *Coffee*—History—Introduction into Europe—Varieties—Composition of coffee when raw and roasted—French coffee—Coffee substitutes and their detection.

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SUGAR, COFFEE, TEA, AND COCOA: THEIR ORIGIN, PREPARATION, AND USES.

BY

RICHARD BANNISTER.

LECTURE I.—DELIVERED APRIL 28, 1890.

SUGAR: WHAT IT IS.

The sense of taste, which resides in the gustatory nerves of the tongue, has evidently been given to guard against taking in by the mouth any corrosive or injurious substances, and also for the purpose of imparting pleasure to the necessary act of eating and drinking, by which we obtain our food. This sense of taste has, without doubt, been given to man as a source of true enjoyment, and is found to be so by all who only eat and drink to live, and who by moderation and due care supply to the stomach proper nutriment for digestion, and for building up and maintaining a healthily nourished body. When, however, our taste is unduly indulged and stimulated, it has proved a fruitful source of mischief, on account of the excessive work thrown on the organs of digestion.

The sense of taste classifies different substances according to flavour, and naturally arranges them into four primary divisions, viz , sweets, bitters, salines, and acids. Sugar, when taken into the mouth in a solid state, is speedily dissolved by the saliva, and thus assumes the physical condition in which it is most capable of stimulating that division of taste which is known to us under the name of sweetness. Sugar is an important constituent of milk, and as it is the most easily digested substance which maintains animal heat, it is not surprising to find it in the milk of the mammalia, the natural food of the young during the first period of their existence. Though in its various forms it is a very important constituent of a normal diet, yet of itself it will not sustain life, and it has been proved that animals fed on sugar alone soon died if they had not at the same time some kind of nitrogenous food for building up the tissues of the body.

Physiologists tell us that, speaking generally, sugar when taken into the stomach passes through its walls in an unchanged condition into the blood, but that it ultimately, under normal circumstances, becomes converted into carbonic acid and water—a change which is attended by the liberation of a considerable quantity of heat. Hence sugar, whether taken as such, or formed during digestion from the starchy elements of our diet, is one of the agents primarily concerned in maintaining the temperature of the body. By reason also of its chemical and physical properties it diminishes the oxidation of fatty and nitrogenous substances, and thus indirectly contributes to the weight of the body, and also to the deposit of fat in the subcutaneous tissues, whereby the loss of the body heat is retarded or largely prevented.

The instinctive love of sugar seems to point out how well it is adapted to our natural wants. This love is not confined to any particular nation, but is general, and from the Table on p. 2 it will be apparent that wherever sugar can be easily obtained the consumption is enormous. The Table would be of greater interest if it were more comprehensive, and included other countries besides those enumerated, but such returns cannot be obtained.

It would appear that in the southern countries of Europe, where the temperature is higher and the facilities of locomotion small, the consumption is less than in more northern climes, where the cold of winter compels the population to keep up the temperature of the body, and where facilities are more general for the supply of an article to keep pace with the demand for it.

In Great Britain and the United States the consumption per head is greatly in excess of all other countries, and although the United States took much less comparatively than we did ten years ago, yet in the return for 1887 it is shown that whilst the consumption of sugar increased in Great Britain 1·2 lb. per head,

in the United States the increase was 22·9 lbs. during the same period.

If this rate of progress is maintained, the people of the United States will soon occupy the premier position; and there is reason to believe that they have already attained to this distinction, chiefly on account of the large quantities of sugar used to preserve canned fruits, which are so extensively imported into this and other countries for consumption.

TABLE I.—Lbs. Sugar Consumed per Head.

Countries.	1880–4.	1887.
Spain	5·1	—
Italy	7·6	—
Russia	7·7	9·0
Portugal	9·5	—
Austria	13·2	12 1
Germany	15·0	18·9
Belgium	15·7	—
Sweden	17·5	—
France	22·6	27·0
Switzerland	22·7	—
Holland	28·3	23·1
Denmark	29·6	—
United States	38·0	60·9
Great Britain	68·8	71·0

TABLE II.

The consumption of raw sugar in the United Kingdom was in—

Year.	Tons.
1700	10,000
1710	14,000
1731	36,100
1741	40,883
1751	38,108
1761	56,400
1771	62,746
1780	61,034
1791	70,160
1801	138,689
1811	161,337
1821	152,844
1831	189,050
1841	202,881
1851	311,677

TABLE III.—Consumption of Raw and Refined Sugar in the United Kingdom.

Year.	Raw.			Refined.			Total Tons.
	Tons.	Lbs. per head.	Average price per cwt. in bond.*	Tons.	Lbs. per head.	Average price per cwt. in bond.*	
Average.							
1855-9	383,263	—	28 10	13,474	—	38 3	396,737
1860-4	446,956	—	24 1	18,338	—	34 3	565,294
1865-9	525,494	—	22 3	40,496	—	31 8	565,990
1870-4	603,608	—	24 1	96,446	—	33 10	700,054
1872	585,297	41	26 2	88,286	6·2	36 4	673,583
1873	630,397	44	24 0	109,872	7·6	33 10	740,269
1874	641,272	44	22 5	128,681	8·9	30 8	769,953
1875	740,382	51	21 2	129,732	8·9	30 4	870,114
1876	681,483	46	21 0	129,913	8·8	29 5	811,396
1877	751,253	50	25 9	162,760	10·9	33 9	914,013
1878	680,608	45	21 6	154,922	10·3	29 3	835,530
1879	821,682	54	20 3	143,508	9·4	27 5	965,190
1880	786,127	51	21 9	145,541	9·5	29 3	931,668
1881	873,361	56	21 9	131,660	8·4	28 11	1,005,021
1882	925,996	59	21 1	131,947	8·4	28 8	1,057,943
1883	925,821	58	20 1	156,902	9·9	27 2	1,082,723
1884	892,069	55	15 6	201,989	12·6	20 11	1,094,058
1885	899,599	55	13 10	255,475	15·7	18 2	1,155,074
1886	731,071	45	13 0	307,296	18·7	16 8	1,038,367
1887	841,175	51	12 1	335,241	20·2	15 8	1,176,416
1888	802,147	48	13 5	334,234	20·0	17 6	1,136,381
1889	840,689	50	—	440,483	26·1	—	1,281,172

* Duty abolished 1875.

Sugar lends itself so readily to disguise disagreeable flavours of bitterness, acidity, and saltness, that it will always be a popular adjunct to unpleasant foods or medicines, and will enter largely into the composition of prepared fruits and confections for the million.

To guard against the abuse of sugar, it is only right to point out that an excess of sugar in the mouth diminishes the activity of the salivary secretion, and in the stomach is very liable to undergo acid fermentation, giving rise to one form of acid dyspepsia.

It should therefore be used in great moderation in special constitutional conditions, as, for example, the gouty and rheumatic, and avoided altogether in the case of diabetic persons.

Sugar and sweetness have been for ages indissolubly linked together, and substances possessing a sweet flavour, though not derived from the vegetable kingdom, and even when possessing poisonous qualities, have been called sugar on account of their sweetness to the palate. Thus the acetate of lead is often called sugar of lead; and the true sugars, whether derived from fruits, milk, or vegetable juices have all, from their sweetness, been put in one class, although in composition appearance, and flavour, they vary.

The progress made in organic chemistry has led chemists to study more closely the composition and properties of sugar derived from different sources, and now the term "sugar" is, in chemistry, applied to a very large class of organic substances composed of carbon, hydrogen, and oxygen, termed carbohydrates. The oxygen and hydrogen present in them are in the same proportion as they exist in water.

The sugars are again classified according to their chemical or optical properties; but for our present purpose it is only necessary to note that in commerce the term sugar is generally understood to apply to the crystallised sugar obtained from the sugar cane, or to sugar of the same composition and physical properties derived from the beet, sugar maple, sorghum, palm, or other vegetable substance, and in sufficient quantity to make it an article of commerce. For brewing purposes cane sugar is often used on account of its wide distribution, but from investigation and experiment it has been found that cane sugar specially modified by chemical treatment and sugar manufactured from starch are more suitable, and these have now, at many large breweries, displaced raw cane sugar.

Again, in confectionery and jam making, cane sugar, in the form of "loaf," is generally employed, but in the commoner descriptions of jam, which are made from poor fruit, or from the pulp deprived of a greater part of its juice, which has been used for jellies or syrups, a liquid dextrinous starch sugar is in large demand, on account of its giving body to the jam, and supplying to some extent the properties which only sound good fruit naturally possesses.

Pure cane sugar is a carbohydrate, having the chemical composition $C_{12}H_{22}O_{11}$. Its crystals are hemihedral, of the monoclinic system, and emit light when broken. It is insoluble in absolute alcohol, but exceedingly soluble in water. This property of solubility has been taken advantage of in purifying the crystals of cane sugar from adhering syrup, and a method has been devised of washing sugar containing syrup with alcohol diluted with certain proportions of water. The crystallised sugar could thus be quickly estimated, and though not chemically accurate, sufficiently so for ordinary commercial purposes. Cane sugar does not reduce copper as grape sugar does, and it is not directly fermentable.

When heated it melts at 320° Fahr.; at a slightly higher temperature it decomposes into dextrose and levulosan, and at 410° Fahr. caramel is produced. Above this temperature various gaseous bodies are generated.

Cane sugar forms definite chemical compounds called sucrates, with certain mineral substances as lime and strontium, and efforts have been made to obtain by these combinations commercial sugar from cane and beet juice, but without success.

Cane sugar is converted into invert sugar ($C_6H_{12}O_6$) by the action of acids, heat, yeast, and many other agencies, and this property of inversion is the great trouble of the sugar refiner, who has to adopt different means, according to the circumstances of the case, to prevent this change. It will be referred to later on that invert sugar not only will not crystallise itself as cane sugar does, but it also prevents definite quantities of cane sugar passing into the crystalline form.

In fact, the great discovery of the age in our sugar industry would be a method of converting invert and other sugars into cane sugar. All attempts to solve this problem have hitherto failed, but the practical solution of it would work a revolution in our sugar industry by opening up new sources of supply

and modifying our present methods of sugar refining.

Sugar: its history.

Sugar being very widely distributed in the juices of plants, trees, and fruits, there is very great difficulty, from a historical point of view, in tracing its exact origin. Honey, as the natural secretion of bees, was well known as typical of sweetness, but it would appear that the bee's faculty of obtaining sugar from flowers was not realised, it being supposed that the bee made the honey within itself out of the extract it obtained from the flowers. Thus we find that Theophrastus, 371-286 B.C., describes sugar as a sort of "honey extracted from canes or reeds." Strabo also states, on the authority of Nearchus, the admiral of Alexander, "that reeds in India yield honey without bees." Another writer, Dioscorides, describes it "as a sort of concreted honey, found upon canes in India and Arabia Felix; it is in consistence like salt, and is, like it, brittle between the teeth." Pliny says it is as "honey collected from canes like a gum, white and brittle between the teeth; the largest is the size of a hazel nut; it is used in medicine only." It is evident from these quotations that the Greeks and Romans had no reliable knowledge of the methods of extracting sugar from the vegetable substances containing it, but it can be inferred that the sugar was obtained from a species of cane or reed, and that it was supposed the sugar oozed out, and, on exposure to the air, solidified. Sugar cannot, however, be obtained from the cane without the aid of art. Naturally the juice will not flow out, and consequently pressure must be exerted, or the canes must be sliced and macerated. As Pliny states that the lumps of sugar may be as large as a hazel nut, it has been conjectured that the sugar he refers to was sugar candy of Chinese manufacture. This has been largely produced, of two qualities, for many centuries, and imported into India for consumption. From thence it might find its way into Europe, but the quantity obtained must have been small when so rare as to be looked upon only as a medicine.

The Saracens in the 9th century having become possessed of certain islands in the Mediterranean, began to cultivate the sugar-cane which they brought from Arabia, and to them we are indebted for the introduction of the sugar-cane, and also for the manufacture of sugar from it. In the 12th century sugar could be more cheaply imported from Sicily than from Egypt; and the Crusades, which did so much for commerce, were the means of bringing sugar under the notice of the sturdy warriors of France and Britain, who, in their turn, introduced it into their respective countries. The Saracens, before the Crusades began, had extended their territory, and settling down in Spain, they cultivated the sugar-cane extensively, and established sugar factories at Valencia, Granada, and Murcia. As the Spaniards and Portuguese became maritime powers, and extended their conquests to the American continent, they took out the sugar-cane for cultivation. Historians, however, differ in their views as to whether the cane was or was not indigenous to the American continent, but the balance of evidence is in favour of its having been a native of the West Indies and the New World in general. It is beyond the limits of doubt that these European explorers did take with them a knowledge of the best known methods of extracting sugar from the cane, and the factories they established in the West Indies increased in number and importance. Peter Martyr, writing in 1530, states that in 1518 there were twenty sugar works in St. Domingo, established by the Spaniards, and goes on to say:—

"It is marvellous to consider how all things increase and prosper in the island. The canes or reeds wherein the sugar groweth are bigger and higher than in any other place, and are as big as a man's wrist, and higher than the stature of a man by the half. This is more wonderful, that, whereas in Valencia in Spain, where a great quantity of sugar is made yearly, whensoever they apply themselves to the great increase thereof, yet doth every root bring forth not past 5 or 6, or at most 7, of these reeds, whereas at St. Domingo 1 root beareth 20, and sometimes 30."

Gradually, the production of sugar centred in the West India Islands, and spread to the mainland adjacent. For about 300 years the sugar consumed in Europe was brought almost entirely from the West Indies, a small quantity only being imported from the East Indies, from causes to be explained hereafter.

One of the earliest records of sugar being used in Great Britain appears in the accounts of the Chamberlain of Scotland, 1319, in which it is set down at 1s. 9½d. (more than an ounce of standard silver) per lb.

In 1459, sugar continued to be a great luxury, for in that year Margaret Paston, writing to her husband, begs that he "vouchsafe" to buy her a pound of sugar

In the churchwarden's account of St. Mary-at-Hill, London, 1516, there is the following entry.—"At Cambridge's Obit., sugar, 1 lb., 7d." In the list of the viands provided for the funeral repast of Sir John Redston, Lord Mayor in 1531, sugar is set down at 7d lb. In the household book of the Dean of Salisbury, 1625, there is set down "lb. of hard sugar 16d., of powder do. 14d." Anderson's "History of Commerce" informs us as to the market price.

At the restoration of Charles II. the Parliament, observing the great detriment which the sugar trade, open to all nations, did to the kingdom, confined it absolutely to our own people by several Acts of navigation, in consequence whereof the ports of London and Bristol soon after became the great sugar magazines for supplying that article to all the north and middle parts of Europe, reducing the price of the Portuguese sugars of Brazil in time from £8 to £2 10s. per cwt. This continued until the French, in their turn, so greatly improved the quantity and quality of sugar obtained from their colonies as to be able to undersell us in most parts of Europe. The European supply of sugar thus came mainly from French sources, and though Holland still drew its supply chiefly from its own colonies, other countries had to buy French produce. Later on, through continental wars, this system received a crushing blow, and it was thought by many that Europe must be solely indebted to England and Holland for its sugar supply, or go without altogether.

It followed, therefore, that during the wars of the French revolution, the external commerce of the Continent was so crippled, that colonial sugar could not be imported, and Europe was not suited to the growth of the sugar-cane. Efforts had therefore to be made to obtain an internal source of supply, and experiments were conducted with beet, carrots, and other sweet roots indigenous to the middle and south of Europe, to see whether sugar sufficiently pure for the table could be produced from them. The first results were not satisfactory, but Achard, of Berlin, persevered with beets, and was so successful that the Prussian Government gave him a special reward for his experiments. His process was a remarkable one. He cleaned the beet from dirt and other impurity, and then boiled it till it was so far softened that a straw could be thrust into it; the roots were then sliced, submitted to pressure, and the juice extracted. The mass remaining in the press was treated with water, and again pressed to extract more syrup, and even after this treatment the pulp was considered rich enough for fermentation to produce alcohol. The first juice was strained and boiled down to two-thirds of its bulk; it was again strained through a thick blanket, and then boiled down to half its bulk, and again strained through flannel. This liquid, or syrup, was then put in shallow pans in a room kept at a temperature of 120°. Crystallisation began by the formation of hard crystals on the surface of the liquid, which were broken down to hasten further crystallisation. After a time, a gummy skin appeared at the top of the liquid, the pan was then removed from the hot room, and the contents were pressed in strong linen bags previously moistened with water. What remained in the linen sack was a brown sugar, resembling what is now known in the trade as muscovado. Achard's experiments were repeated by a commission of the French National Institute, but the quantity of sugar obtained only amounted to 18 lbs. for every 1,152 lbs. of fresh beet treated, or 1 5 per cent. The sugar so obtained was of bad colour and offensive flavour, and had to be further purified to fit it for use as an article of diet. Lampadius of Freyberg experimented with Achard's process, but it proved a failure commercially.

When peace was restored after the fall of Napoleon, colonial sugar was again imported into France. Although the duty upon it was very high, and beet sugar was produced free of duty, yet the foreign sugar displaced the home grown, and to stop this displacement the import duty on foreign sugar was greatly increased. This increased tariff had the desired effect, for it placed the production of beet sugar on a firm foundation, and made it a successful industry. In 1828 the yield of sugar from beet amounted to 4,000,000 kilos., and in 1838 to nearly 40,000,000 kilos., or a tenfold increase. The beet-root sugar was sold in France at the same price as its highly-tariffed rival, consequently the profits made by the beet-root sugar maker were immense. The public complained at the price charged for the home product, and the colonists also made their grievance felt. The result was that the Government could not withstand the attacks from within and without, when accompanied by a serious loss of revenue through the substitution of the duty-free sugar in place of foreign manufactured. A small duty of 16½ francs per 100 kilos. was imposed on beet sugar in 1838, and in 1840 the duty was

further increased to 27½ francs, or about 11s. per cwt. Even then there was a differential duty of 20 francs per 100 kilos. in favour of home grown beet sugar, which was a margin more than sufficient to cover the extra cost of manufacture. The complaints made by the home manufacturer that he was unfairly handicapped in the competition were to some extent neutralised by the affirmations of the colonial producer that the bounty placed him at a very great disadvantage. The truth seemed to be between the two extremes, for some of the home manufacturers were unable to continue their business, whilst at the same time the returns from the duty did not come up to the estimate of the revenue authorities. In these circumstances the drastic measure was proposed of suppressing the beet-root sugar industry altogether by abandoning the cultivation of beet, and paying a compensation of 40,000,000 francs to the planters. This proposition, seriously entertained by many who wished to deal out justice to the home and colonial producer of sugar, had a marked effect on the beet-root grower. His views of hardship were greatly modified, and he was willing to agree to a specified annual increase of duty (5 francs per 100 kilos.) till the duty on home and colonial sugar was equalised. The change commenced in 1844, and in 1848 the duties were uniform. The ruin of the home grower, though prophesied, was not effected by the change, for the falling off in the supplies of sugar from the French colonies, which took place between 1842 and 1848, when slavery was abolished, and other changes in the sugar industry of the world, gave such advantages that the beet-root manufacturer had practically a monopoly of the home market. He did not, however, enjoy continuous prosperity, but from the profits realised he was able to improve his methods of manufacture, till in 1858, the sugar estimated to be produced from the beet crop was 150,000,000 kilos., or about 150,000 tons. Ten years later the production was doubled.

The growth of the beet-root sugar industry in France has been somewhat minutely traced, because it fairly represents what has taken place in Holland, Belgium, Germany, and Russia. It is remarkable that an industry created as it was by the exclusion of foreign sugar from the Continent, and fostered by the imposition of heavy duties on its rivals, should have risen into such prominence, and that even after the privileges it enjoyed were taken away it should be able not only to hold its own in the country of its production, but be imported largely into other countries to take the place of its old competitor, colonial-grown cane sugar. Other anomalies connected with the sugar industry have since arisen, but they will be treated in a subsequent part of this lecture, when considering the burning question of "Bounties" which now agitates the Governments of this and other countries.

Maple Sugar.

Sugar is produced in large quantities in Canada and the United States from the *Acer saccharinum*, or sugar maple. The tree is valuable for timber as well as for sugar production, and as in the vicinity of towns timber has been in demand for building purposes, whilst facilities for the transit of goods have at the same time been increased, it has happened that the maples have been cut down, and sugar for the use of the population has been obtained from distant sources. In thinly populated districts the maple sugar industry is still carried on, and as the sugar is made in early spring before farming operations have fully commenced, it helps to swell the returns of the farm, because the outlay in securing the sugar crop is very small, and the profit is large.

The tree is pierced in early spring to a depth of two inches, and when the juice begins to flow as much as three gallons per day can be obtained from a single tree. The flow of the sap or juice is very uncertain, being largely dependent on climatic conditions, and varying from day to day, according to the weather. As soon as the foliage of the tree begins to form the sap ceases, or becomes so sour that it is useless for sugar making.

The produce of sugar from sap may be reckoned, on the average, as 1 lb. of sugar for every five gallons of sap, and the yield of a tree per season will be about 4 lbs. of sugar. The methods in use for clarifying and concentrating the juice are very primitive, but they closely correspond with what is done in the West India Islands when common muscovado sugar is produced, and the operations must be conducted with even greater rapidity on account of the juice being in a condition to pass rapidly into fermentation and decomposition. Maple sugar crystallises very easily in the mother liquor, and in this respect also resembles sugar from the cane.

Sorghum.

Of late years certain grasses, which at one period of their growth are rich in sugar, have

been cultivated in the United States. These grasses—chiefly *Sorghum vulgare* and *Sorghum saccharatum* have been under special cultivation and investigation by the United States Department of Agriculture, and elaborate reports on the subject have been issued. The crop has been cultivated because it appears to stand against the frost better than the sugar-cane, and it also arrives at maturity at a different season of the year. It was thought therefore that sorghum cultivation might supplement cane-growing, and thus one central factory might be used for manipulating the two crops. The industry, however, is not a large one, and as the quantity produced is on the descending scale it is apparent that that there is either some defect of quality, or that the cost of production is too high for commercial purposes.

In 1880, trials were made with sorghum growing on the Duke of Rutland's estate at Belvoir. Our variable climate, however, speedily put an end to these experiments. In the spring of that year the cold was very great and continuous, consequently the plants made very slow progress in growth, and though the month of August was favourable, the succeeding months were very unseasonable, and the crop never arrived at maturity. Under more propitious circumstances other results might have been obtained, but the experiment proved that a crop depending for its success so much upon warmth and regularity of temperature could never be depended on in a climate like ours.

In this, as in other crops, local circumstances may sometimes favour the growth and cultivation of a special plant or tree for the production of sugar, but as a rule the sugar of commerce known as cane sugar is produced from the cane or beet; and our remarks must therefore be confined to them in a general lecture, especially when, in this country at least, the sugar of commerce is obtained entirely from these two sources, the raw sugar for direct consumption being the product of the cane, and the refined sugar being more or less a mixture of the two.

The sugar-cane is in reality a gigantic grass. Its varieties are too numerous to recapitulate. The principal are the *Bourbon*, which came originally from the Malabar coast; the *Otaheite*, much cultivated in the West Indies; the *Batavian*, the *Chinese*, the *S. Pacific*, and the *Elephant cane* of Cochin China, which justifies its name by reaching the astonishing height of 11 feet in six months

In structure the cane has a knotty stalk, and at each knot a leaf and an inner joint. The root-bearing portion, or stole, is divided into two parts, the first formed of several peculiar joints varying in number from five to seven, divided from each other by a radicle leaf. The first cane joints are also provided with rudimentary roots, which develop when necessary until they form a basis sufficiently strong to support the cane itself. The roots are slender, with a few fibres at their extremities, and are seldom more than 1 foot long. The joints of the stalk vary from 40 to 80 in number; the individual joints themselves run from 2½ to 3 inches in length in the latter, to 8 to 9 inches in the former, and even in the same plant have various differences of length and thickness. The sap vessels are large and very numerous; the leaves, alternate and divided into two parts by a nodosity, expand on the top of the plant like a fan. From the centre of the last radicle knot the germ of the first cane joint springs, and requires from four to five months for its entire growth. During this time some 15 to 20 joints spring from it in succession, the period of maturity of each being ascertained by the decay of its leaf. Under cultivation very few of the canes ever bloom, and consequently the propagation has to be effected entirely by cuttings, any part of the stem having a perfect eye or bud serving the purpose.

On ripening, the canes are cut as close to the stoles as possible – the juice of the lower joints being richest in sugar. The top and the two upper joints are discarded, their juice being of very poor quality.

As to climate, anything approaching cold opposes growth, and so the whole of Europe is unfit, with the exception of a small portion of Spain. In certain parts of India the juice is sometimes spoiled by frost, and this is the case in Louisiana. An almost ideal soil is the "brick mould" of the East and West Indies —a mixture of sand and clay, hoed and dug with ease—constituted so as to allow air and moisture to penetrate to some depth, draining well, yet moist in the hottest seasons. Some of the best sugars are produced on limestone soils.

The importance of good manure will be apparent when it is considered that 1,000 tons of cane take from the soil nearly 5 tons of mineral matter, and it is obvious that if the soil cannot supply this in a form capable of assimilation, a full crop of sugar cannot be raised. The most important matters appear

to be potash, silica, phosphoric acid, lime, and magnesia, with a certain amount of nitrogen. Good stable manure and well fermented farmyard dung are much superior to superphosphate, which suits root crops better than graminaceous plants. Green soiling is much in favour, and attention is beginning to be paid to proper rotation of crops.

The canes having been gathered, the next operation is naturally that of extracting the juice. This is contained in small cells; and there are, broadly speaking, two methods of obtaining it. The older is by pressure, whereby the cells are broken, and the juice squeezed out; and for this purpose heavy roller mills, combined (or not) with disintegrators, are in use. The other depends on the fact that a solution of a crystallisable body, separated from another liquid by a thin membrane, is gradually deprived by that liquid of a part of the dissolved substance. That is, when cells containing cane juice are immersed in water, some of the sugar passes through the cell wall into the water, and by renewing the water systematically, the greater part of the sugar can be so extracted.

Beet.

The other great source of commercial sugar, the beet-root (*Beta vulgaris*), is a hardy biennial indigenous to Southern Europe, but cultivated with success in the United States, Canada, and New Zealand, and, as far as climatic conditions are concerned, in this country also. Its production here has always been extremely limited, although, about 22 years ago, Mr. Duncan, a London sugar refiner, tried to make sugar-beet production a success at Lavenham, in Suffolk. He there established a factory for extracting the juice from the beet, which juice, when brought to charge and concentrated, was sent for refining to his London factory. The growth of beet was stimulated by the offer of prizes to the most successful growers, but owing to circumstances arising out of the bounty system, the local factory was closed in 1874, and afterwards the London refinery was shut up.

The general characteristics of good beets are regular pear-shape, smooth skin, firm flesh, uniform structure, clean, sugary flavour, high specific gravity, and a weight seldom exceeding 1½—2½ lbs.

Perhaps the most esteemed of the many varieties are "white Silesian," "green neck," "red neck" (a favourite in France), and the "grey neck," all producing from 2½ to 3½ tons of sugar per acre. Internally, the beet is built up of concentric rings of small cells containing sugar and other bodies (principally salts of potash) in a watery solution. The sugar itself is identical with cane sugar, but the larger proportion of potash salts causes more difficulty to the refiner, and commercial samples are not quite so sweet as those from the cane. Beets contain no uncrystallisable sugar; molasses are produced by unavoidable changes in the course of manufacture.

Manure must be applied to beet soils with great caution, and only in the early autumn. Neglect often brings about big watery roots abounding in nitrogenous matters. Sowing should take place at the beginning or middle of April; if earlier, frost is apt to nip the young plant; if later, it runs a risk of not ripening. If the autumn is dry the roots may be left in the ground while the juice increases in gravity, but of all things frost must be avoided. After taking up, a good plan is to cover loosely in the field for two days, then trim and stack. The roots are well cleaned, sliced or rasped, and pressed or macerated much in the same manner as the cane is treated.

The Table IV. on p. 9 is of special interest, as it shows the steady increase in the quantity of beet sugar produced from the year 1873 to 1887, and the corresponding diminution of cane sugar. No doubt the increased consumption of refined sugar has accomplished this result; for while the beet cannot, on account of its strong objectionable flavour, be consumed in the raw state, still its freedom from molasses or uncrystallisable sugar causes it to be very much in demand for the use of the refiner, and at the present time there is very little refined sugar made exclusively from cane without any admixture of beet. The loaf sugar either of British or foreign manufacture now on the market will, when warmed in the hand, speedily reveal its origin, and however crystalline it may be, or faultless the colour, refined sugar containing beet will never lose entirely its offensively-objectionable smell and flavour. To the refiner, however, it possesses, as before stated, invaluable qualities, and on this ground its consumption is not likely to decrease, because refined sugar is steadily coming into more general use, even in those countries where raw cane sugar can be easily obtained.

TABLE IV.— Production of Sugar.

Year.	Beet.		Cane.				Total Tons.
			British.		Foreign.		
	Tons.	Per cent. of total.	Tons.	Per cent. of total.	Tons.	Per cent. of total.	
1873.....	1,110,166	38	362,729	12	1,478,257	50	2,951,152
1874.....	1.054,055	38	334,164	12	1.377,599	50	2,765,818
1875.....	1,317,623	43	332,878	11	1,412,606	46	3,063,107
1876.....	1,059,281	39	343,570	12	1,337,619	49	2,740,470
1877.....	1,101,141	40	407,195	15	1,263,918	45	2,772,254
1878...	1,420,827	45	393,536	13	1,305,207	42	3,119,570
1879.....	1,574,153	45	409,482	12	1,534,624	43	3,518,259
1880.....	1,403 929	43	371,486	11	1,503,444	46	3,278,859
1881.....	1,749,545	48	386,032	11	1,474.444	41	3,610,021
1882.....	1,783,200	47	498,396	13	1,517,688	40	3,799,284
1883.....	2,146,534	50	494,834	12	1,609,238	38	4,250,606
1884.....	2,360,314	48	608,037	12	1,939.494	40	4,907,845
1885.....	2,545,889	50	571,774	11	2,020,873	39	5,138,536
1886	2,137,351	44	545,030	11	2,157,820	45	4,840,201
1887.....	2,728,810	49	613.347	11	2,192,388	40	5,534,545

Sugar of Commerce.

The sugar of commerce can be divided into two large classes—Raw and Refined.

Each class contains many varieties and many shades of quality, but the term raw sugar is generally applied to sugar of whatever degree of purity manufactured on the plantation or place of production, and refined sugar embraces the large and comprehensive class of sugar re-manufactured from raw sugar at refineries or central factories.

At first sight it may appear to be a mistake to export from the sugar plantation sugar containing many impurities, and which has to be re-manufactured into the refined sugar of commerce, but a few moments' consideration will show why it has been necessary to submit many kinds of raw sugar to a further process of purification before being sent into actual consumption. To make sugar of good quality expensive machinery is required, and it is necessary to have an ample supply of fuel and water. The machinery now in use on sugar plantations is generally obtained from this country, and it has to be repaired and kept in working condition generally by English workmen. Fuel and water are usually very scarce, and coal, when used, has to be sent from Europe. Capital also generally commands a much higher rate of interest than in this country, so on these general grounds, as well as on special ones, the refining industry first found a home in Great Britain, France, the Netherlands, and Germany, but, from causes to be afterwards enumerated, the refiners' occupation in London, Bristol, and other large centres has been for many years a failing one, and France, Germany, and the Netherlands have appropriated the manufacture of loaf sugar, and can sell it on the English market cheaper than it can be produced at home.

On a sugar plantation the cane juice is only converted into sugar at a certain period of the year, when the canes are ripe; whilst at a refinery raw material can be obtained for continuous work, and the combination of capital, machinery, skill, and production on a large scale, enables sugar to be produced at a cheap rate, and of first and uniform quality.

The manufacture of sugar is one requiring considerable chemical knowledge, and at the plantation much sugar is lost through not having the proper appliances and apparatus at hand. In nature's laboratory the juices of the cane are changed, by an active chemical principle in the cane itself, into a sweet substance which is essentially a weak solution of cane sugar. Given certain conditions of temperature and ripeness of cane, this cane sugar is gradually converted into another description of sugar—glucose, which differs in chemical composition from cane sugar, possesses very different characters, and not only will not

crystallise as cane sugar does, but has the property of preventing by its presence the crystallisation of a quantity of cane sugar at least as great in amount as itself.

The sugar planter's art is not confined to growing the canes, and cutting them for extracting the sugar when the maximum quantity is present. The most responsible work comes in when the canes are removed to the sugar-house for crushing and extracting the juice; and it is here that the best of skill is required to obtain from the juice the maximum quantity of cane sugar in the best marketable condition. The nitrogenous ferment is in the juice, and the temperature and density of the juice are in favour of a rapid conversion of the cane sugar present into glucose. The juice is distinctly acid, and the chemist is aware that by acids it is very easy to convert cane sugar into glucose. On a commercial scale this process of making glucose would not pay, because glucose can be prepared with ease from cheaper materials than cane sugar; and when touching upon the use of sugar in breweries, glucose sugar will demand fuller treatment than is here necessary when considering it simply as an impurity in cane juice.

The first operation in the sugar-curing house is to add to the freshly-crushed juice lime or some other alkali to neutralise the acid of the juice, and to suspend the action of the ferment. The juice is then boiled in different ways, to coagulate the albuminous matter which contains the ferment, to clarify the juice, and to drive off superfluous water. This boiling is generally done over an open fire, and the same effect occurs as when for domestic purposes we boil a clear cane syrup. The sugar coming in contact with the bottom of the vessel is more or less burned, a substance called caramel is formed, and a quantity of glucose is produced at the expense of the cane sugar.

The appearance and composition of the common descriptions of commercial sugar show how crude the operations are at some of the factories or plantations, and from the finished article it is evident what advantages would be gained by employing better machinery, and working on a more scientific basis.

Muscovados and others of their class are light in colour, clean, with a good crystal, and from their sweetness and smallness of grain are popular favourites for cooking and other domestic purposes.

Three descriptions of sugar before us, viz., "Barbadoes," "White Clayed," and "Demerara," are fairly representative specimens of the raw sugar that is imported from our colonies and other tropical countries.

Barbadoes.—This sample is one which has been very fairly prepared with the commonest (crudest) appliances in use. It has been boiled down over an open fire to the crystallising point, the syrup has then been run into casks for crystallisation, and when the crystals have formed, the casks are turned bung downwards for the uncrystallised portion—the molasses—to drain out. The molasses contains a large quantity of crystallisable sugar, and it is boiled down to the crystallising point to obtain a further crop of crystals.

As the sugar in the cask is not by any means free from molasses, it follows that, when the cask is bunged up and exported, the molasses will settle down in the lower part of the hogshead, and this mixture of crystallised sugar and molasses forms the dark nodules seen in the sample, and is known in the trade by the designation of "Foots." When buying sugar of this description it is of the first importance to the buyer to know whether the quantity of "foots" is great or small, and if present in excessive quantity it is dangerous to buy such sugar for domestic use. When a duty was charged on sugar, a core of the sugar was taken out from one side of the cask to the other, so as to get a fair average sample of the whole bulk for an equitable assessment. For commercial purposes it is equally important to obtain a fair sample, but this is very difficult to do, especially as all the casks in one consignment even will not be alike in this respect, and it is therefore very necessary to avoid buying such sugar of too low a grade. The unsatisfactory character of sugar so made, and the low price it commanded in foreign markets, led many of the sugar planters to adopt methods for purifying the crystals from the molasses adhering to them.

Clayed Sugar.—A process introduced by the Spanish sugar growers was a marked improvement on the previous one. In this process the syrup was made to run into "forms," which in outline resembled a sugar-loaf turned upside down, and had a hole at the apex, which could be kept shut or open at pleasure. When the crystallisation of the syrup had taken place, the hole was opened for the discharge of the molasses. This discharge was hastened by spreading over the broad end a layer of wet clay. The moisture

steadily left the clay, percolated between the crystals towards the narrow point, and washed out the molasses. The process improved the appearance of the sugar, and gave it greater uniformity of composition, but the crystals suffered from the treatment, being made smaller through the solvent action of the water. When the operation was complete and the crystals dry, they were emptied from the forms and put into casks for exportation. This claying process is still in general use, for although there is considerable loss by the treatment, the complexion and uniformity of quality command a price which more than covers the increased cost of manufacture.

A small sample from the original package will fairly represent the bulk, and the distributor is thus spared the expense of thoroughly mixing together the heavy and dry sugar present in the hogshead previously mentioned, and putting the two kinds through a grinding machine to ensure uniformity in colour and grain.

Demerara Sugar.—The sugar with a large crystal, known in the trade as Demerara, requires special treatment for its production. Its special characteristics are a golden colour or bloom, a well-defined crystal, and a fine flavour. Very frequently it commands as high a price as loaf sugar, and at all times it fetches a far higher price than the small grained raw sugar of commerce.

Special care is taken that the canes crushed shall be sound; all rotten, diseased, or sour canes being carefully separated. The canes themselves are carefully assorted into different sizes, so that the layers put into the crushing mill shall be of the same thickness, and thereby subjected to an equal and uniform pressure.

TABLE V.—Composition of Different Qualities of Cane Juice.

Specific Gravity.	Weight per cent. of			
	Albumen.	Ash.	Sugar.	
			Crystallisable.	Uncrystallisable.
1·031	0·71	0·48	3·40	1·30
1·043	0·55	0·30	8·00	2·50
1·063	0·29	0·18	12·40	1·60
1·070	0·37	0·32	16·76	0·24
1·071	0·37	0·44	17·30	0·20
1·072	0·48	0·36	16·70	0·30

From this it appears that the juice thus obtained contain from 8 to 17 per cent. of cane sugar, ·20 to 2·5 per cent. of glucose, and it has a strong acid reaction. The acids present are both organic and mineral, the principal mineral acid being phosphoric. There is a distinct relation between the amount of acid and glucose present in the juice; the greater the acid, the more glucose, and, consequently, the sounder the cane the better the juice, and the larger the proportion of cane sugar.

TABLE VI.—Proportion of Ash to Cane Sugar in Ten Samples of Juice.

Cane Juice.	Beet Juice.
1 to 12·6	1 to 15·7
1 ,, 19·9	1 ,, 16·3
1 ,, 21·2	1 ,, 16·8
1 ,, 26·6	1 ,, 17·6
1 ,, 39·3	1 ,, 17·6
1 ,, 46·3	1 ,, 17·7
1 ,, 52·3	1 ,, 17·8
1 ,, 53·8	1 ,, 18·2
1 ,, 65·0	1 ,, 18·4
1 ,, 68·8	1 ,, 21·2
Average 1 ,, 40·5	Average 1 ,, 17·7

The juice having been extracted, the next operation is to prevent its passing into fermentation or acidity. It is conveyed into a close wooden tank, into which it is delivered in spray, and this spray is acted on by a stream of sulphurous acid gas, which enters the vessel from the bottom. This gas effects two objects, it prevents fermentation, and also bleaches the juice, so that when it leaves the vat the juice is brighter and clearer than when it entered it. The chemical changes which have taken place in the juice are that it is more acid from being impregnated with sulphurous acid, and the glucose has been slightly increased at the expense of the cane sugar.

Clarification is the next process in the refining operation, and this is effected by first adding suitable quantities of milk of lime, *i.e.*, till the juice has only a slightly acid reaction, as excess of alkali immediately darkens the syrup; more recently, acid lime phosphate has been employed in combination with milk of lime, with very satisfactory results. The boiling of the syrup so treated brings about rapid clarification, the flocculent matter, on standing, falls to the bottom, the clear syrup under the scum is carefully drawn off, the scum itself is pressed in properly constructed filters, and the clear juice obtained from it added to the bulk of the syrup. This clear

juice is a second time clarified, and then boiled and concentrated for crystallisation.

The evaporation is carried out in vacuum pans, the boiling point of the syrup being reduced, so that at no time it exceeds about 160° F. The boiling must not be too violent, or the crystals will be small, but if the evaporation is too slow, the sugar obtained is not of a satisfactory quality. The crystallisation proceeds rapidly, and when the critical point is reached for drawing off the sugar, or "striking," as it is technically called, it is run into moveable vats holding about 6,000 lbs. each. Before it has cooled it is put into a centrifugal machine with a little water, if necessary, which has the effect of clearing the crystals. When this operation is complete, the crystals of sugar remaining in the machine are carefully removed, examined, and packed for market.

The syrup separated by the centrifugal machine from the crystals of sugar contains a large proportion of cane sugar and the whole of the glucose. This syrup is usually diluted with water, made alkaline with lime-water, and then slowly boiled, and afterwards run into crystallising vats. In two or three weeks crystallisation is complete, and the crystals of sugar are then separated from the syrup by the centrifugal machine. These crystals of sugar are of small grain and are light in colour. The syrup separated may be treated as before, but the price of sugar generally regulates this operation, and if the market price be low the syrup may be used for rum-making.

It has been said that the manufacturer of Muscovado sugar makes good rum at the expense of the sugar, and that the maker of Demerara crystals produces good sugar at the expense of the rum. The Jamaica sugar growers make a very poor sugar, whilst the rum produced in the island is the best in the world, and the converse is true of the Demerara planter. His sugar is good, but the Demerara rum is of very poor quality, and fetches a very low price. The chemicals employed for purifying and clarifying juice must have a bad effect on the syrup residue, and the materials used for making rum are too impure to compare favourably with syrup residues obtained by the primitive methods generally in use in Jamaica. It may be taken as a fact that the rum made on the plantations which are famous for their special qualities of sugar is poor, and that, generally speaking, of late years, owing to improvements in sugar production, the rum which is sent to market is rapidly deteriorating in quality.

A sample of Demerara rum was sent to me in 1888, for examination, by an old friend who occupies the position of Chief Commissary of British Guiana. Its fault was too apparent, on account of its offensiveness of smell and taste, and the quality was too bad to allow it to be reckoned commercial rum. An analysis of the sample showed that organic sulphur compounds were present, and they were no doubt derived from the sulphites and other chemicals of a like kind used for bleaching the sugar. It was evident that there could be no improvement in the quality of the rum unless the chemicals were abandoned, or the objectionable sulphur compounds kept out of the spirit. The chemicals could not be put on one side, and consequently the second alternative—the arrestment of the sulphur compounds—only presented itself for solving the problem. The Commissary has devised an apparatus containing layers of charcoal, for passing through it the spirit vapour at a high temperature. The result has been that the sulphur compounds were thus decomposed, the sulphur left behind with the charcoal, and the spirit so much improved, that he is able to report that the rum from the distillery supplying the bad rum, "which was formerly sold with difficulty at low rates in London, very recently commanded the top price of the London market." This practical method of purification of rum made from chemically-treated syrups must be of very great value to the Demerara sugar-makers, and it may be made the means of bridging over the difference which now exists in the commercial value of the rums known in the trade as Jamaica and Demerara.

The demand for Demerara sugar has tempted the home refiner to manufacture an article known in the trade as "Imitation Demerara." One or two of these specimens are of very fair quality, of good grain and colour, and made almost entirely from cane sugar. But there are others having an artificial bloom, and an offensive smell, showing that they are made largely from beet, and by chemical tests the colour is proved to be artificial. The public should be on their guard against buying this objectionable counterfeit, for its use will certainly bring Demerara sugar into disrepute, and will make the consumer suspicious of its quality. It has been contended, in defence of this home product, that Demerara sugar when imported contains a large amount of impurities, that in

the interests of the consumer it should be refined and made more pure by the treatment. The contention is ingenious but not true, for Demerara sugar does not contain 1 per cent. of foreign matter, and is essentially suited for direct consumption. The sugar has been imitated because it fetches a high price in the market, and as it can only be made at a certain time of the year the supply is irregular. Scarcity of supply hardens the price, and there is no doubt that the quality of the sugar and the irregularity of the supply have tempted refiners to imitate the sugar, and to obtain a price for the refined imitation which it would not otherwise command. Legitimate competition always benefits the consumer, but in this instance the consumer may find to his cost that "Imitation Demerara" is comparatively dear, and some specimens of it are certainly very objectionable to smell and taste.

East India Sugar.

Almost every part of India and Burmah is suited to the cultivation, the only drawback being the dependence on irrigation for moisture at certain seasons. Notwithstanding, the area under canes is continually increasing, although the modes of growth, expression of juice and preparation, remain practically what they were in primitive times. "Refining" in the modern sense is unknown, except in the few European establishments, religious prejudice precluding the use of modern methods in native factories. The product of the European refineries is regarded by the native population as unclean, being, as they think, contaminated with bones and blood, on account of animal charcoal having been used for decolourising the cane syrup. The one innovation is the adoption of improved mills.

In other cane countries 30 to 36 tons of cane per acre are common. The half is hardly reached in India, so great is the neglect of proper selection of seed. Too rapid rotation of crops, absence of manures containing phosphates and mineral matters, late and irregular planting, careless sowing, deficient irrigation, and bad cutting, all bring down the yield.

In the West Indies 70 to 85 per cent. of the weight of cane is expressed; in India 50 to 55 per cent.; and whilst in the former the weight of dry sugar on each acre is three times that of molasses, in the latter the quantities are practically reversed, as there is twice as much molasses as dry sugar.

The juice is dealt with in two ways:—(1) Boiled to a dry consistency, when it is called "*shakur*" if clarified—"*goor*" if unclarified. (2) Boiled to semi-liquid, "*rab*;" pressed in bag with the feet, strained, and kneaded by trampling in the sun, this becomes the "*kacha chini*" of internal commerce.

The only further developments of semi-refined sugars in native hands are effected by boiling in milk and straining.

Exported to Europe, the raw sugars are valueless for refining, and can only be used by brewers.

"Rab" per acre = 4,500 lbs.
"Goor" ,, = 4,000 lbs.

Average out-turn of dry sugar (Muscovado):—

Barbadoes = 4 tons per acre.
Singapore = 3 tons, 4 cwt.——2 tons, 2 cwt.
Vicinity of Calcutta = 1 ton, 3 cwt.

Refined Sugar.

The sugar refiner establishes his refinery where fuel and water can be obtained cheaply and in plentiful supply, and at a seaport town connected with those countries from which raw sugar is imported in large quantities. Thus Bristol, which at one time had the command of the West India markets, also possessed a thriving sugar refining trade. As Liverpool and Greenock withdrew the West India trade from Bristol, so the refining trade left the banks of the Avon, and was established at Liverpool and Greenock. London had at the same time a very prosperous refining industry, but the foreign bounty system ruined the London refiners or compelled them to retire from business, and concurrently the Liverpool and Greenock refiners suffered, but not to a like extent, on account of being more largely engaged in the manufacture of soft sugars, which were not imported on bounty like refined loaf sugar.

During the last ten years, the Greenock system of manufacture has been successfully established on the banks of the Thames, and loaf sugar, now known in the trade as "cubes," has superseded the old loaf sugar, and enabled the makers of it to reap a profit, and to a large extent revolutionise their own branch of trade. It has been stated that in 1888 there were in London five refineries at work, turning out 200,000 tons of hard and soft sugars; in Liverpool ten refineries, turning out 258,000 tons; in Greenock seven refineries, turning out 233,000 tons; in Bristol two refineries, turning out 33,000 tons; in other places two

refineries, turning out 15,000 tons; making a total of 739,000 tons.

The refiner, having the command of a large and varied selection of cane and beet sugar, chooses for refining that most suitable to his special requirements, and in this way has, as before stated, a direct advantage over the owner of a sugar plantation who is tied down to his own produce, and can only work for a portion of the year. Continuous work and the choice of materials enable the refiner to turn out refined soft sugar at a lower price than raw sugar of the same colour and grain, and during the last few years sugar known as "refiners' pieces" has come steadily into favour with grocers, on account of its uniformity of quality and the convenient size and weight of the bags in which it is sent from the refinery, and these different descriptions of refiners' produce with loaf sugar in cubes, packed in 1 cwt. and 2 cwt. boxes, have for the present given new life to our refining industry, and enabled a few manufacturers to make profits instead of losses.

Some of these "pieces" whose complexion is very fair have a very unpleasant odour. In fact, it is the rank smell of some of them which unfits them for use as distinct substitutes for common raw cane sugar, because it matters not how dark and unsightly the raw sugar is, it has a smell and flavour distinctly pleasant to nose and taste.

Some idea of the impurities to be removed by the refiner may be gained when it is considered that 100 parts of raw sugar ash contain practically:—

	Cane.		Beet.
Potash	28·79	....	34·19
Soda	·87	....	11·12
Lime	8·83	....	3·60
Magnesia	2·73	....	·16
Oxide of iron	6·90	....	·28
Sulphuric anhydride	43·65	....	48·85
Silica	8·29	....	1·78

after the usual treatment with sulphuric acid. In addition, there are glucoses, low sugars, and other organic matter present.

The operations of the refiner consist in re-melting the raw sugar, carefully filtering the syrup from its impurities, clarifying it by passage through animal charcoal, boiling down the decolorised syrup at a low temperature in the vacuum pan till the syrup is ready to crystallise, and then crystallising this syrup in the way to produce the exact description of sugar he desires. The sugar when at the crystallising point is technically called the "masse-cuite;" and if loaf sugar is required the mass is run into moulds of suitable size, and if granulated or soft sugar is wanted, the syrup, when of proper consistency, is put into a centrifugal machine, by the action of which the syrup is driven out from the crystals. This syrup is again boiled and condensed till it reaches the crystallising point, when it is transferred to the centrifugal machine and treated as before.

Moulded cube sugar is made in the form of slabs or sticks, which are afterwards cut into cubes or tablets. The inventions for this purpose are extremely numerous, the chief being perhaps those of Langen, Tietz, Duncan and Newlands, and Walker and Patterson—all in operation on a manufacturing scale. The masse-cuite is cast, so to speak, in moulds, liquored, and dried, either by revolution in the centrifugal or by stoving.

An inferior class of cube sugar is sometimes obtained by pressing the centrifugal granular sugar in moulds of required shape; usually cubes or sticks of sugar (which can easily be cut into cubes) are produced.

A sugar much in favour in the United States is the granulated—which must not be confounded with the so-called German or Austrian granulated, this being mostly raw beet sugar washed with steam. It is practically free from moisture and impurity, is easily dissolved, and does not lose weight or colour on keeping. It is refined in the ordinary way, and boiled to a small sharp grain like that of loaf, and washed as usual in the centrifugal. On leaving it contains 1 to 1½ per cent. of moisture, and in this state it is delivered to the granulating machine, in which it is dropped in a continuous shower on a hot cylinder, and gradually worked to the end, and then sifted and sorted automatically into grades ready for packing. Hersey's machine will granulate 6,000 lbs. per hour.

Many special processes are in use for the removal of such impurities as resist the general mode of treatment just described. Thus, the "alum process," for potash salts (Duncan and Newlands), consists essentially, in the addition to the cold syrup of raw sugar, of enough sulphate of alumina to precipitate the whole of the potash, neutralisation being effected by lime. Oxalic acid has been proposed by Gill for the same purpose. Strontium, which combines with sugar, is sometimes employed, but not at present to any great extent.

Favourites in some refineries are Easte's

"Chloride of Sulphur," and Boivin's "Sucrate of Lime" processes; in this country their use is limited, if, indeed, they are employed at all.

Sugar Analysis.

Sugar analysis is a very wide subject, which cannot in the space at our disposal be adequately considered; but as the ordinary commercial analysis of sugar is mainly confined to the determination of its value to the sugar refiner, it will be interesting to notice how commercial analysis is usually conducted.

The determinations usually made are:—(1) The moisture; (2) the cane sugar; (3) the ash; (4) the uncrystallisable sugar; (5) the other organic matters; (6) the insoluble constituents.

The organic matters referred to in No. 5 are usually classed together, since their separate estimation would entail lengthy and elaborate processes without any corresponding advantages to compensate for the labour. In this group are betaine (an alkaloid present in beet juice), cellulose, albumen, gum, fat, caramel, and wax. The insoluble substances present are generally accidental impurities, and consist chiefly of sand, clay, and vegetable fibre.

For the estimation of the cane sugar the polariscope is generally used, in fact, it would be impracticable to conduct the large number of analyses required by the purchaser and refiner of sugar by chemical manipulation only.

On account of the importance of this instrument to the sugar refiner it demands a passing remark respecting its construction and application to sugar analysis.

A ray of ordinary light is propagated by vibrations in all directions at right angles to the path of the ray, but by suitable means—such as passing the ray through a crystal of Iceland spar—all these vibrations can be reduced to vibrations simply in one plane. A ray so transmitted is said to be polarised.

Cane sugar, in common with some other bodies, has the power of twisting or rotating this plane when the polarised ray of light is made to pass through a solution of it, the amount of twist being regulated by the quantity of sugar in the solution through which it is made to pass.

The polariscope is merely a convenient practical instrument for utilising all these properties, and is constructed to produce a polarised ray, then, by means of the solution to be tested, rotating its plane, and finally, by properly-constructed scales, to measure the amount of twist caused by the solution through which the ray has passed. The strength of the sugar solution and the length of the column of liquid through which the ray passes being known, there is no difficulty in working out by a simple calculation the quantity of cane sugar present in the sample.

In the ordinary commercial analysis of sugar, however, there are certain substances present which interfere with this determination. The uncrystallisable sugar twists the ray in an opposite direction, and therefore the quantity of uncrystallisable sugar must be determined separately. Again, the salts present in the sugar have a prejudicial effect on the crystallisation of the cane sugar, and those present in beet sugar are worse than those in that made from the sugar-cane. It will therefore be apparent that in setting out the value to the refiner of a commercial sugar, certain modifications of the actual results obtained have to be made to cause the assumed yield practically to coincide with the actual quantity produced by the refiner.

The following example will show how this is done in practice. A sample of beet sugar was found to give 92 per cent. of crystallisable sugar, 1¼ per cent. of uncrystallisable sugar, and 1 per cent. of ash. The 1 per cent. of ash would in the case of beet sugar prevent five times its weight of crystallisable sugar from crystallising in the refining process, and in the case of cane sugar three times its weight. The result of the analysis would thus be given:—

Crystallisable sugar		92 per cent.
Deduct uncrystallisable sugar	1¼ per cent.	
,, ash 1 × 5	= 5 ,,	
Total deduction	6¼ ,,	
Value to refiner	85¾ ,,	

Even in a refinery many parcels of sugar cannot be estimated as above described, their colour, composition, or other peculiarity requiring special treatment.

Sugar for brewers' use, and for general analysis, has to be examined differently, but as the methods in use are somewhat elaborate, and would require special description, it is not necessary to refer to them in detail in a popular lecture. Those who wish to make the subject a specialty must study works devoted to the analysis of commercial materials, which contain not only methods of analysis, but also point out the difficulties which arise in con-

ducting general sugar analysis, and the best means to evade or overcome them.

Sugar Duties Imposed.

The importation of sugar was sufficiently large in the time of James I. to attract the attention of the then Chancellor of the Exchequer, and a duty was imposed upon it. The greater part of our supplies of sugar were at first obtained from the British West Indies, the agreement between the colonies and the mother country being that the colonies must send their sugar here exclusively, and the mother country would, in return, give them a monopoly. British sentiment was also aroused against the importation of sugar produced by slave labour, and consequently the sugar market was very unsettled from these causes. It was seen that no restrictions, however severe, could keep out slave-grown sugar, or limit our supplies to what was grown in our own colonies. The agitation only increased the price of sugar to the consumer, and stimulated artifice in defeating the regulations laid down for the importation of sugar. At length common sense overcame sentiment, and though no efforts for the abolition of slavery were relaxed, yet it was seen that the only practical course open was to allow the importation of sugar from any country. Healthy competition soon changed the source of our sugar supplies, and in this connection the following comparison may be interesting.

TABLE VII.—Imports of Sugar.—West Indies compared with Total.

Year.	West Indies.		Total.
	Practically all raw.	Per cent. of Total	
Average.	Cwts.		Cwts.
1846–50	2,716,800	38·9	6,980,000
1851–55	3,137,000	38·8	8,074,000
1856–60	3,151,000	35·4	8,902,000
1861–64	3,611,000	33·2	10,851,000
1872–75	3,970,677	23·3	16,998,437
1876–80	4,076,306	20 9	19,487,004
1881–85	3,210,066	13·8	23,265,981
1886–89	2,033,201	8·2	24,702,329

From 1801–1810 the average was 91·1 per cent. of the total sugar imported.

This change of policy has had a disastrous effect on our sugar-producing colonies. Protected at first by differential duties, they depended on the favour thus shown for their profits, and with the abolition of slavery they found themselves obliged to pay much more for labour than their competitors. Finally, the equalisation of duties took away the last vestige of protection, and the colonial sugar industry has, as a matter of course, made little headway, it being indeed on the road to decay, and the sugar plantations have become of little value. The change of policy, although seriously injuring our colonial industry, has wonderfully stimulated the consumption of sugar through the reduction in price, and we have lately had to go to continental sources for a large proportion of our supplies.

In the reign of Queen Anne the duty on sugar of all kinds was 3s. 5d. a cwt.; in 1780 it was 6s. 8d., in 1787 it was 12s. 4d., and in 1791 it was raised to 15s. Increased war expenditure heavily taxed the resources of the Chancellor of the Exchequer, and without giving much consideration to the question as to whether sugar could successfully carry a larger duty, he raised the duty in 1797 to 17s. 6d., in 1799 to 20s , and in 1806 to 30s. From the action of the Legislature it can be seen that the last impost was due rather to the action of persons driven to their wits' ends for money than of cool-headed statesmen, for it was enacted that if, during a certain period named, the price of sugar in bond should fall below 49s. a cwt., there should be a rebate of duty of 1s. a cwt.; if below 48s., 2s.; and if below 47s., 3s. a cwt. might be remitted.

In 1826, the duty on West India sugar was made 27s., without regard to price. In 1830, the duty on West India and Mauritius sugar was reduced to 24s., while East India sugar was as high as 32s. The following Table will be of value in studying the variations of the sugar duty. In 1836, the duties on these sugars were equalised at 24s., but sugar from other countries continued to be charged with duty at 63s. a cwt. This great difference of rates was intended to act as a prohibition on the importation of what may be justly termed foreign-grown sugar, and the effect of this difference was shown in the great variation in price in bond of our colonial sugar and its competitors. It must follow that such a protective duty would cause the colonial sugar grower to place a fancy price on the sugar he made, so that the difference between the two rates of duty might appear a little less than it really was. And this increase of price was so apparent that in 1844 a colonial sugar

TABLE VIII.—DUTIES FROM 1837 TO 1854, WITH QUANTITIES OF HOME-GROWN SUGAR CHARGED.

Year.	Home-grown.		Customs Duties.								
	Cwts. charged.	Excise duty.	Colonial.	East Indian.		Foreign.					
				Any British Possession within East India Company's Charter in which foreign sugar is prohibited.	Any other British Possession within those limits, and thence imported.						
1837.....	—	—	£1 4 0	£1 4 0	£1 12 0	£3 3 0					
1838.....	129	£1 4 0	,,	,,	,,	,,					
1839.....	16	,,	,,	,,	,,	,,					
1840.....	104	£1 4 0 and 5%	1 5 2⅔	1 5 2⅔	1 13 7⅔	3 6 1⅔					
1841.....	2,355	,,	,,	,,	,,	,,					
1842.....	3,477	,,	,,	,,	,,	,,					
1843.....	3,843	,,	,,	,,	,,	,,					
						Any foreign country (not produced by slave labour).		Other foreign sugar.			
1844.....	5,597	,,	,,	,,	,,	£1 15 1½		£3 6 1			
			Equal or Not Equal to White Clayed.								
			Equal.	Not equal.	Equal.	Not equal.	Equal.	Not equal.	Equal.	Not equal.	
1845.....	4,371	14/-	16/4	14/-	16/4	14/-	£1 1 9	18/8	£1 8 0	£1 3 4	3 3 0
							Any foreign country.				
							If imported direct.			Otherwise imported.	
							Equal or not equal to white clayed.				
							Equal.	Not equal.			
1846.....	3,585	,,	,,	,,	,,	,,	1 0 5	17/6	£1 4 6	£1 1 0	£2 2 0
1847.....	177	,,	,,	,,	,,	,,	0 19 10	17/-	1 3 4	1 0 0	,,
1848.....	nil.	,,	From 1848 to 1854 the duties were progressively reduced.								
1849.....	,,	,,									
1850.....	,,	11/-									
1851.....	6	10/-									
1852.....	347	,,									
1853.....	1,538	,,									

sold in bond at 33s. was of no better quality than its competitor at 17s. 6d. a cwt.

Such an indirect tax on the consumer could not long be defended, and as at this juncture the quantity of sugar imported from our colonies largely diminished, it was necessary, in the interest of the user of sugar, to make a change in the rates of duty to meet the abnormal condition of the sugar market.

In 1845, the duty on British colonial sugar was reduced to 14s. per cwt., a special rate of 23s. 4d. per cwt. was imposed on free labour sugar, and slave labour sugar remained at 63s

At this period of our history the principles of free trade were not only widely preached, but took hold of public opinion. One result was the abolition of the Corn Laws, and in 1846 the Act 9 and 10 Vict. c. 63 equalised the duty on all descriptions of foreign sugars, whether produced by free or slave labour. The full equalisation of the sugar duties did not come into force until July 5, 1854.

TABLE IX. — TABLE OF DUTIES FROM THEIR EQUALISATION IN 1855 TO THEIR ABOLITION IN 1875, WITH QUANTITIES OF HOME-GROWN SUGAR CHARGED.

Year. Ended 31st March	Cwts. of home-grown sugar charged.	Rates of duty.					
		Refined.	White clayed.	Yellow Muscovado.	Brown.		Molasses.
1855.	1,217	16/-	14/-	12/-	11/-		4/6
1856.	657	£1	17/6	15/-	13/-		5/4
1857.	104	,,	,,	,,	,,		,,
1858 to 1862	nil.	,,	,,	,,	,,		,,
1863.	140	,,	,,	,,	,,		,,
1864.	nil.	,,	,,	,,	,,		,,
						Not equal to brown.	
1865.	1,064	12/10	11/8	10/6	9/4	8/2	3/6
1866.	590	,,	,,	,,	,,	,,	,,
1867.	18	,,	,,	,,	,,	,,	,,
			Not equal to refined.				
			1st class.	2nd class.	3rd class.	4th class.	
1868.	2,940	12/-	11/3	10/6	9/7	8/-	,,
1869.	17,443	,,	,,	,,	,,	,,	,,
1870.	28,710	,,	,,	,,	,,	,,	,,
1871.	29,721	6/-	5/8	5/3	4/9	4/-	1/9
1872.	34,965	,,	,,	,,	,,	,,	,,
1873	62,738	,,	,,	,,	,,	,,	,,
1874.	83,690	3/-	2/10	2/8	2/5	2/-	10d.
1875.	5,005	,,	,,	,,	,,	,,	,,

Difficulties from other quarters had presented themselves for solution before the equalisation of the duties, but the necessity for settling them had been partially suspended by the pressure of the burning question of the equalisation of the sugar duties. It has been mentioned in a previous part of this lecture that when the first Napoleon, through being at war with his maritime neighbours, lost the command of the foreign market for the supply of sugar to France, he tried to cultivate the beet for the sugar it contained. Production was stimulated by the fact that sugar in France had risen in price to about 6 francs a pound, and as the consumption of raw sugar in that country was considerable, it was self-evident that the sudden cutting off of supplies caused great inconvenience, and gave rise to dissatisfaction. After much difficulty, the problem of a home sugar supply was solved; it could be produced from beet in sufficient quantity for the national requirements, but the product obtained, though good in colour, was most offensive in smell and taste, and could not be employed as an article of diet without special purification. The French, as well as other nations who had to depend upon beet for their sugar supply, were compelled to manufacture refined sugar for domestic use. Other countries, too, who produced sugar from the cane, made different qualities of commercial sugar, and it was apparent from the descriptions of sugar of varying quality put on the market, that a uniform rate of duty of all qualities of sugar was not just in its incidence, or fair to the consumer. Complaints were made by the representatives of those countries which produced as their staple trade low qualities of sugar, that a uniform duty on all sugar imported was very unjust, while the refiner of sugar, and the producer of best brands of raw sugar were satisfied with a uniform scale. Complaints were so general, and the object aimed at was so just, that an effort was made in 1855 to classify the sugars imported. The classification decided upon was—

	s.	d.	
Refined	16	0	per cwt.
White clayed.....	14	0	,,
Yellow Muscovado	12	0	,,
Brown ,, ...	11	0	,,
Molasses.....	4	6	,,

The principle thus established was good, and in intention was all that could be desired for an equitable settlement, but as these classifications had to be made with rapidity and despatch, it was apparent that such a novel assessment of value hastily thrust upon Government officials would provoke discontent, and give grounds to persons wishing to upset the classification to say that the assessment had not been correctly made. Dissatisfaction continued to grow till, in 1862, the question was brought before the House of Commons, and a committee was appointed to inquire into the subject and report to the House.

Representatives of all sections were heard, and, as usual, self-interest seemed to guide all the witnesses in their opinions and conclusions.

Our colonial planters considered the classified rates of duty unjustly operated against them in charging their sugars with a higher rate of duty as soon as the quality was improved. The grocers, through their representatives, contended that the classification should be simply into two classes, refined and unrefined, and thus they would be able to obtain a full supply of good grocery raw sugar for consumption.

The refiners were not in favour of one uniform duty, as this policy would shut out of the market the low quality sugars, and thus reduce our importation of those sugars from which they drew their supplies for refining purposes.

With such a conflict of interests it was to be expected that there would be a corresponding divergence of opinion, and as the advocates of the different classes of interests were men of position, and were represented on the Commission, the final report was naturally not unanimous; still the following was carried by a large majority:—

1. That the amount of revenue now derived from sugar could not with justice to the consumers of the lower classes of sugar be raised by any uniform duty applicable to all classes.

2. That it is not possible to charge sugars with duties varying exactly with the quality or value.

3. That it is necessary to maintain the principle of a scale of duties with standards designed to include several classes of sugar within each range of duty.

4. That the duties ought to be so regulated as to encourage the largest possible supplies of sugar from the various sources of production, in whatever form the same may be imported, whether as refined sugar or in combination with other substances, to be afterwards separated by the process of refining.

5. That the existing scale may be rendered more equitable by such an alteration as shall admit at lower rates of duty the inferior portion of the sugars which are now liable to pay 12s. 8d. and 16s. respectively.

6. That sufficient evidence has been laid before the Committee to warrant the conclusion that such alterations might be made without any important risk to the revenue.

7. That the evidence does not justify the Committee in recommending the adoption of refining in bond.

This report, though short, was a very able one, and, in principle at least, was satisfactory; but in its adaptation to trade requirements difficulties of necessity arose, especially with regard to duty assessment and classification. The refiner, since he did not manufacture in bond, had to pay duty on the raw sugar as it went into his factory, and not on the quantity of refined actually made. The question to solve was therefore, taking refined sugar as a standard of quality, what rates should be levied on raw sugars of different grades as regulated by this standard? It was a simple matter for the chemist to find out the composition of any sample of sugar submitted to him, and to express the results in moisture, cane and grape sugar, and mineral matter. But the refiner who had to manipulate the sugar in the process of refining was aware that a chemical analysis, though useful within certain limits, could not be taken as the actual outcome of what was obtained in commercial practice. It has been before stated that glucose prevents its own weight of cane sugar from crystallising, and the soluble alkaline salts act more seriously still in the same direction, especially in the case of beet sugar. Thus it is expected that the refiner, when working on beet sugar, will for every percentage of ash present lose five times as much crystallisable sugar, and in the case of cane sugar three times. These difficulties, arising in construing the chemist's results of analysis into the actual yield of the refiner, were not easily surmounted, and they were further increased by our drawing large supplies of refined sugar from the continent on which drawback had been paid. It was contended by the home refiners that the drawbacks granted by certain foreign countries were too high, and that they acted as bounties, enabling the foreign refiner to put on our market loaf sugar at a lower price than it could be produced here. This complaint soon reached the acute stage, and in November, 1864, a convention was signed between Great Britain, Belgium, France, and the Netherlands, its object being to regulate by common agreement the international questions relating to the laws affecting sugars, and especially to assimilate the drawback on exported refined sugar to the duties on the raw material. A prominent feature of the programme was that a series of experiments should be conducted on a commercial scale to determine the real yield due from sugars of different origins and qualities. Pending these experiments, Article I. regulated provisionally the minimum yields of refined sugar per 100 kilos. of classified raw

sugar used, these yields to be modified according to the results of the proposed trials. In 1865 arrangements were made for carrying out the experiments, and it was decided that the sugar to be operated on should be bought in England, the English market offering the greatest variety, and that the refining should be carried on in neutral territory, and the expenses of the experiments shared by the contracting countries.

Cologne was the place selected for the experiments, an approved factory was hired, and the experiments were conducted by practical refiners, under the supervision of the Prussian Revenue officers, and concluded in August, 1866.

In the following month a conference was held between the representatives of the Powers signing the convention and the delegates of the same who had been charged with the supervision of the experiments. The yields of the different operations were worked out, and the provisional estimates in Article I. of the convention were modified accordingly, and were as follows :—

Nos. of Series of Dutch Standards.	Provisional. Minimum yield.	Actual yield by Cologne experiments.
	Kilos.	Kilos.
18, 17, 16, 15.....	87	94
14, 13, 12, 11, 10 ...	85	88
9, 8, 7	81	80
Below 7.....	76	67
Average	82½	82½

On the existing rate of duty per cwt. for refined sugar the yields were equivalent to—

	s.	d.	
Refined	12	10	per cwt.
1st Class Raw	12	1	,,
2nd ,, ...	11	4	,,
3rd ,, ...	10	3	,,
4th ,, ...	8	7	,,

The series of experiments had been difficult of execution, nor were the troubles of the Sugar Convention yet over. In October, 1866, a declaration was signed by the four parties to the convention, accepting the new scale of minimum yields for the duration of the Convention (ten years), and fixing May 1st, 1867, for the commencement of its operation.

In Great Britain an Act was passed in the following April, and the duties and drawbacks were fixed, according to standard, thus :—

	s.	d.	
Refined and Candy..	12	0	per cwt.
1st Class Raw.....	11	3	,,
2nd ,, ...	10	6	,,
3rd ,, ...	9	7	,,
4th ,, ...	8	0	,,

An effort was made to bring the convention into effect on March 1st, 1867. Holland declined, and named April 1st instead, but this did not meet with acceptance, and the original date, May 1st, was adhered to.

In principle the convention was agreed to, but France had a method of her own in carrying it out, which gave rise to much bitterness and angry feeling amongst the refiners. By Article IV. of the convention, Powers granting a uniform drawback were to correlate import duties with the yield obtained by experiment. France was not charging a duty at the time the convention was signed, as she had just introduced a system of "temporary free admission" of sugar intended for exportation after refining. She accordingly retained her existing duties, viz., two rates for the four classes of raw sugar.

Below standard 13, 42 francs per 100 kilos.
13 to 20, 44 ,, ,,

As she had no drawback to equalise with duties, the import duty on refined sugar was, by Article XIII., to be 15 per cent above the duty on raw sugar of the highest class, this percentage to be modified by the results of the experiments. These experiments raised the yield from 87 to 94 kilos, so that pure sugar taken as 100 was only 6·4 per cent.—94 : 100 :: 6 : x ($x = 6{\cdot}4$) — instead of 15 per cent. 87 : 100 :: 13 : x ($x = 15$ per cent.).

It was clear enough that in the terms of Article XIII. the yield being altered from 87 to 94, the duty on refined sugar should be modified accordingly, but instead of adhering to the terms of the convention, the French authorities took the average yield of the four classes, which remained the same, and imposed an import duty on refined sugar of 44 fr. + 15 per cent. = 50 fr. 60 c. The British sugar refiners contended that the rate should have been 44 fr. + 6·4 per cent. = 46 fr. 81 c., and that France was, if not paying a bounty, imposing a protective duty on foreign refined sugar. The operation of these rates will be seen in the following Table : —

TABLE X.

Raw Sugar.			Refined Sugar.				
					Effect of higher rate, 50 fr. 60 c.		Effect of lower rate 46 fr. 81 c.
Class of sugar used.	Yield per 100 kilos.	Duty on importation per 100 kilos.	Duty paid by French Refiner per 100 kilos.	Duty paid by Foreign Refiner on importation per 100 kilos.	Surtax on Foreign Refiners per 100 kilos.	Surtax on French Refiner per 100 kilos.	Surtax on French Refiner per 100 kilos.
Nos.		Frs.	Frs.	50 fr. 60 c. / 46 fr. 81 c.	Frs.	Frs.	Frs.
15—18	94	44	46·81		3·79	—	—
13—14	88	44	50·00		·60	—	3·19
10—12	88	42	47·72		2·88	—	·91
7—9	80	42	52·50		—	1·90	5·69
Below 7	67	42	62·68		—	12·08	15·87

The operation of the higher scale was to protect the French refiner on all but the lowest qualities, and the effect of the lower scale would have been to overtax him on all qualities below Standard 15. No understanding could be arrived at between Great Britain and France, though Holland and Belgium read the terms of the convention in accordance with the views of the British Commissioner.

As a compromise, it was suggested that a fresh meeting of the Commissioners who drew up the 1864 convention should take place at the Hague, to determine the matter in dispute. This meeting was held, and resulted in fixing the duty on refined sugar at 48 fr. 85 c. per 100 kilos. In August, 1872, a conference of delegates from Belgium, France, Holland, and Great Britain met to discuss the question of modifying the terms of the convention of 1864, which was considered not to have fulfilled its purpose, viz., the adjustment of tariffs so as to abolish bounties. The remedy advocated by the English representatives was compulsory refining in bond; but owing to difficulties in carrying out such a scheme and the objections raised to it, the conference simply closed with an agreement being entered into by the delegates to invite their respective Governments to inquire into scientific methods of analysis with a view to discover what processes, if any, existed, which were not too technical or lengthy to admit of application on a large scale.

During the year the inquiry was instituted, and the conclusion arrived at was that the colour tests of the standards were faulty, and that a great improvement in the examination would be the application of the polariscope to the determination of the crystallised sugar present. In the following year a conference was held at Paris, and whilst not being able to suggest any remedies, the members were unanimous in opinion that the convention of 1864 had not fulfilled its purpose, and that the principal defects of that convention mainly arose from the fact that the classification of raw sugar by colour was liable to large errors; that sugars of different origin and of widely-different saccharine value got into the same class; that the different shades of sugar from which one particular per-centage yield was required extended over too wide a range; a trader by systematically using the best in one class could get a small bounty on the whole refined produce; that raw sugars were, for the purpose of evading the duty, artificially darkened to appear worse than they were; and, further, that British refiners obtained drawback on half-refined sugar (pieces) as refined sugar, by decolouration through charcoal.

Refining in bond, which was again suggested as the only true remedy, was objected to on the ground of expense, and, as a half-way measure, it was suggested that optical saccharimetry should be made a part of the official determination of the value of sugar, and that the classes of sugar should be either increased in number or suppressed altogether. From so many repeated failures it was evident that the question of bounties was one which was looked upon differently in the countries interested, and, as there could be found no common ground of agreement, it was apparent that conferences and discussions could do little to solve the problem. In 1876 another conference was held in Paris, to consider a modified scheme of refining in bond presented by the Dutch delegates. This scheme consisted of taking account of all sugar entering

the refinery, duty being levied upon the refined sugar as it passed into consumption, no import or export duty, and each country to be free to abolish or fix its own rate of duty on sugar for home consumption. A Belgian scheme, based on a French method of saccharimetry, and revision of types or standards, was also considered, and the French representatives expressed themselves favourable to levying surtaxes on sugars from countries paying bounties.

None of the proposals obtained general assent, and after delays and discussions innumerable, nothing was done to get over the bounty system.

The sugar industry of this country having been almost ruined by the system of foreign bounties, the subject was brought before the House of Commons, and a select committee was appointed, which recommended a conference of the sugar-producing Powers of the world, and accordingly invitations were issued in 1881.

Side issues were raised by different Governments, which had the effect of delaying the assembling of a conference, and in some cases conditions were imposed which could not be accepted by other Powers. Associations interested in the sugar trade, and in the abolition of bounties, kept up an agitation till 1887, and in this year the Government was induced to open up negotiations for a conference.

It will be at once apparent, from the length of time the agitation continued, that it was not a distinctly political question, and from the number of countries interested, we can see that the question to be settled was one of vast importance, and considered so by politicians of all shades of opinion. Preliminaries for a conference were settled, and at last, in July, 1887, a formal invitation was issued from the Foreign-office to the countries concerned. On November 24, representatives from the following countries met in London, under the presidency of Baron de Worms:—Germany, Austria-Hungary, Brazil, Denmark, Spain, France, Great Britain, Italy, Netherlands, Russia, and Sweden. Portugal, Norway, and Roumania declined, because they were not interested in the question. The United States was not officially represented, but the Secretary to the United States legation attended some of the meetings.

Seven sittings were taken up with considering the question involved, and drawing up a draft convention for the consideration of the respective Governments represented. This draft engaged the Powers to afford complete guarantees against bounties, to levy duty (if any) on the amount of sugar actually destined for home consumption, by a system of manufacturing and refining in bond.

Belgium made a reservation in favour of retaining the prevailing system of charging duty on the sugar syrup, her reason for so doing being that refining in bond was deemed to be impracticable. As a compromise she offered to raise the estimate of produce on which the charge was based, and lower the duty to a point which she considered would practically abolish bounties.

During April and May, 1888, the conference sat in London, and amplified the draft convention on the following bases:—

1. Government supervision of factories and refineries.

2. The exclusion or taxing of bounty-fed sugar.

On August 30th of the same year the convention was signed by the representatives of Great Britain, Germany, Austria, Hungary, Belgium, Spain, Italy, Holland, and Russia. Austria's adherence was conditional on the agreement of all other sugar-producing European powers to join the convention at or before the time fixed for its coming into force, viz., September 1st, 1891.

Denmark and France declined to sign, the former objecting to the exclusion of bounty-fed sugar as liable to clash with the most favoured-nation clause in her treaties, and the latter deferring her adhesion till all sugar-producing countries had joined the Union. France, however, if she has not adopted the true economic principle as regards bounties, has at length begun to feel the burden of her present system too heavy, and is now seeking to reduce it considerably. A recommendation now made by the Government will, if adopted by the Chamber, lower the amount with which the French refiner is practically subsidised by 30 to 50 per cent., and, leaving him less able accordingly to cope with his foreign competitors, must diminish to a large extent the supply of refined sugar to this country. As it is not impossible that Germany and other continental sugar-producing countries may pursue a similar policy, the stimulus to abnormal production will be largely withdrawn. Such a partial disappearance of foreign competition would, of course, greatly benefit the English refining trade, though probably the English consumer would miss the bonus virtually given to him by the foreign

taxpayer when, as would no doubt be the case, the present low prices of sugar had risen to something like their former level.

The convention is still, however, beset with difficulties, and it may even now happen that, from causes which cannot be here touched upon, the whole work may have to be done over again before a satisfactory settlement is made.

Bounty-fed Sugar: its Meaning.

From what has been said when dealing with the classification of sugars for duty, it is evident that different descriptions of sugar, as well as many of the same kind, vary greatly in composition. As long as raw sugar was consumed as such, the variations in its composition were not so apparent as when much of it was refined and exported to other countries.

To enable the home manufacturer to compete fairly in foreign markets, it is the rule that the duties which have been paid on the goods exported shall be returned at the time of shipment, and this return of duty is called the drawback.

When such goods are exported in the same condition as they were in when the duty was charged, there is no difficulty in granting an equitable drawback.

If, however, the goods be charged with duty in one condition and exported in another, there is considerable difficulty in assessing the drawback, and this is the case with refined sugar. The duties on the raw sugar are, in the case of beet, levied on an assumed yield of sugar from a certain quantity of roots or juice, and in the case of raw sugar, on the quantity of refined sugar a certain weight is supposed to yield. In practice, the *real* is greater than the *estimated* yield, and as a consequence there is a certain quantity of refined sugar produced, on which no duty has been paid. If this excess quantity be consumed in the country of production, the sugar refiner benefits at the expense of the home consumer, the price charged for the duty-free sugar being the same as that on which duty had been paid. If, however, any portion of this duty-free sugar be exported, the exporter receives from the State the duty which should have been paid on the sugar by the refiner, which is, to all intents and purposes, a present to him from the taxpayers of the country through the Government. This bounty is generally applied by the exporter in underselling his foreign com

TABLE XI.—Calculated Bounty on Sugar.

	France. (1887.)	Germany. (1888 Law.)	Belgium. (1887.)	Holland.
1. Total production of sugar.....(tons)	555,000	90,000	150,000	36,000
2. Estimated proportion of surplus sugar manufactured to total (1)	36½ per cent.	25 per cent.	20 per cent.	16 per cent.
3. Amount of surplus sugar .....(tons)	200,000	250,000	30,000	6,000
4. Rate of duty.....	50 frs. per 100 kilos, + 10 frs. on all sugars.	10/3 per cwt.; viz., 6/- on all finished sugar, and 4/3 on the roots.	45 frs. per 100 kilos.	27 fl. per 100 kilos.
5. Estimated total loss of revenue from surplus sugar escaping duty.	£4,000,000	£1,000,000	£550,000	£162,000
6. Estimated bonus on production, dividing total loss of revenue by quantity produced.	£7 4s. 0d. per ton.	£1 per ton.	£3 13s. 0d. per ton.	£4 10s. 0d. per ton.
7. Total sugar exported .....(tons)	159,000	619,000	111,000	96,000
8. Apparent bonus on export, dividing total drawback on surplus sugar exported by total quantity exported.	£3,180,000, or £20 per ton.	£1,000,000, or £1 12s. 0d. per ton.	£550,000, or £5 per ton.	£162,000, or £1 14s. 0d per ton.
9. Estimated bonus on production, dividing total drawback on surplus exported by quantity produced.	£5 14s. 0d. per ton.	£1 1 per ton.	£3 13s. 0d. per ton.	£4 10s. 0d. per ton.

petitor, and the rivalry thus created forces down the price of sugar, and enables the consumer of the foreign sugar to participate in the gift made to the exporter by the taxpayers in the country of its origin.

To show how this system of drawback works, a study of Tables XI. and XII., prepared by the Board of Trade, will appeal to the understanding much more forcibly than any words of mine can do; because the quantities of surplus sugar made are given, and the amount of money which is taken out of the pocket of the taxpayer as a present to the sugar refiner.

TABLE XII.—CALCULATION OF BOUNTIES.

	Total bounty on Export.	Rate per ton on Surplus Exported.	Rate per ton on production.
	£	£ s. d.	£ s. d.
France	3,180,000	20 0 0	5 14 0
Germany	1,000,000	1 12 0	1 0 0
Belgium	550,000	5 0 0	3 13 0
Holland	162,000	1 14 0	4 10 0
Austria-Hungary	500,000	Bounty does not arise on export surplus.	

The figures given show how heavily the countries named are taxed to favour the sugar refiners, or rather to encourage the home manufacturer of sugar. In a young and rising country such protection may be excused, because it fosters home trade and enables different manufactures to be profitably established at home. But on the other hand, it cannot be denied that such favours granted to those engaged in any special manufacture must be made at the expense of the general taxpayer, who derives comparatively no benefit from the concession; that bounties when given have a tendency to increase the cost of production and to limit improvements in manufacture, to foster the maintenance of large profits at the expense of the general community, and to destroy legitimate competition, which has proved so beneficial to improvement in manufacture, and to the lowering of prices to the consumer.

The experience of the past and present confirms these views, and we may close this lecture with an apt quotation from McCulloch on the subject under consideration:—"The history of all businesses carried on in this country by the aid of bounties, proves that they are hardly less disadvantageous to those engaged in them than to the public."

LECTURE II.—DELIVERED MAY 5, 1890.

Sugar was chiefly referred to in our first lecture as a commercial article, presented to the public under many forms and qualities, but it would be doing an injustice to two very important and growing industries if nothing was said respecting the use of sugar in jam making and allied manufactures, as confectionery and sweets, and, in the second place, in the brewing of beer. The cheapness of sugar has caused it to be largely employed in jam-making and distilling, and in the brewing of beer. Tables of consumption have been prepared for reference, which will illustrate the advance made in the use of sugar as an adjunct to, and frequently as a substitute for, malt in brewing the malt liquor of commerce, and for which Great Britain and Ireland have long been famous.

JAM-MAKING AND CONFECTIONERY.

The quantity of sugar used in jam-making and confectionery is very large, but there are no statistics available to show what is thus consumed. It has been computed that the quantity used in Scotland is about 40,000 tons per annum, and this is steadily increasing, on account of the large quantity of land which is being put under fruit cultivation, and especially to the growth of strawberries. The soil of certain districts is admirably suited for strawberries, and as far north as Aberdeen they are cultivated very extensively.

In England fruit culture is steadily advancing, and the quantity of sugar required for preserving is necessarily on the increase. An estimate has been made, and published in an official document, that seven of our leading London jam-makers and confectioners use 34,000 tons of sugar per annum. It would be interesting to know what is used in the entire trade, and at a future time the consumption may be considered of sufficient importance to justify the preparation of such a return.

Sugar is not used in the manufacture of jam simply to impart sweetness, but it acts as a very reliable preservative of the fruit. Its antiseptic and preservative properties are considerable, and this is recognised in the curing of hams and other meat, as well as in the preservation of fruit. When sugar was very dear, and fruit comparatively cheap, it was a common practice to put fruit in bottles, then to partly cook the fruit by putting the bottles in hot water, and afterwards to exclude the air by suitable means. The operation was generally imperfect, and only kept the fruit a very short time. As soon as sugar became cheap it was used as a preservative, and, in smaller or larger quantities, its use with fruit is now general.

Each manufacturer of preserves professes to have a specialty of manufacture, by which the preservation is more perfect, or the fruit retains special characteristics of appearance or flavour.

The modern jam manufacturer endeavours to produce jam which possesses in a marked degree the natural colour, and also retains the natural form of the fruit. All fruits are not alike in this respect, but whenever this object can be attained, the practised jam maker shows his finished jam to the public as whole fruit in a thick syrup. Some manufacturers use glass vessels instead of earthenware, to make the colour and character of their jam appeal more strongly to the senses, and from the success which has attended this movement it is evident that the general public appreciate their effort to exhibit, in such a popular and

self-evident manner, the improved make of preserves. The low price of sugar has been the chief motive power in this marked advance in jam-making. Sugar can be used in larger quantity, and thus the jam is now preserved with less boiling. Long boiling always deteriorates the quality of jam; its colour is darkened, the fruit is broken up, the flavour injured, so that jam thus made, even from the best materials, is in look and taste no better than that made from faulty fruit. There is no doubt that the modern method of jam-making has been to some extent brought about by the desire to imitate some of the elegant French products imported, and the French deserve great praise for their ability to appeal to the eye as well as to the taste in preparing such familiar family requirements as preserves, confections, &c. It is, however, necessary that, even in modern jam-making, the fruit when mixed with the sugar should be speedily raised to the boiling point, and kept steadily boiling till the operation is completed. In fruits there are, as in the sugar-cane and the beet, active nitrogenous substances which will quickly change cane sugar into other descriptions of sugar crystallising quickly, and this action is most rapid considerably below a boiling temperature. If this chemical change be allowed to take place, the jam when kept will crystallise, and to the uninitiated the jam looks as if it was deteriorating by fermentation.

Manufacturers, knowing the bad effects of long boiling, are apt to fall into the opposite extreme, and neglect to boil either long enough or quickly enough. They overlook the fact that such treatment is favourable to the chemical change before-mentioned taking place, the conditions according closely with those which prevail when the fruit is allowed to remain long on the tree. A batch of jam will become granulated and unsightly, whilst another boiling, made with a portion of the same fruit and sugar, in similar proportions, will remain bright, clear, and satisfactory in every respect. The difference is simply due to the fact that, in the first batch, the invertase of the fruit at the temperature of the operation acted on a portion of the cane sugar and inverted it, and this sugar on keeping became granular, and gave the jam its unsightly appearance. When the cause is known, it is easy to guard against future mishaps; but the discovery of the fault presents difficulties, even to the chemist, and without the aid of chemistry the investigation would be almost certain to be barren of results. We have seen a jam maker of large experience troubled from this cause. The jam was sound but granulated, and by the uninitiated was said to be in a condition of incipient fermentation. The cause was traced, and future mistakes avoided; but the faulty jam in the hands of the retail trade did the manufacturer much injury, as it directed particular attention to the jam of his manufacture, and prejudiced the public against it.

There is a description of sugar known in the trade as liquid glucose, imported largely from France, and commonly used by jam makers when preserving faulty fruit. In making fruit jellies and syrups the fruit has to be deprived of a large portion of its juice. The residue is commonly made into "family jam," and to restore to some extent the natural condition of jam made from whole fruit, glucose is extensively used, and, as it will not crystallise, it readily lends itself for this purpose. Such jam has a fair colour, but the abundance of fruit seeds in it, and the deficiency of fruit flavour, indicate at once its origin.

Cheap sugar fosters the manufacture of cheap jam, confectionery, and sweets, and perhaps in no branch of industry have greater strides been made than in fruit-growing and preserving on account of the cheapness of sugar.

Sugar used in Brewing and Distilling.

Before 1847 no sugar was allowed to be used by distillers except that which was duty-paid, and it was not permitted to be used as a substitute for malt in brewing beer. Malt, although liable to an Excise duty, was allowed to be used duty free in distilleries, the duty being charged on the spirit produced from it.

The West India sugar planter, who was at the time named the principal sugar producer, complained of the injustice done to colonial sugar in prohibiting it from being used, like malt, duty-free in distilleries, and in 1846 public attention was directed to the subject. At that time it was not known what the value of sugar as compared with malt was to the brewer and distiller, and experiments were made by Messrs. Phillips and Dobson, of the Inland Revenue department, to settle these points to the satisfaction of the trade and the revenue. When this had been done, there was no difficulty in discussing the sugar question in the spirit of justice and fair dealing. The

ground taken by the sugar producer was so sound and just that, in the year 1847, sugar was permitted to be used in distilleries duty free, and in breweries on the payment of a Customs and Excise duty equivalent to that charged on the malt for which it was used as a substitute.

From that time to the present sugar has grown in favour with brewers, and the reasons for its doing so arise generally from two causes, viz., the altered taste of the public, and the facility with which sugar lends itself to the brewer's purposes for producing the beer now suited to the taste of the ordinary beer drinker.

The beer in fashion before the introduction of sugar was made from malt and hops only. It was generally brewed in winter and kept for summer use, and to ensure its continuing fairly sound it was heavily hopped. Such beer took a long time to get bright and fit for use unless aided by the addition of "finings," which speedily clarified the beer and made it brilliant; but though some of the beer was then artificially clarified, the greater part was stored in vats, and kept for very long periods At that time wine was not a common drink, as it is now, and therefore in the houses of the rich home-brewed ale was a fashionable drink; and it was considered a valuable acquisition to possess old ale which had been brewed for periods up to twenty years and more, in fact, brewed when the heir was born, and drunk when he came of age. Brewers stored their beer in vats and kept it till it had acquired the somewhat sour flavour of old ale, but some descriptions of badly-brewed beer speedily got sour, and this was sold as old ale. In the West of England, and in Belgium, this fashion of drinking old ale has not yet died out; but in other parts of this country, and throughout the beer-producing States of the world, the public taste has run in favour of mild ale and porter. Consequently, the vatting of malt liquor is now seldom attempted, and ale is brought to maturity in the casks into which it is racked at the time the beer is brewed.

Quickness of consumption has thus been fostered, and to meet this new state of things the brewer has been led to use fewer hops than formerly, and to employ in conjunction with the malt from 5 per cent. to 25 per cent. of sugar. This addition of sugar reduces the quantity of albuminoids and dextrin present in the liquid extract or wort produced in the operation of brewing, and causes the beer obtained from this mixture of malt and sugar

TABLE XIII.—Quantities of Sugar and Molasses used in Brewing and Distillation in the United Kingdom in each year from 1847—1890.

Year.	In the Brewing of Beer.	In the Distillation of Spirits.		Barrels of Beer brewed in the United Kingdom.
	Sugar.	Sugar.	Molasses.	
	cwts.	cwts.	cwts.	
1847....	72,453	20,460	—	—
1848....	24,887	10,849	2,075	—
1849....	16,421	3,389	16,969	—
1850....	9,869	5,273	22,369	—
1851....	6,589	—	15,193	—
1852....	7,277	10,759	100,209	—
1853....	13,251	524	44,799	—
Year ended March 31.				
1855....	22,807	11,905	187,006	—
1856....	15,440	25,710	155,556	—
				March 31.
1857....	20,793	346	94,133	17,984,773
1858....	27,796	692	3,212	18,166,635
1859....	25,553	997	15,413	19,152,564
1860....	54,664	101	49,527	20,340,096
1861....	85,304	18	32,178	19,534,460
1862....	77,840	11,292	391,443	19,989,313
1863....	91,543	12,832	244,431	20,081,408
1864....	70,535	1,641	85,064	21,360,461
1865....	33,019	1,251	26,659	22,546,889
1866....	68,765	3,114	28,004	25,388,600
1867....	243,868	5,028	86,582	25,206,665
1868....	356,089	13,884	61,520	24,301,841
1869....	369,350	321	137,417	24,542,664
1870....	295,865	1,278	61,143	} cannot be given.
				Sept. 30.
1871....	285,266	909	194,275	26,431,760
1872....	260,610	1,477	202,386	28,270,511
1873....	417,091	4	247,593	29,774,988
1874....	613,988	10	233,578	30,670,081
1875....	868,943	8,665	89,327	31,014,381
1876....	879,328	1,808	86,526	32,279,459
1877....	834,052	—	178,779	31,988,991
1878....	956,287	—	220,549	32,083,824
1879....	1,101,936	—	191,654	29,767,075
1880....	1,136,434	—	322,899	30,742,649
1881....	1,280,134	—	212,084	27,352,361
1882....	1,142,845	103	179,759	27,847,308
1883....	1,130,811	237	170,665	27,114,202
1884....	1,128,232	—	212,474	28,058,248
1885....	1,217,019	3,109	367,460	28,663,760
Year ended Sept. 30.		—— 31st March.——		
1886....	1,309,964	—	341,087	28,234,175
1887....	1,465,939	12,355	168,074	29,286,849
1888....	1,523,870	20,047	221,442	29,199,083
1889....	1,810,714	38,317	210,621	31,023,818
1890....	—	31,152	211,464	31,602,753

to get bright more readily than if malt only had been used, and to have a palate-sweetness appreciated by the ordinary beer consumer.

There is no doubt that this change in the public taste has had the effect of reducing the price of beer, because the brewer can better utilise his plant than formerly, and work with comparatively less capital. The beer brewed goes quickly into consumption, and the brewer's aim is to produce an article which is adapted to the wants of his customers in the shortest time he can.

During the transition period referred to, the chemistry of brewing has received much attention, and the composition of the materials used, and the chemical changes which take place in the different brewing operations have been carefully and intelligently worked out in France, Germany, Denmark, and Great Britain. The result is that brewing has been reduced to a fairly perfect science, and any typical beer that may be required can be produced at will.

This knowledge has been brought into profitable use in the selection of brewing materials, and special articles have been manufactured from sugar and grain to suit the brewer's requirements. Invert sugar, glucose, torrefied grain, special preparations of rice and maize, are some of the many malt substitutes, or malt adjuncts, employed by brewers, and it is only just to mention that each kind has its special characteristics to commend it to the favour of the brewer who has the requisite knowledge to benefit by its use, and to utilise it in the production of the article for which it is specially suited. In this connection it may be of interest to show how malt, and the most general malt substitutes, are assessed with different rates of duty, according to the purpose for which they are used.

	£	s.	d.
One quarter (8 bushels) of malt used to produce as malt duty	1	1	8½
,, ,, ,, produces as beer duty.....	1	5	0
,, ,, ,, will produce 18 gallons of spirits at proof, duty 10s. 6d. a gallon.....	9	9	0
One quarter of malt and grain, 20 gallons spirits, duty	10	10	0
Free. One cwt. of sugar will yield 10 ,, ,, ...	5	5	0
,, molasses ,, 7 ,, ,, ...	3	13	6
,, rice ,, 7½ ,, ,, ...	3	18	9
One ton of beet-root ,, 15 ,, ,, ...	7	17	6

The distiller has argued that he is more heavily taxed than the brewer, and his standard of taxation is naturally the duty on spirits, and the quantity upon which he has to pay. The brewer, on the other hand, draws a distinction between spirits and beer, and the point he raises in his defence is that beer is a food as well as a drink, and, having become a necessary of life, should not be treated as an intoxicant like spirits, and the Legislature has hitherto very properly made a similar distinction.

Coffee.

History.—The coffee plant is a native of Arabia and Abyssinia, but it is now naturalised generally in tropical countries, and is specially cultivated as an article of commerce in the West Indies, South America, and other parts of the world where the mean temperature of the year is about 70° F.

Its early history seems not to have been known to the Greeks and Romans, but in North-East Africa it has been used from time immemorial, and as far as its history can be traced, it does not appear that orthodox Mahometans have always looked upon it with favour, or thought that it was a harmless beverage. About the beginning of the 15th century it seems to have come prominently into notice, and its cultivation spread from Aden to Mecca, Cairo, Damascus, and Aleppo, and reached Constantinople from Syria, in 1554, in the reign of Solyman the Great.

Khair Beg, the governor of Mecca, was unacquainted with the preparation of coffee or its qualities, and leaving the mosque one day, he saw some devout Mahometans whose duty it was to spend the night in prayer, drinking something which seemed to have an effect on their nerves similar to that of an intoxicant. At this sight he was much surprised and also offended, and when told the character of the drink, he was still far from satisfied that it could be drunk by the faithful.

The subject was of sufficient importance to court inquiry, and on the following day the learned of the city were called together in convocation, and the subject of coffee drinking was thoroughly discussed, Two celebrated Persian physicians maintained that coffee could not be legally drunk by Mahometans, on account of its stimulating properties. This view was approved, and in the face of some opposition an edict was issued forbidding its use. Shortly afterwards a coffee drinker caught in the act was publicly bastinadoed.

The action of the Governor was reported to the Sultan of Egypt. He revoked the order, recalled the Governor, and, according to the records of the time, he caused the two physicians to come to an untimely end. The question of the use of coffee had become essentially a religious one, and, notwithstanding the prompt action of the Sultan, it was once more prohibited, but afterwards again permitted.

In Cairo, in the year 1523, a fashionable doctor set up a crusade against the use of coffee, on the ground that it was prejudicial to health, and that on account of its intoxicating qualities it was not a lawful drink for the faithful. Coffee-houses were, however, common, but ten years later a preacher vigorously denounced the coffee-houses, with the result that a mob broke into them, destroyed the pots and dishes, and abused the company found in them.

The Judge-in-Chief held that the question had long ago been decided in favour of coffee, and ordered coffee to be served to the people assembled, he himself taking the first cup. After this episode coffee became more popular than ever.

In Constantinople coffee soon came into common use, and coffee-shops were established throughout the city. Here, again, opposition was encountered, and the coffee-house became a battle ground for religious bigotry, the priests being annoyed that while the mosques were empty the coffee-houses were full. A petition was got up by priests, zealots, lawyers, and doctors, and was so numerously signed by those who depended for light and leading on the priests, that the Mufti closed the coffee-houses, and prohibited the drinking of coffee altogether.

The public coffee-houses might be compulsorily closed, but it was quite impossible to carry out the regulation in private life. Some persons continued to drink coffee because they liked it, others followed the practice because it was prohibited, and between the two the number of coffee drinkers became large enough to defy the prohibition, and at last the police, unable to carry it out, took bribes from those who violated the law. Such a state of things could not continue, and with a new Mufti the prohibition was removed. It was then seen from the number of the people who drank coffee that the prohibition had proved an effective advertisement for the coffee-house keepers, and from that time to this coffee has been looked upon by the Turks as a pleasant and comforting beverage, stimulating without intoxicating, and suitable as a drink for the most orthodox Mahometan.

The first European who mentions coffee is said to have been a physician named Prosper Alpinus, who went to Egypt in 1580 in the capacity of physician to a Venetian consul This physician used his position to make himself acquainted with the botany of Egypt, and in 1592 he published in Venice his "History of the Plants of Egypt." In this history he gives an account of a tree whose seeds were much used by the Arabs and Egyptians for making a drink. The seeds of the tree he called "bon" or "ban," and by decoction they were converted into a drink much used by Egyptians and Arabs, and to which he ascribes special qualities and virtues. In another work, "Medicina Egyptiorum," published in 1591, Prosper Alpinus gives an account of the tree nearly identical with that before mentioned, and fully describes the method of preparing the beverage—which he calls "chaoua"—from both the seeds or berries and their husks. This account has been generally overlooked by writers on coffee.

A German physician named Leonhart Rauwolff, who was a great Eastern traveller, also notices coffee. He says that when at Aleppo, in 1573, this drink was there used, and he thus describes it:—

"They have a very pleasant drink called *chaube*, which is almost as black as ink. It is good for illness, chiefly that of the stomach: and is made of a fruit called Bunnu, which in bigness, shape, and colour resembles a bay-berry. It is surrounded with two thin shells, and, as I was informed, is brought from the Indies. These shells have within them two yellowish grains in two distinct cells, and agree in their virtue, figure, appearance, and name with the the Bunchum of Avicenna, and the Banca of Rhasis, therefore I shall consider them the same until I am better informed by the learned."

Faustus Bainesius, who wrote the first known treatise expressly dealing with coffee, inclines

to the same opinion as Rauwolff. This work was printed in Rome in 1671, and bore the title, "De saluberrima potione Cahu, seu Cafe nuncupata." In 1674, one Velschius contended that coffee was not "bunchum." The two works of Prosper Alpinus on the medicinal and other plants of Egypt, which have been previously referred to as having been published in Venice, appear to have had little or no effect in making coffee a familiar drink to the Italians, for in 1615 coffee as a beverage seems scarcely to have been known in Italy. It seems, however, to have become known, as a curiosity at least, in most European countries, and in those having commercial relations with the East it became sooner known as a beverage. Du Four, who wrote on coffee in 1685, says the French knew nothing of it until 1645, and that it was not used in France till 1657. Galland says that Thevenot, who returned from the East in 1657, then introduced it into France. When in the East he drank it constantly, and on his return home he introduced it to his friends at his house in Paris.

La Roque wrote a book of travels in 1715, entitled, "A Journey into Arabia Felix," and in it he admits that Thevenot was the first who taught the French people the use of coffee; but he at the same time contends that his father, who had been to Constantinople with the French Ambassador, brought back with him the Turkish implements for preparing coffee, and as early as 1644, when he returned to Marseilles, drank coffee every day.

In 1671, a coffee-house was opened at Marseilles. It was considered as a great curiosity, and attracted much attention. La Roque states that coffee was not known in Paris before 1669, although it had been used previously by Thevenot, in his own house, as a beverage. Its introduction into Paris was brought about by the visit to Paris of Solyman Aga as ambassador from Mahomet IV., and it was through this embassy that the idea of opening a public coffee-house was first entertained. In 1672, an Armenian named Pascal sold coffee publicly at the fair of St. Germain, and afterwards, in the same year, opened a coffee-house on the Quai de l'Ecole, which was the first public coffee-house ever known in Paris.

Owing to our maritime advantages, coffee was known in England some years earlier, and the "Journal des Scavans," published in 1675 (28 Jan.), affirms that the English knew the use of coffee twenty years before the French did.

Biddulph, an Englishman, writing from Aleppo in 1603, says:—"The Turks have for their most common drink coffa, which is a black kind of drink, made of pulse like peas, called coava, which being ground in a mill, and boiled in water, they drink it as hot as they can suffer it, which they find to agree with them against their crudities and feeding on herbs and raw meat. It is more wholesome than toothsome for it causeth a good concoction, and driveth away drowsiness."

William Finch, an English merchant in the East India Company's service, wrote, in 1607, that:—"The people of the island of Socot(o)ra have for their best entertainment a china dish of coho, a black bitterish drink made of a berry like a bay berry, brought from Mecca, supped off hot, and it is reckoned good for the head and stomach." None of the writers, either English or foreign, say a word about the coffee being roasted, but roasting seems to have been general from the fact that many describe the liquor of the infusion as dark, Rauwolff being very emphatic in comparing its colour to ink. The first coffee-house in London was opened in 1652, and the circumstances which led to it are worth recording as showing how large industries often arise from certain incidents which may be considered only accidents.

Mr. Daniel Edwards, a Turkey merchant, returned from Smyrna in 1652, and brought with him to London a Ragusian Greek, named Pasqua Rossée. This man prepared coffee for his master's breakfast in London as he had done in Smyrna, and the novelty of the beverage, as well as the desire to partake of it, so excited the curiosity of friends and acquaintances that visitors poured in to Mr. Edwards, and so took up his time that the fore part of the day was lost in satisfying their wants and explaining the nature and origin of the beverage supplied.

Necessity, the mother of invention, prompted Mr. Edwards to devise a plan which would satisfy his friends and the curious, and at the same time would allow him to have the command of his own time without interruption. The plan was to open public rooms in which his Greek servant would make and sell coffee to the public. This shop or coffee-house was situated in St. Michael's-alley, Cornhill, and was without doubt the first coffee-house opened in London. The fashion of coffee drinking soon spread, and the attention of the authorities

was soon directed to these public places of resort, and to impose some check upon them, it was enacted by 12 Car. II., cap. 24, that a duty of 4d. a gallon should be imposed on all coffee made or sold.

It was evident that the coffee-houses of those days were distasteful to the authorities, for in 1663 (15 Car. II., c. 9, s. 15) it was made illegal to keep coffee-houses unless licensed by the General Quarter Sessions for the county in which they were kept.

These coffee-houses became places for social meetings, and eventually for political ones. Owing to the turbulence of the times such meetings were not permitted, but before they could be put down, it was found necessary to close the coffee-houses altogether in 1675, and power to close them was given by the following proclamation, dated 29th December, 1675 :—

"Because of such houses, and by occasion of the meeting of disaffected persons in them, divers false, malicious, and scandalous reports were devised and spread abroad, to the defamation of his Majesty's Government, and to the disturbance of the quiet and peace of the realm."

Such a gross interference with the liberty of the subject was not submitted to without protest, and eventually the whole matter was referred to the Judges for decision. In their great wisdom it was laid down, "That retailing of coffee might be an innocent trade, but as it was used to nourish sedition, spread lies, and scandalise *great men*, it might also be a common nuisance." This prohibition was too drastic to last, and afterwards coffee-houses were allowed to be opened, the Excise duty being charged not on the liquid as before, but on the berry at the rate of 2s. a pound.

The English and Western European markets were entirely dependent on their supplies from the Egyptians and Arabs, the berries when in their commercial state being incapable of growth. Every effort was made to obtain a coffee plant, or seeds that would germinate. It has been said that at Dijon, in 1670, a Frenchman obtained plants and grew them to maturity. The seed was, however, tasteless and insipid, and appeared to have served no purpose beyond the gratification of curiosity.

Boerhave states that a Dutch Governor got berries from Mocha and planted them in Batavia. In 1690 a plant was said to have been sent to Amsterdam, which came to maturity and furnished the berries which became the parent stock of the coffee plants of the West Indies.

In 1714, a plant from the botanical garden at Amsterdam was sent to Louis XIV., and it was placed in the garden at Marly. A little later the Dutch began to cultivate coffee in Surinam ; in 1721, the French commenced the same cultivation in Cayenne, and in 1728 the English in Jamaica.

The introduction of the coffee plant from Arabia into different countries where it is now grown seems to have been done by the Dutch when their foreign commerce stood higher amongst European nations than it does now. It is said that seeds from Mocha were planted in Java, and from there a plant was taken to the Botanical Gardens at Amsterdam. Cuttings from it were taken to the Dutch colony of Surinam, and from there to Berbice and Demerara, which were then under the rule of Holland. The commencement of coffee-growing in the West Indies led the French to try and start it too in their colonies, whose climate was favourable to the cultivation of coffee. It is said that owing to the jealousy of the Dutch, a Frenchman could only get a cutting from the Botanical Gardens at Amsterdam by actual theft.. It is recorded that he thus obtained a shoot, which was taken to Paris and cultivated. In 1720, a French officer, named Declieux, sailed for the West Indies with one small plant obtained from the shoot in question. It was a long and tedious voyage, the water was consequently diminished in supply, but Declieux looked to the wants of the plant first and himself afterward, watered it from his daily allowance, kept it in good health, and at last landed in Martinique, where the plant grew and eventually became the stock from which sprang the plantations of Guadeloupe, Jamaica, Porto Rico, Hayti, Cuba, the Lesser Antilles, Central America, and all South America, excepting, of course, the Dutch possessions.

Description of Plant.—The genus "Coffea" (family *Rubiaceæ*) comprises about 60 species, of which some 22 are found in America, 15 in Africa, and 7 in Asia ; probably, however, some of these so-called species are mere varieties, due to differences of climate and soil. The most important are *Coffea Arabica* and *Coffea Liberica* (or *Liberiana*). The former is the well-known coffee shrub, and attains, naturally, a height of 15 to 20 feet. Its foliage resembles that of the Portugal laurel, and the flowers those of the jessamine, being small and white. The berries are first dark-green, changing through yellow and red to deep crimson.

Beneath the skin of the ripe berry is a glutinous saccharine pulp, closely enveloping the beans. These are usually two plano-convex seeds, but sometimes the berry contains one round seed which yields the "Pea-berry" (or carracole) coffee of commerce. The silver skin adheres closely to the bean, the parchment more loosely.

C. Arabica flourishes between 36 N. and 30 S. lat., usually at elevations in sub-tropical regions. The most favourable temperature is 60° to 80° F., anything below 55° F. being unsuitable. A constant supply of moisture is also necessary. It flourishes in Brazil, Java, Ceylon, India, Central America, the West Indies, Arabia, Natal, and (recently) Australasia.

C. Liberica is a native of Liberia, and is distinguished from *C. Arabica* by a much more vigorous growth. It is affected less by disease than the latter, and may be much improved by cultivation. The produce is, however, coarse in flavour, and it is found advantageous to graft from *C. Arabica*.

Cultivation. — The surface soil must be good; the subsoil may be poorer, but should not be stiff clay. The best soil is perhaps that known in Brazil as "terra roxa," a top-soil of red clay 3 to 4 feet thick, with a subsoil of gravel. As a general rule, virgin forest land has been found most suitable; in the West Indies, ground where lance-wood, red-wood, and olive-wood grow is well adapted for coffee. In the selection of ground there are, besides, such factors as elevation, aspect, shelter from wind and rain-wash, temperature, rainfall, and proximity to water, to be considered. Shelter from wind is of the first importance, and should not be sacrificed for rich soil, as the latter can be obtained much quicker than the former. On flat land the cost of drainage is great, and a wet soil is fatal. Steep slopes are also unsuitable, on account of excessive rain-wash. Frost, of however short duration, is very injurious.

There are three principal methods of planting:—By seeds planted on the estate, a plan open to the disadvantage of weak and bad growths being unavoidable; another way is by transplanting young shrubs of 6 to 8 inches, selected from nurseries; the third and, according to some, the best method, is by means of branch-end slips. The trees are planted, according to locality, from 4 to 12 feet apart, that is, from 300 to 2,700 trees per acre. Where protection from sun and wind is necessary, some quick growing tree is planted between the rows, and round the confines of the plantation.

Pruning is practised to keep the shrubs at a convenient height for gathering the fruit, and to strengthen their lateral growth. Plantations are usually so situated that the surface soil is much washed away, and in spite of every effort to prevent this, a good manure is sooner or later necessary. The particular type varies of course with different soils, but well-rotted dung, with ground bones, is generally the best.

The coffee plant is liable to diseases and pests of several kinds. One is a leaf blight, due to the fungus *Hemileia vastatrix*, and consisting of yellow blotches which spread over the leaves, causing them to fall off. They suffer in a similar way from the attack of a fly or moth, and also from a leaf rot which covers them with a glutinous matter, turns them black, and also causes them to drop off. The tree trunks are subject to the action of a "borer" beetle, and bugs and canker also afflict the plant at times. The harvesting or picking of the fruit takes place as the berries ripen—that is, as they become red—and may last three months. As they are gathered they are conveyed to the curing-houses, and hence their further preparation proceeds in four stages—pulping, fermenting, drying, and classifying or sorting. The first of these operations consists in separating the beans from the enveloping pulp. This is done by machinery, the object being rapidity without injury to the beans. After pulping it is necessary to ferment the saccharine matter present, otherwise the "parchment" coffee would not dry. The beans are next dried in the sun, or by artificial heat, and at this point they are usually sent to port for shipment, where the shipper subjects them to a further sunning. The parchment and silver skin are removed and separated by winnowing, and then the beans are sorted according to size and shape by means of a "separator," which at the same time removes sand and dust.

The coffees in general use in England are Jamaica, Ceylon, Costa Rica, Brazil, Java, and Mocha.

Jamaica.—The cultivation of coffee in Jamaica dates back more than 150 years.

Sir N. Laws was the first person who planted coffee in Jamaica on a commercial scale, but he died in 1731, before the crop arrived at maturity.

In the following years several planters and

merchants took the matter up, as they saw that coffee might become a profitable crop, if the duty could be made lower on its importation into Britain, solely on the ground of its place of origin.

Subscriptions amounting to £220 10s. were obtained from 22 subscribers towards covering the expense of procuring an Act of Parliament for lowering the duty on Jamaica coffee, and as these names may be of interest to the trade, they are given *in extenso* :—

List of Subscribers.

London, Anno 1732.

A list of the persons who subscribed and paid into the hands of Mr. Roger Drake and Co. the several sums undermentioned towards defraying the charges of an application for an Act of Parliament to encourage the planting of coffee in the island of Jamaica :—

	£	s.
John Ascough, Esq.	10	10
Thos. Beckford, Esq.	10	10
Jas. Dawkins, Esq.	10	10
Hen. Dawkins, Esq.	10	10
Messrs. Drake, Pennant, and Long	21	0
Thos. Fish, Esq.	10	10
Mr. Jas. Fitter	5	5
Cope Freeman, Esq.	10	10
John Gibbon, Esq.	10	10
Mr. Jn. Gregory	5	5
Capt. Joseph Hiscox	10	10
Mr. H. Lang and Co.	5	5
James Lawes, Esq.	10	10
John Lewis, Esq.	10	10
Mrs. Susannah Lowe	10	10
Samuel Long, Esq.	10	10
Chas. Long, Esq.	10	10
Messrs. Mayley and Gale	10	10
Valentine Mumbie, Esq.	10	10
Favele Peeke, Esq.	10	10
	10	10
Capt. Geo. Wane	5	5
	£220	10

In consequence of this agitation in favour of Jamaica, an Act was passed in the following year, entitled "An Act for encouraging the growth of coffee in the plantations in America." The duty was reduced from 2s. to 1s. 6d. per lb., and the exports from Jamaica in 1752 were 60,000 lbs., and in 1775, 400,000 lbs. The cultivation of coffee in this island is still continued, and for the five aears ending July 31, 1887, the average acreage was 19,495; and the average quantity exported during the five years ending September 30, 1887, reached 61,350 cwt. per annum. It grows well almost anywhere on the island, but best at an elevation of 1,000 to 4,000 feet. Owing to the undulating surface any required altitude is available.

Ceylon.—Coffee seems to have been introduced by the Arabs, and to have been used for a long time in the adornment of temple gardens on account of its beautiful sweet-smelling flowers. Previous to 1868 it had become a lucrative industry, but the advent in that year of the *Hemileia vastatrix* dealt a blow to the trade, the effects of which, fortunately, have been somewhat mitigated by the subsequent introduction of tea-planting, cinchona cultivation, &c. The rapid development of these, arising, so to speak, from the ashes of the almost defunct coffee trade, will be seen from the following figures :—

Exports from Ceylon.

Tea :—		
1880	114,845	lbs.
1885	4,352,895	,,
1889	32,516,682	,,
Cinchona :—		
1876	16,842	,,
1886	15,000,000	,,
Coffee (average exports) :—		
1851—1855	387,240	cwts.
1856—1860	552,219	,,
1861—1865	721,405	,,
1866—1870	956,153	,,
1871—1875	851,895	,,
1876—1880	744,209	,,
1881—1885	380,145	,,
1886—1889	155,122	,,

Costa Rica.—Coffee was first planted here in 1796, at Cartago, and since the separation from Spain, in 1821, its production has been continuously favoured by the Government. Export duties have been repealed, model estates started, good roads made, and special privileges conferred on cultivators. That success has attended this policy is shown by the fact that this State exported 320,000 cwts. in 1884.

Brazil.—The celebrated fields of Brazil—Santos and Rio de Janeiro—are situated on a plateau of which the eastern edge is but slightly removed from the sea. Hillsides looking north are chosen as affording the greatest shelter from the cool south winds, and from the light frosts which occasionally occur during the winter months. Santos

coffee, as a rule, is not so well cleaned as that from Rio, but the bean is usually larger, and of a better colour and aroma. Taken altogether, Brazilian is perhaps as good as any grown; indeed, it has been often sold in London, New York, Hamburg, and Amsterdam as "Old Government Java." Statistics of the quantity produced are somewhat meagre, but the annual amount is probably over 6,000,000 cwts.

Java ranks after Brazil in the amount of coffee produced. The culture is mostly in the hands of the Government, and effected by forced labour. Nurseries being very expensive and troublesome, a common expedient is to plant "stumps" from wild or casual seedlings. No pruning is done, and so the trees grow bushy, with several stems. Water is scarce in some parts, and in consequence the pulping and washing are performed by the labourers at home. After pulping, the beans are taken to a drying house, and dried over a slow wood fire, the reason for dispensing with the sun's heat being that a certain flavour is believed to be imparted by the wood smoke. The exports in 1878 exceeded 1,200,000 cwts., nearly all of which went to Holland.

Coffees are difficult to describe, but a few words on the best-known varieties may not be out of place. Their value depends largely on the distinctive flavour of the particular kind of coffee, and this flavour depends almost entirely on the roasting and cooling, and on the way the beverage is prepared.

Mocha is generally considered the finest of coffees. There are two varieties, the "long berry" and the "short berry." The former are greyish-yellow in colour, and give a rich mellow liquor. Mocha short berry is smal and of a pale greenish-yellow tint; the infusion is similar to that of the long berry, but cleaner and more delicate.

Mysore is a good sized berry, bluish-grey, with more or less silvery covering; it yields a fine, strong, and clean liquor.

Ceylon Plantation is a fair sized, pale-greenish berry, gives a beverage with fair body, full, but smooth flavour, and very clean.

Costa Rica is a bluish-green berry, large and bold; yields a strong, useful, though somewhat coarse liquor.

Java is a very fine coffee, with large oblong berries, varying in colour from whitish to pale yellow and greenish. The liquor is strong and clean.

Brazil, although used to a considerable extent, has a peculiar, almost unclean, flavour; it is useful in mixing off with other kinds.

TABLE XIV.—Analysis of Coffee.

	Mocha.		East Indian.	
	Raw.	Roasted	Raw.	Roasted
Caffeine	1·08	·82	1·11	1·05
Saccharine matter	9·55	·43	8·90	·41
Caffeic acids	8·46	4·74	9·58	4·52
Alcohol extract, containing nitrogenous and colouring matter	6·90	14·14	4·31	12·67
Fat and oil	12·60	13·59	11·81	13·41
Legumin or albumin	9·87	11·23	11·23	13·13
Dextrin	·87	1·24	·84	1·38
Cellulose & insoluble colouring matter	37·95	48·62	38·60	47·42
Ash	3·74	4·56	3·98	4·88
Moi ure	8·98	·63	9·64	1·13
	100·00	100·00	100·00	100·00

The constituents of coffee which are of importance to the physiologist are the aromatic substances, the alkaloid caffeine, and the true food stuffs, viz., the carbohydrates, fat and soluble albumen.

The aromatic principles of coffee, whether natural to the berry or produced during the process of torrefaction, exert an exciting influence on the nerves of taste and smell, and thus indirectly produce an increased desire for, and enjoyment and digestion of, food.

The alkaloid caffeine is identical in chemical constitution, and therefore in physiological action with that of tea. Although the percentage of the alkaloid in the coffee berry is much less than in the leaf of tea, yet a cup of coffee, as ordinarily prepared, contains an equal if not greater quantity of the alkaloid than a similar cup of tea. The chief difference in the action of coffee and tea is due to the presence in coffee of the large quantity of true food stuffs, and the almost complete absence of tannin. The carbohydrates, fat, and soluble albumin impart a certain amount of nutritive value to coffee over and above the purely stimulant effect of the alkaloid common to tea and coffee. Also owing to the special character of its fatty substances, coffee has a slightly laxative effect upon the alimentary canal.

From these considerations, viz., that coffee is equal to tea in its stimulant effect on the brain and circulation, superior to tea in its influence on digestion, and that it is practically free from tannin, and does not therefore interfere with the assimilation of a meat diet, it can be understood how coffee had come into popularity as an after-dinner beverage, even before the chemist and physiologist had combined to demonstrate its superiority to tea for that purpose.

Chemistry of Coffee.—As before stated, coffee contains an alkaloid identical in composition with the alkaloid of tea, and called caffeine It contains nitrogen as well as carbon, hydrogen, and oxygen, and has the chemical formula—$C_8H_{10}N_4O_2$.

It was at one time thought that the coffee berry lost much of this alkaloid during the roasting process, but this is not so. Paul and Cownley have made a long series of experiments on this subject, and the quantity present in the unroasted and roasted specimens they examined was from 1 to 1·3 per cent. The results obtained are as follow:—

TABLE XV.—CAFFEINE.

Kind of Coffee.	Per-centage of		
	Moisture.	Caffeine.	
		Berries dried at 212° F.	Air-dried berries.
Coorg	8·0	1·20	1·10
Guatemala	8·6	1·29	1·18
Travancore	10·0	1·29	1·16
Liberian	8·0	1·30	1·20
Liberian	8·0	1·39	1·28
Rio	9·1	1·20	—
Santos	9·0	1·29	—
Manila	6·6	1·20	—
Ceylon	6·2	1·24	—
Perak	7·3	1·22	—
Costa Rica	7·2	1·24	—
Pale Jamaica	8·7	1·21	—
Mysore	8·0	1·28	—
Jamaica	9·0	1·28	—

The above results were obtained by the following method:—"The finely powdered coffee is mixed with moist lime, and percolated with alcohol. The residue left on evaporating the percolate is treated with water and a few drops of dilute sulphuric acid filtered, and the filtrate exhausted with chloroform, which on evaporation leaves the caffeine fit for weighing."

Roasted coffee contains about 1·3 per cent. of caffeine. From the above figures it appears that of all methods the surest, when examining coffee for adulteration, is the determination of the amount of caffeine.

There seems to be no appreciable loss of caffeine by volatilisation in the roasting of coffee when this is properly carried out. The data on which this opinion is based are collected in the following Table:—

TABLE XVI.

	Loss of weight in roasting.	Caffeine.		
		In raw coffee.	In roasted.	
			Found.	Calculated.
	Per cent.	Per cent.	Per cent.	Per cent.
Low roasted ...	13·7	1·10	1·30	1·28
Medium roasted	16·0	1·10	1·36	1·31
Over roasted ...	31·7	1·10	1·25	1·61

Of the loss of weight 8·22 per cent. was water expelled at 100° C.

Roasting of Coffee.

The roasting of the coffee berry is an operation requiring great skill and judgment. Large dealers roast their own, and can command the necessary knowledge required for the proper performance of the work. Smaller dealers usually send their green coffee to be roasted at a general roaster's, as they have not the means to roast on the premises, and they thus run the risk of failure, or of getting other people's coffee for their own, which may or may not be an advantage, according to the circumstances of the case.

A good coffee roaster must understand the peculiarities of the different descriptions of coffee he has to roast. Some are tougher or more moist than others, and in such cases each kind must receive exceptional treatment. A perfectly-roasted berry is of a rich chestnut colour; it has lost its toughness and become crisp, so that it is readily disintegrated in the mill, and at the same time it has not a dark brown tint, which means that the coffee has been over roasted. Over-roasted coffee, however good its quality originally, is spoiled. It may give a darker liquor than if lighter roasted, but it possesses little or no aroma, and has had destroyed the natural constituents which make up the quality of good coffee.

Coffee when properly roasted will lose from 16 to 18 per cent. of its weight. A great part of this is due to the moisture which has been driven off by the heat; but the constituents of the berry have been also modified, as is shown in the Table XIV. ("Analysis of Coffee") showing the composition of the unroasted and roasted berry, and an aromatic oil has been produced which has an intense flavour.

A judicious blend of different kinds of coffee always produces a better liquor than any single coffee, but this mixture ought always to be made after roasting and not before. There is always a danger of the best green coffees, when imported, having been mixed with inferior qualities grown in the same district, and such mixtures will never roast well; but in roasting, different kinds should be treated separately, and then mixed before grinding.

The cooling of the roasted berry is also a delicate operation, requiring care and judgment, and if this operation be not properly performed, the best of coffee will be spoiled, and will produce a liquor of inferior quality.

When coffee is bought in bond, the general estimate is made that the cost of roasting will be from 2s. 6d. to 3s. a cwt., and that the loss of weight in roasting will be about 20lbs.; *i.e.*, 112 lbs. of raw coffee will yield 92 lbs. of roasted. This estimate is, however, a very wide one. In practice on a large scale, with gas for fuel, the cost for fuel and labour will not exceed 1s. 3d. per cwt., and the loss of weight will not exceed 17 lbs. per cwt. If the loss exceeds this amount the probability is that the coffee has been over-roasted, and will consequently have been deteriorated in aroma and delicacy of flavour.

As a nation we have been constantly blamed for our inability to appreciate good coffee, or to make it as skilfully as our French neighbours. The censure generally takes the form of a comparison between the habits of the two nations as to the roasting of coffee, the French roasting it in their own homes, and the English buying it from the grocer. It must be apparent, from the skill required in roasting coffee, that the home-roasting of small quanties must very often prove a failure, and no doubt this is often the case. But the fact remains that French coffee is popular, and that it stands high in comparison with the coffee supplied at English coffee-houses or hotels. After careful observation, I have come to the conclusion that by far the greater part of this popularity is due to the more liberal use of the coffee in making the beverage. Coffee, as compared with tea, is an expensive

TABLE XVII.—Coffee.—United Kingdom.

	Imports.						Consumption.	
Year.	Ceylon.	Other British Possessions.	Brazil.	Central America.	Other Countries.	Total.	Cwts.	Pounds per head.
	cwts.	cwts.	cwts.	cwts.	cwts.			
1873..	863,131	258,822	140,967	227,206	193,552	1,683,678	288,669	1·01
1874..	541,470	311,965	200,154	151,531	200,051	1,405,171	284,465	·98
1875..	755·715	242,097	224,453	210,908	160,983	1,594,156	290,413	·99
1876..	485,249	307,666	197,765	128,244	222,454	1,341,378	297,694	1·00
1877..	780,341	274,682	187,912	228,686	138,096	1,609,717	293,127	·97
1878..	509,154	269,917	200,998	156,544	136,797	1,273,410	298,154	·98
1879..	627,438	307,381	260,297	260,141	162,132	1,617,389	309,788	1·01
1880..	540,676	355,246	272,442	208,388	179,187	1,555,939	290,802	·94
1881..	326,728	241,766	266,756	198,087	179,395	1,212,732	285,209	·91
1882..	379,884	303,803	227,939	285,108	162,232	1,358,966	285,380	·90
1883 .	227,378	261,945	403,966	191,779	313,160	1,398,228	289,715	·91
1884..	250,311	268,525	189,186	285,534	141,043	1,134,599	294,788	·91
1885..	245,444	235,978	192,098	221,194	140,896	1,035,610	298,306	·91
1886..	155,755	276,617	203,325	235,191	158,574	1,029,462	289,207	·88
1887..	133,996	185,236	300,495	245,344	181,141	1,046,212	268,322	·81
1888..	107,055	276,610	160,258	229,543	181,880	955,274	277,994	·83
1889..	56,595	182,565	382,423	223,810	195,213	1,040,606	259,279	·76

drink, and as the extract the roasted berry yields is comparatively small, the French have overcome this by using much more coffee than we do. It is on record that two or three cups of coffee thus prepared, and drunk quickly after each other, have produced effects similar to symptoms of poisoning, of a transient character it is true, but yet distinctly marked. The fashion for French coffee has led to many imitations in this country, and some manufacturers supply an article thus named. An examination of it shows that it has been roasted with sugar, and then, in almost all cases, mixed with a large proportion of chicory. Such a mixture gives great depth of colour, but when compared with the beverage made from pure coffee, and of the same depth of colour, the difference in aroma and flavour is most marked, and the counterfeit is easily detected.

The steady falling off in the consumption of coffee proves beyond question that coffee is not a popular drink. Its preparation for the table is much more complicated than that of its rival, tea, and as it is more expensive to prepare, it makes no progress in public favour, but rather loses ground. Fiscal regulations certainly favour it, but if the small duty were abolished altogether, there is no reason to believe that the consumption of coffee would thereby be increased to any appreciable extent.

Table XVII. (p. 36) shows the imports and clearances for home consumption during the 17 years ending with 1889.

Chicory,

Or succory, which is the prepared root of the wild endive, has had much to do with keeping down the consumption of coffee in this country. Originally a native of China, and introduced into Europe in the 16th century, it is now found growing wild in many parts of the continent and in this country. The root, which is large and fleshy, has when dried and roasted been much used as a substitute for coffee. It was at one time extensively cultivated in Yorkshire, but from Table XVIII., which follows, it will be apparent that the foreign-grown chicory is being substituted for that of home growth.

Chicory naturally contains a large quantity of sugar, some of which during the process of roasting becomes caramelised, and imparts to the chicory a bitterness similar to that natural to coffee. It also yields a large extractive, which coffee does not, and naturally coffee-house keepers and others have used chicory largely as an adulterant.

TABLE XVIII.—Chicory.—Imports and Consumption.

Year.	Imports. Cwts.	Home grown. Cwts.	Consumption.	
			Total cwts.	lbs per head.
1873...	116,492	9,131	104,746	·36
1874...	124,855	7,895	106,357	·36
1875...	106,656	5,549	99,807	·33
1876...	118,164	5,072	99,965	·33
1877...	112,072	4,704	104,187	·34
1878...	122,835	4,375	100,109	·32
1879...	123,373	3,311	109,302	·35
1880...	145,457	3,181	117,503	·37
1881...	143,697	2,365	116,350	·37
1882...	128,007	2,869	102,881	·32
1883...	127 781	2,503	105,713	·33
1884...	119,355	2,952	100,958	·31
1885...	122,367	3,701	102,987	·31
1886...	117,959	4,449	102,249	·31
1887...	138,090	3,116	109,243	·33
1888...	116,059	2,906	103,319	·30
1889...	125,611	1,707	99,103	·29

Chicory also, till comparatively recent times, was not a taxable commodity, and the substitution of it for coffee was thus encouraged.

In December, 1832, the Lords of the Treasury stated that "no objections are to be made by the officers of Revenue to dealers and sellers of coffee keeping and selling 'chiccoree,' or succory, *unmixed* with coffee," but they would be liable to a prosecution if coffee was kept or sold mixed with "chiccoree," or succory, or any other article.

On January 20, 1840, attention was again drawn to the illegality of selling coffee mixed with chicory, but on August 31, in the same year, the Lords of the Treasury ordered that "No objection must be made on the part of the Revenue to dealers in and sellers of coffee mixing chicory with coffee, or to their having the same so mixed in their possession."

Such an order gave great dissatisfaction to the importers of coffee, and to all connected with a pure coffee trade, and at the same time the regulations pleased the coffee-house keepers and dealers in cheap coffee, who could with impunity substitute cheap chicory for the dearer coffee.

The authorities were, however, hampered in their movements by the fact that at that time there was not at hand any means accepted as

reliable by scientific men for distinguishing chicory in the presence of coffee. Physical tests could be applied, and they would show that certain mixtures differed in their conduct with water from others whose history was known, but this deportment did not constitute legal proof. This question, and others of a similar nature, pressed heavily on the Revenue officials for settlement, and at this time the Inland Revenue Laboratory was established, principally for coping with the adulteration of coffee and tobacco.

Elaborate research into the composition and qualities of coffee and chicory was rewarded with success, and both by the microscope and by chemical and physical means the presence of the smallest quantity of chicory in coffee could be detected. The results obtained were referred for verification or otherwise to the best botanists and chemists of the day, and in 1853 reports were received from them which formed the basis of future legislation on the subject.

The facts obtained were then very interesting, and are so even now, and the following Tables, showing the deportment of chicory and other substitutes for coffee under examination, will satisfy even the sceptical that good work was done in this investigation : –

TABLE XIX.—Weight of Substance dissolved in 2,000 parts of Water, to produce an equal depth of Colour.

Caramel		1·
Mangold-wurzel		1·66
"Bouka" (a coffee substitute)		1·66
Sparke's vinegar colouring		1·74
Black malt		1·82
White turnips		2·
Carrots		2·
Chicory (darkest Yorkshire)		2·22
Parsnips		2·5
Maize		2·86
Rye		2·86
Dandelion root		3·33
Red beet		3·33
Bread raspings		3·64
Acorns		5·
Over-roasted coffee	mean 6·21	5·46
Highly-roasted coffee	mean 6·21	5·77
Medium-roasted coffee	mean 6·21	6·95
Another specimen of coffee	mean 6·21	6·66
White lupin-seed		10·
Peas		13·33
Beans		13·33
Spent tan		33·
Brown malt		40·

TABLE XX.—Colouring Power of Various Substances dissolved in an equal quantity of Water.

Caramel	1000·
Mangold-wurzel	602·4
"Bouka" (a coffee substitute)	602·4
Sparke's vinegar colouring	574·71
Black malt	549·45
White turnips	500·
Carrots	500·
Chicory (darkest Yorkshire)	450·45
Parsnips	400·
Maize	350·
Rye	350·
Dandelion root	300·3
Red beet	300·3
Bread raspings	274·72
Acorns	200·
Over-roasted coffee	183·15
Highly-roasted coffee	173·31
Medium-roasted coffee	143·88
Another specimen of coffee	150·15
White lupin-seed	100·
Peas	75·18
Beans	75·18
Spent tan	30·
Brown malt	25·

TABLE XXI.—Specific Gravity of Solutions at 60° Fahr.—1 part of substance to 10 of water.

Spent tan	1002·14
Lupin seed	1005·7
Acorns	1007·3
Peas	1007·3
Mocha coffee	1008·
Beans	1008·4
Neilgherry coffee	1008·4
Plantation Ceylon coffee	1008·7
Java coffee	1008·7
Jamaica coffee	1008·7
Costa Rica coffee	1008·98
Native Ceylon	1009·
Costa Rica coffee	1009·5
Brown malt	1010 9
Parsnips	1014·3
Carrots	1017·1
"Bouka"	1018·5
English chicory (Yorkshire)	1019·1
Black malt	1021·2
Turnips	1021·4
Rye meal	1021·6

English chicory	1021·7
Dandelion root	1021·9
Red beet	1022·1
Foreign chicory	1022·6
Guernsey chicory	1023·2
Mangold-wurzel	1023·5
Maize	1025·3
Bread raspings	1026·3
British Gum	1027·9
Gum Arabic	1038·6
Cane sugar	1040·9
Starch sugar	1042·8

TABLE XXII.—Sugar in Coffee, before and after Torrefaction.

		Sugar per cent.	
		Raw.	Roasted.
1	Plantation Ceylon	7·52	1·14
2	do.	7·48	·63
3	do.	7·70	0·0
4	do.	7·10	0·0
5	Native Ceylon	5·70	·46
6	Java	6·73	·48
7	Costa Rica	6·72	·49
8	do.	6·87	·40
9	Jamaica	7·78	0·0
10	Mocha	7·40	·50
11	do.	6·40	0·0
12	Neilgherry	6·20	0·0

TABLE XXIII.—Sugar in Chicory and other Sweet Roots, Before and After Torrefaction.

	Sugar per cent.	
	Raw.	Roasted.
Foreign Chicory	23·76	11·98
Guernsey Chicory	30·49	15·96
English Chicory	35·23	17·98
do. (Yorkshire)	32·06	9·86
Mangold-wurzel	23·68	9·96
Carrots (ordinary)	31·98	11·53
Turnips do.	30·48	9·65
Beet-root (red)	24·06	17·24
Dandelion-root	21·96	9·08
Parsnips	21·70	6·98
„ Bouka," a coffee substitute	—	5·82

TABLE XXIV.—Sugar in Various Seeds, Before and After Torrefaction.

	Sugar per cent.	
	Raw.	Roasted.
Acorns	3·64	2·70
Horse beans	—	1·62
Peas (grey)	—	1·08
Maize	—	·82
Rye meal	—	1·96
Bread raspings	—	1·78
Lupin seed	—	·74
Brown malt	8·48	—
Black malt	—	1·66

TABLE XXV.—Silica in Roasted Coffee.

	Per cent. in ash.
Sample No. 1	0·
„ „ 2	0·
„ „ 3	0·26
„ „ 4	0·2
„ „ 5	0·17
„ „ 6	0·28
„ „ 7	0.
„ „ 8	0·45
„ „ 9	0·
„ „ 10	0·
„ „ 11	0·
„ „ 12	0·09

Acting on the knowledge obtained, the Lords of the Treasury, on August 3, 1852, rescinded the order of August, 1840, and enacted that coffee dealers might keep and sell chicory, provided that it was sold separately from coffee, and in packages sealed or otherwise secured, and bearing a printed label with the name of the firm of the seller.

The trouble this regulation gave in its execution was so great that in the following year it was allowed (by General Orders, February 28, and May 13, 1853) that licensed dealers in coffee might sell chicory prepared and mixed with coffee, provided the package in which such mixture was delivered to the purchaser was labelled "Mixture of chicory and coffee," and that no finings or colouring matter, nor any substance or article whatever, except chicory, be allowed to be sold mixed with coffee.

Such a binding order compelled the executive of the Revenue Department to take action, and for about twelve years the adulterators of coffee were constantly prosecuted. The adul-

TABLE XXVI.—Analysis of the Ash of Coffee and Chicory.

	Coffee.							Chicory.							
								Deducting Sand and Silica.				Deducting Sand and not Silica.				Not Deducting Sand and Silica.			
	Plantation Ceylon.	Native Ceylon.	Java.	Costa Rica.	Jamaica.	Mocha.	Neilgherry.	Darkest English (Yorkshire).	English.	Foreign.	Guernsey.	Darkest English (Yorkshire).	English.	Foreign.	Guernsey.	Darkest English (Yorkshire).	English.	Foreign.	Guernsey.
Potash	55·10	52·72	54·00	53·20	53·72	51·52	55·80	38·53	27·85	46·07	46·27	37·07	27·13	40·20	41·41	33·48	24·88	29·56	32·07
Soda	—	—	—	—	—	—	—	9·34	16·90	3·17	5·49	8·99	16·46	2·77	4·92	8·12	15·10	2·04	3·81
Lime	4·10	4·58	4·11	4·61	6·16	5·87	5·68	10·79	10·81	7·78	7·65	10·38	10·53	6·79	6·85	9·38	9·60	5·00	5·31
Magnesia	8·42	8·46	8·20	8·66	8·37	8·87	8·49	6·06	8·08	5·33	5·55	5·83	7·87	4·66	4·97	5·27	7·22	3·42	3·85
Sesquioxide of iron	·45	·98	·73	·63	·44	·44	·61	4·38	3·50	8·29	5·08	4·22	3·41	7·24	4·55	3·81	3·13	5·32	3·52
Sulphuric acid	3·62	4·48	3·49	3·82	3·10	5·26	3·00	11·38	11·78	8·38	8·67	10·95	11·48	7·32	7·76	10·29	10·53	5·38	6·01
Chlorine	1·11	·45	·26	1·00	·72	·59	·60	5·67	5·23	5·03	6·58	5·46	5·10	4·39	5·89	4·93	4·68	3·23	4·56
Carbonic acid	17·47	16·93	18·13	16·34	16·54	16·98	14·92	2·04	3·22	4·36	4·60	1·97	3·14	3·81	4·12	1·78	2·88	2·80	3·19
Phosphoric acid	10·36	11·60	11·05	10·80	11·13	10·15	10·85	12·27	12·61	11·00	9·59	11·81	12·29	9·60	8·59	10·06	11·27	7·06	6·65
Silica	—	—	—	—	—	—	—	—	—	—	—	3·81	2·61	12·75	10·52	3·81	2·61	12·75	10·52
Sand	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9·32	8·03	23·10	20·19
Total amounts	100·63	100·20	99·97	99·06	100·18	99·68	100·04	100·40	99·98	69·41	99·48	100·49	100·02	99·53	99·38	100·85	99·98	99·66	99·68

teration could, however, be done so easily, and the mixture so readily disposed of, that the adulterator could afford to break through the regulations and run the risk of fines, and this was done to such an extent that in 1860 a duty of 3s. a cwt. was levied on home-grown chicory. This rate was in 1861 increased to 5s. 6d. and 8s. 6d.; in 1862 to 11s., later to £1 1s. 9d.; in 1864 to £1 4s. 3d., while the Customs' duty on foreign chicory was £1 6s. 6d. per cwt. In 1872 the duty was made less by one-half, on account of the coffee duty being reduced from 6d. to 3d. a lb. The practical equalisation of the duties on coffee and chicory in 1864 put a stop to Excise interference, as the substitution of one for the other was no loss to the revenue. The poor consumer was thus deprived of his protector, and remained at the coffee dealer's mercy until the public analyst rose up to protect him. The analyst's powers are not, however, very great, and do not extend beyond making it an offence to sell coffee containing chicory for pure coffee. The quantity of chicory which may be added is not subject to legal control, and, therefore, the consumer can be to any extent defrauded by the substitution of chicory for the more expensive coffee, and he is powerless to protect himself. The skilful vendor of these mixtures is careful to roast his coffee with sugar, which sugar becomes caramelised during the roasting, and the clear bitter flavour of the caramel thus introduced masks the earthy taste of the chicory which, when present in large proportions, imparts to the coffee (so called) a full, earthy, mawkish flavour. Such mixtures of coffee, burnt sugar, and chicory are now generally sold in tins, under the name of French coffee. These mixtures containing large quantities of chicory must be preserved in tins, for if exposed, the chicory and caramel quickly absorb moisture, on account of their hygroscopic properties, and become clogged into a mass, which soon runs into decomposition. The tinned coffee of 35 years ago was eagerly purchased because of its cheapness and handiness for consumption, but the consumer thought not how very little the mixture was intrinsically worth, or that though apparently cheap, yet the profit actually made out of it was sufficient to place the manufacturer of it in a position of affluence in a very short time. The imposition of a chicory duty somewhat curtailed the profits made on tinned coffee, but sufficient profit now remains to make the trade a very lucrative

one, and to place the sale of coffee and its twin sister, tea, in the highest position of importance for profit among the goods vended by the family grocer.

In 1882 the duty on coffee and chicory was retained, but the same rate of duty which had been imposed on "other vegetable matter applicable to the uses of chicory or coffee" was repealed, and in its place a duty was levied on all imitations of coffee or chicory and on coffee mixtures.

This duty was to be secured by stamp labels attached to packets of certain weights, and it was expected that many substitutes which before had escaped duty would in this manner be brought to charge. The result has not answered expectations, for since the imposition of the label in lieu of the old duty the receipts have steadily declined, as will be apparent from the following official return :—

TABLE XXVII.

Year.	½d. labels.	1d. labels	Net amount received.
			£ s. d.
1882-3.....	1,410,365	802,434	6,344 2 2½
1883-4.....	1,432,203	645,429	5,673 0 10½
1884-5.....	1,110,664	539,893	4,563 8 9
1885-6.....	1,021,868	446,525	3,989 8 3
1886-7.....	799,914	370,971	3,212 4 0
1887-8.....	704,862	332,921	2,855 12 8
1888-9.....	670,050	309,828	2,686 17 9

Chicory, which is generally employed as a substitute for coffee, has been frequently adulterated in its turn by the addition of cheap substitutes. The following illustrations will give an idea of the manner in which the fraud has been carried on. A chicory roaster, who was also a mustard manufacturer, used up in his roasted and ground chicory all the husks of the mustard seed employed in making mustard, and when detected his excuse was that the husks were not added for adulteration, but simply to assist the roasting of the chicory. These husks were absolutely worthless as mustard husks, and they only became of value when substituted for chicory. Another similarly used roasted grain, and another the common biscuits known in the trade as dog biscuits. In all these cases the same excuse for their use was made, namely, that the substances added were to assist the roasting of the chicory. It is only proper to remark that these ingenious people always found the defect of the chicory remedied by the addition of a much cheaper substance, and never by that of a dearer one.

Not many years ago a sensation was caused in the coffee trade by the sale of roasted ground acorns as a substitute for coffee, and this rubbish, under the name of "Pelotas Coffee" and "Coffee Surrogate," was extentensively advertised as a superior coffee substitute, possessing certain desirable qualities not found in coffee.

Later on an ingenious utiliser of waste products had his attention directed to an accumulation of date stones, obtained from the dates used at a distillery in the north of England for the manufacture of alcohol. These worthless stones were removed to a large manufacturing town, roasted, and presented to the public as "Date Coffee." The extractive produced from the roasted stones was exceptionally low, but the Stock Exchange speculator ran up the £5 shares of the company to about five times their value, and those behind the scenes took care to be cleared out of shares when the crash came. The worthlessness of the article was soon proved, and the company has long since gone into liquidation. It is well established, from the test of experience gained in Great Britain, and in continental countries in which coffee is in use as a general beverage, that the best of all coffee substitutes is roasted chicory. It lends itself more readily as a good substitute than other vegetable substances, by rapidly giving up in decoction its extractive matter, which imparts a dark colour to the mixture in which it enters, and thus covers the naturally poor extractive obtained from coffee. Being not in the slightest degree injurious to health, it cannot be condemned as unwholesome, and many prefer a mixture of coffee and chicory to pure coffee itself.

In addition to this, the difference in price between the poorest commercial coffee and the best chicory is very great, and, consequently, both price and flavour offer a strong inducement to add chicory to coffee. This inducement to add chicory can be shown in a very simple manner by reference to Table XX., p. 38.

It will be seen that 6·21 lbs. of coffee, and 2·22 lbs. of chicory are equal to each other in tinctorial power, and that 1 lb. of caramel is their equivalent in this respect. One pound of chicory will therefore be equal in colouring power to 2·8 lbs. of coffee. The price of chicory is about 3½d. per lb., and the average price of

roasted coffee may be fairly taken at 1s. 5d. At this rate the colouring power derived from 1 lb of chicory of the value of 3½d., is as great as from 2·8 lbs. of coffee of the value of 3s. 11d. It may be urged that other properties of coffee have to be considered beside the colour of the aqueous extract, and there is force in this contention, but with the frequenter of the coffee tavern, the standard of quality of coffee is its colour, and even at hotels of ordinary repute, colour rather than quality is apparently the standard of the ordinary coffee consumer.

The dealer well acquainted with his business knows from experience the quantity of chicory every description of coffee will carry before deterioration of taste and flavour is pronounced, and to this judicious admixture in suitable proportions can be attributed the success of certain firms who have made ground tinned coffee a specialty.

The coffee trade is, however, a declining one, as has been shown from the imports for consumption, and whilst some consider that the legalising of mixtures has led to this decline, others believe that the dearness of coffee, as compared with tea, and the trouble of preparation, have been the main causes which have led to its diminished consumption.

LECTURE III.—DELIVERED MAY 12, 1890.

TEA: ITS HISTORY.

The tea of commerce consists of the leaves of a hardy shrub which is often found growing in conservatories in this country, and even in the open air in sheltered and favoured situations. It, however, is not a native, and the climate most suitable to its growth is found between the 25th and 23rd degrees of north latitude, and the 115th and 122nd degrees of east longitude. This habitat is given simply because when tea came into repute it was cultivated in the particular locality named as an article of commerce, but the plant flourished in other districts where it was not tended as of any commercial value. The tea plant, no doubt, came into popularity when it was cultivated in China only, and the first accounts we have of the use of tea as a beverage certainly fix China as its place of origin.

A learned Chinese, who lived a thousand years ago, said of the infusion of tea that—

> "It tempers the spirits and harmonizes the mind;
> Dispels lassitude, and relieves fatigue;
> Awakens thought and prevents drowsiness,
> Lightens or refreshens the body, and clears the perceptive faculties."

Giovanni Botero, an Italian author of repute, mentions in his book on the causes of magnificence and greatness of cities that "the Chinese have a herb out of which they press a delicate juice, which serves them for drink instead of wine; it also preserves their health, and frees them from all those evils which the immoderate use of wine produces among us."

The Dutch East India Company, twenty years later, 1610, introduced tea into Europe, and it is said to have been first imported into England from Holland about the year 1650. As soon as imported it became a fashionable drink amongst the leaders of society, and it is on record that certain members of the aristocracy, interested in its importation, used their influence in their own immediate circles to introduce the new beverage. Their efforts appear to have been successful in a way which they probably did not intend, for in 1660, when coffee-houses were only just established in London, an Act of Parliament came into force which imposed a duty of 8d. on every gallon of "chocolate, sherbet, and tea made and sold." In Samuel Pepys's diary, he enters, "September 25, 1661, I sent for a cup of tea (a China drink), of which I had not drunk before." As Mr. Pepys held the official position of Clerk of the Acts (Navy-office), he would not have made such an entry if tea had entered into ordinary use as a beverage.

In 1662 Charles II. married the Princess Catherine of Portugal, who liked tea, and in 1664 the East India Company bought 2 lbs. of tea as a present for the king; three years later, they directed their agent at Bantam to send home 100 lbs. weight of the best tea he could get. The consumption of tea considerably increased, and the method of levying a duty on the infusion, and not on the commercial article itself, was soon found to be impracticable in its incidence. There was no definition of the strength of the infusion, or relation between the water used and the tea, &c., employed, laid down in the Act of Parliament imposing the duty, and as an improvement it was enacted in 1689 (Act I. William and Mary), that an excise duty of 5s. a pound should be imposed on the tea itself.

Considering that tea was an importation of very recent date, it evidently came speedily into notoriety for fiscal purposes, and as it appeared to be the drink of the rich on account of its price, little harm was done at the time in making it subject to a heavy duty. In time, however, the fashion of tea drinking extended, and as tea was a beverage which refreshed and stimulated without clouding the mind as intoxicants did, its use became more general, and the demand for it was only limited by its price and the difficulty of obtaining it.

Before it was thoroughly established as a

beverage, it had to encounter much prejudice, on account of tea being of foreign growth, and the fashion of tea drinking a foreign one. Jonas Hanway was a fair specimen of the opponents of tea, and in 1707 he published an "Essay on Tea, considered as pernicious to health, obstructing industry, and impoverishing the nation." Some advocates of tea drinking had stated that tea cured and prevented scurvy; but Hanway said that the sailors referred to "owe their health to rest, to sailing with a trade wind, to rice and other kinds of farinaceous foods, and not to tea."

A specimen of his style of declamation may be interesting, as well as amusing: the following is therefore given as an illustration:—

"Will the sons and daughters of this happy isle—this reputed abode of sense and liberty—for ever submit to the bondage of so tyrannical a custom as drinking tea? Must the young and old and middle-aged, the sickly and the strong, the poor and rich, in warm weather and cold, in moist and dry, with one common consent, employ so many precious hours in so low a gratification as drinking tea?

"Custom is said to be a second nature—in many instances it is a first—but as we shall never walk on our hands so conveniently as on our feet, I am persuaded the inhabitants of this island will never increase in number, or enjoy a blooming health, whilst they continue such an extravagant use of tea."

After dwelling on the force of fashion with regard to tea, he answers a fair correspondent, whom he assures—

"It is in your power to destroy this many-headed monster, which devours so great a part of the best fruits of this land."

And if successful, the inscription on the statue to be erected to her memory shall run thus:—

MDCCLV.
To
the remembrance
of the fair Guardian Spirits of
Britain,
whose influence and example
abolished the use of
a Chinese drug called
TEA;
the infusion of which had been for many years
drank in these realms and dominions,
injuring the health,
obstructing the industry,
wasting the furtunes,
and exporting the riches
of His Majesty's liege subjects.
etc., etc.

The Dutch, in the 17th and 18th centuries, were our great competitors in the East, and whilst we had a chartered company known as the East India Company, the Dutch had their chartered company also, which had a more direct trade with China than the British company and had better opportunities of opening up a tea trade with China and the countries adjacent. The result of the competition was that the Dutch company brought tea to Europe for consumption, and as it presented no difficulty in storage for smuggling, it was largely imported into this country by the smuggler, and the duty was thus evaded. This state of things could not, for fiscal reasons, be long tolerated, and to modify the injury done to legitimate trade, it was thought desirable to reduce the duty and thus curtail the profits of the smuggler. Before 1745, tea was charged with an excise duty of 4s. per lb., and an *ad valorem* duty of customs of 14 per cent. In that year, on a recommendation of a special committee of the House of Commons, the duty was reduced to 1s. per lb. and 25 per cent. *ad valorem*. These two, when taken together, made the duty about half what it was before.

The effect of this change was soon apparent; the clearances for duty at once increased, this result being due not so much to increased consumption as to obtaining from a legitimate source a portion of the tea which had before been supplied by the smuggler's agency. McCulloch gives figures to show the extent to which smuggling was carried on as a consequence of the high duties. He states that "in the nine years preceding 1780 above 118,000,000 lbs. of tea were exported from China to Europe in ships belonging to the continent, and about 50,000,000 in ships belonging to England. But, from the best information obtainable, it appears that the real consumption was almost exactly the reverse of the quantities imported, and that while the consumption of the British dominions amounted to above 13,000,000 lbs. a year, the consumption of the continent did not exceed 5,500,000 lbs If this statement be nearly correct, it follows that an annual supply of about 8,000,000 lbs. must have been clandestinely imported into this country in defiance of the Revenue laws." After making the fullest allowance for errors that may have crept into this estimate, it cannot be denied that smuggling must have been carried on on a very large scale, and that the legitimate trader must have been sorely pressed by the fraudulent one. In fact, the Statute-book

bears evidence of the prevalence of fraud on the revenue, for the Act 10 Geo. I., cap. 10, which came into force at Midsummer, 1724, empowered the officers for inland duties to enter any warehouses, storehouses, rooms, shops, cellars, vaults, and other places made use of for keeping or making any coffee, tea, cocoa-nuts, or chocolate, and by weighing, gauging, or otherwise to take an account of the quantities and sorts of the said commodities which shall at any time be in their or any of their custody, and each proprietor was compelled to keep sufficient scales and weights necessary for the taking of stock, and to render every assistance to the public officer when so employed.

In the following year—1725—legislation was directed to the protection of the revenue from fraud by the counterfeiting or adulteration of tea, and from altering, fabricating, or manufacturing tea with *terra japonica*, or with any drug or drugs whatsoever. It was also made penal to mix, or cause or procure to be mixed, with tea any leaves other than leaves of tea, or any ingredients whatsoever, under a penalty of £100. And to make this matter more stringent, as well as to cultivate a feeling of insecurity in those practising this system of adulteration, it was enacted that half the fine recovered from the offender should be given to the informer.

In the reign of George II. (4 Geo. II., c. 14) there were persons ill-disposed enough to the Revenue to manufacture sloe, liquorice, the leaves of tea already used, and the leaves of other trees in imitation of tea, and this was also made a penal offence.

The Act 17 Geo. III., c. 29, shows, from the elaboration of the statements made in that of George II., that tea adulteration was increasing both in amount and ingenuity, and it was thereby enacted that "any person who, after June 1, 1777, shall dye or manufacture in imitation of tea any leaves of tea that have been used, or any sloe, liquorish, or elder leaves, &c., or shall sell or offer to sell the same, shall on conviction forfeit £5 for every pound of such leaves so dyed." A penalty was also incurred by persons having in their possession more than six pounds of any such leaves, and not satisfactorily accounting for the same. Power was also given to enter suspected premises by special warrant to search for such adulterants, and if found they were to be destroyed. A novelty was also introduced into this Act as to the appropriation of penalties recovered. One half was to be paid to the informer, and the other half to the poor of the parish in which the offence was committed. These Acts of Parliament throw a somewhat lurid light on the state of society at the time they were enacted. It is evident from the preambles of the Acts that not only was smuggling very common, but that factories were established in remote places to supply the public with imitation tea. Such factories would never have come into existence if there had not been a demand for the goods manufactured in them, nor would there have been set up such ingenious methods of making the general public detectives if the illicit manufacture of imitation teas had not been widespread. Such enactments show conclusively that the true method of taxation is to impose only such duties as articles will legitimately bear, excessive rates leading, as a matter of course, to smuggling and other irregularities. With the reduction of the tea duties no new regulations have been found necessary, and beyond a special departmental examination by the Customs of tea on importation, nothing further has been done to protect the Revenue. From 1844-1856 a large number of samples were examined, and 137 selected for analysis. Of these 68 were adulterated. There were two classes of adulterated tea—the "lie teas" prepared by the Chinese, and the spurious teas manufactured in this country. In the former the following substances have been found:—Gum, indigo, vegetable yellow, Prussian blue (rare), carbonate of magnesia, sulphate of lime (rare), silica and dextrin (very rare). In the latter class have been found exhausted tea leaves, and the leaves of beech, elm, plane, poplar, oak, and willow, made up to represent green tea with some of the following:—Gum, Dutch pink, Prussian blue, indigo, carbonate of magnesia, French chalk, and sulphate of lime; and slightly coloured with rose pink to impart a bloom to represent black tea.

The Food and Drugs Act, which embraces within its folds the adulteration of all articles of food and drink, has remained practically a dead letter regarding tea, as no imitation tea has been found, and tea as imported is almost invariably genuine.

East India Company's Monopoly.

What was done for the cultivation of tea in China before it was known to Europeans we are unable to learn, except that Moorish travellers related that in the 8th century Mahometans had free ingress and egress as to China, and that at the time named the general

drink of the people was prepared by immersing the leaves of a small plant in hot water, which was used medicinally and to correct the bad qualities of the water; and from the scraps of history which are available we gather that the wars of Europe had much to do with opening up our Eastern trade.

The Portuguese, the prominent navigators of the 15th century, found a way to India by the Cape of Good Hope in 1497, and for nearly 100 years they had possession of the commerce of that part of the world. When they perceived that it was desirable to have undisputed possession of this proverbially rich territory, they endeavoured to secure a monopoly in a very cheap way, and this for nearly a century was as successful as if they had depended solely on the strongest of fleets and armies to ensure the success of their plans. Soon after they had made important discoveries on the West Coast of Africa they applied to the Pope for a bull to confer on them the "exclusive right to, and possession of, all countries occupied by infidels which the Portuguese either had discovered or might discover" to the south of a certain point of latitude (27° 54′ north). The Pope granted the bull, and the Portuguese were left in possession till the war broke out between Philip II. of Spain and the Low Countries. The Dutch then, wishing to cripple the power of their enemy abroad as well as at home, began to dispute the rights of the Portuguese in the Indian seas; and the English, who had been trying to avoid a rupture with the Pope and Portugal, having fruitlessly endeavoured to discover a northern passage to the East, at last went on the same lines as the Dutch, and treated the Pope's bull with defiance both at home and in foreign lands. The great naval engagements fought between the English and the Spaniards (the Spaniards having conquered Portugal in 1580) led to the destruction of the Spanish navy, and some of the Spanish East India merchantmen which were captured contained such quantities of silks, spices, calicoes, gold, precious stones and gems, that the cupidity of the English adventurer was stirred, and it was determined to open up the treasures of the East by English enterprise and capital,

For the protection and national recognition of those engaged in the trade it was thought desirable that the adventurers engaged should form themselves into an association having special and exclusive privileges. They applied to Queen Elizabeth for two things. First, for a charter of incorporation, and secondly, for the right to exclude any person from trading in any form whatsoever with any country beyond the Cape of Good Hope or the Straits of Magellan without a license from the Company. The charter, comprehensive as it was, was granted, and dated on the last day of the year 1600.

The title of the corporation was "The Governor and Company of Merchants of London trading into the East Indies." The corporation was empowered to make bye-laws, to export all kinds of goods free of duty, to export a certain quantity of foreign coin or bullion per annum, to inflict punishments and impose fines, and had other privileges conferred, which were likely to be of great pecuniary benefit. The charter was granted for fifteen years, but if found not of public advantage, it could be terminated at any time within the aforesaid period, on giving two years' notice.

The corporation, privileged as it was, started badly, many who had joined it for its privileges did not feel disposed to part with their money in fitting out expeditions, and on this account it was necessary to form subsidiary companies whose members possessed greater love of adventure than their colleagues in general, and for thirteen years the business was thus conducted. Large profits were frequently realised by these semi-private adventurers, and the Company was then moved to work on a larger and more comprehensive basis. But the desire to obtain special advantages was so great, that some of those members of the parent corporation who had formed subsidiary companies were opposed to a renewal of the charter, and thus for many years there were several companies or corporations possessed of special privileges, and which were constantly being harassed by private adventurers.

The ultimate settlement was brought about by a consolidation of the different interests associated with all the companies, and by the procuration of a consolidated charter to a corporation called "The United Company of Merchants of England trading to the East Indies" by the judicious and politic advance to the Government of £1,200,000 without interest. Modifications were afterwards made in the Company's constitution, and especially for placing it under more immediate Government control. But the Company was invested with great powers, and even in 1814, when privileges were granted to private traders, they were compelled to send their goods to India in vessels belonging to the Company,

and the same system was compulsory on the part of the Indian merchant who wished to send goods to England.

Much more might be said on the interesting subject of the East India Company, its formation, constitution, and privileges, but it is our present purpose only to connect its operations with the importation and production of tea, and it was necessary to say as much as has been said for the purpose of establishing this connection.

From what has been stated, it is evident that, the supply of tea being till a comparatively recent date in the hands of the East India Company, it was practically a monopoly. Smuggling from the Continent prevailed to a certain extent, but this was considerably modified by the reduction of the duty, and would have been brought within much narrower limits if the absence of competition had not caused the price of tea to be much higher here than it was at Amsterdam, Hamburg, and other towns having an open trade with the East.

The effects of the monopoly were apparent in many directions. There was no keen competition on the part of the buyers for the Company, no inducement was offered by a large semi-irresponsible Company to direct enterprise into other than the ordinary markets, while the self-interest of private adventure led men to encourage competition, and to buy in that market where the best quality could be procured at the lowest price. This self-interest was apparent in the difference in price quoted for the same description of tea on the London and foreign markets.

A company having such special privileges granted them by the Government had certain heavy responsibilities imposed which fettered trade, and thus prevented the agents of the Company from giving the best of terms to the public. Some of these restrictions will have to be referred to later on, but it may be here sufficient to state that statisticians have estimated that in the latter years of the monopoly the consumer of tea had to pay very nearly £2,000,000 sterling a year on the quantity cleared for consumption more than if the same quantity and qualities of tea had been bought in the open markets of the Continent.

Whenever legislative changes were made affecting the tea duties, they were frequently coupled with specific regulations for controlling the supply of tea by the East India Company. Thus when the duty on tea was reduced in 1745, the Government enacted, in 18 Geo. II. c. 26, that as the reduction of duty was intended to increase the consumption, and that as the demand would probably be greater than the supply, the East India Company should have power to import into Great Britain from the continent of Europe any quantity of tea that might be necessary, subject to the several duties, and to the same rules and directions as were given with respect to tea imported by them from the East Indies. The Company had, however, to give notice to the "Commissioners of the Treasury of the intended quantity, with the name of the ship and master in which it is to be laden, and taking a license . . . . for landing and importing thereof."

The Government had, however, a suspicion that the altered state of the market through the reduction of duties might place the Company in such a position that it might either refuse or be unable to supply the increased quantity of tea that would be required, and they therefore took power to themselves to "grant licenses to any other persons, bodies, Politick or Corporate, to import tea from any parts of Europe in like Manner, and subject to such Duties, and under such Limitations, on such Notices, and with such Licenses as are herein before prescribed with Respect to Tea imported from any parts of Europe by the East India Company."

The Company, however, fulfilled its obligations to the satisfaction of the Government, and no licenses to other persons were issued.

When a further modification of duties was made in 1784, the Government again showed their desire to benefit the consumer by taking certain powers to themselves, and it was set forth in 24 Geo. III., cap. 38, s. 5 :—

"And whereas it is just and reasonable that the said United Company should, in Consideration of the great Benefit which may result to their Commerce from the Reduction of Duties hereby made, contribute their utmost endeavours for securing to the Publick the full Benefit which will arise from an immediate and permanent Reduction of Prices; be it further enacted by the Authority aforsesaid, That the said United Company shall, as soon as may be after the passing of this Act, put up and expose to publick Sale, at the least, Five Millions of Pounds Weight of Tea; and shall in like Manner, at some other time before the Thirty-first Day of December, one thousand seven hundred and eighty-four, make another Sale, at which they shall in the like Manner put up at the least two Millions five hundred thousand pounds Weight of Tea; and shall thenceforward continue to make at the least Four Sales in every year, and as near as conveniently may be at equal Distances of Time, and shall put up at such Sales

such Quantities of Tea as shall be judged sufficient to supply the Demand, and that at each and every such Sale the Tea to be put up shall be sold without Reserve to the highest Bidder, provided an Advance of One Penny per Pound shall be bid upon Prices at which the same shall be put up; and that at the Four first Sales which shall be made after the passing of this Act, the Prices at which the said Tea shall be put up and exposed to Sale shall not exceed the following Rates, *videlicet*:—For Bohea Tea, One Shilling and Sevenpence per Pound; for Congo Tea, One Shilling and Fivepence per Pound; for Souchong Tea, Three Shillings and Threepence per Pound; for Hyson Tea, Four Shillings and Elevenpence per Pound; and that it shall not be, at any Time hereafter, lawful for the said United Company to put up their Tea for Sale at any Prices which shall, upon the Whole of the Tea so put up at any one Sale, exceed the Prime Cost thereof with the Freight and Charges of Importation, together with lawful Interest from the Time of the Arrival of such Tea in Great Britain, and the common Premium of Insurance, as a Compensation for the Sea Risk incurred thereon."

The United Company was compelled to provide against the demand of an increased consumption by providing a stock in warehouse equal to at least one year's consumption as determined by the sales of the last preceding year; and in addition to all this, the Treasury had the power to examine all books and documents for the purpose of verifying the *bona fides* of the Company with regard to quantities, the prices for auction purposes, and for other specified particulars.

Special provisions were made for relieving dealers in tea of their stocks which had paid the higher duty, and due consideration was given to the requirements of the trade for obtaining the relief from duty to which they were entitled.

It is difficult to see what connection there was at the time of the reduction of duty between tea and the windows of dwellings; but the Government of the day increased the window tax to recoup the Exchequer for the loss likely to occur from a reduction of the tea duty, and it was enacted that on every house rated by Act 6 Geo. III. at 3s. an additional 3s. should be charged. For every dwelling-house rated for 7 windows there should be an increase of 6s.; 8, 8s.; 9, 10s. 6d.; 10, 13s.; 11, 15s. 6d.; 12, 18s.; 13, 21s.; 14, 25s.; 15, 30s., and 5s. additional for each window up to 25; then 10s. additional for every 5 windows up to 99; then 20s. for every 10 windows up to 179; and for 180 and upwards, £20.

It was laid down in the Act how the money thus raised was to be brought to account, and how the surplus, if any, was to be used for the purposes of Government.

The effect of lowering the duty naturally was that much larger quantities of tea were consumed, the result to the Revenue being that instead of an expected deficit of upwards of £600,000, the actual decrease was only from £700,000 to £340,000. This Commutation Act of Pitt has been considered a very praiseworthy and satisfactory performance, but the increased amount obtained from the tea duties and window tax combined was easily spent, and soon the screw was put on to increase the duty. In 1795 the duty was raised to 20 per cent., *ad valorem*, and after several further increases the duty was fixed in 1819 at 100 per cent. on all teas which realised at the Company's sales above 2s. a pound.

The effect of the monopoly of the East India Company was observable to the distributor and consumer. The Government restrictions imposed on the Company tended to increase prices, and the absence of competition enabled the Company to extort at their sales such high prices that tea could only reach the consumer at a cost which, except to the well-to-do, was almost prohibitive. The regulations of the Government had also a disastrous effect on the quality of the tea. For instance, the tea sold by the Company could not reach the consumer till it had been packed over 12 months, and, in fact, evidence was adduced that the tea was kept on an average 17 months before it was put into consumption. Tea so kept must naturally deteriorate largely in quality, and for an illustration we need only refer to the reduction of the prices of old season's tea as soon as the new comes on the market. It is only just to state that nearly all the Chinese teas are so well cured that they deteriorate least by keeping; but much of the Indian and Assam tea falls off wonderfully through keeping, till at the present time this fact is fully recognised by the trade, and the stock of these teas is kept as small as possible.

The monopoly of the East India Company enabled them to control the supply of tea, and it was always to their interest to put a short supply on the market to obtain better prices for that sold.

Private enterprise, if allowed, would soon have remedied such a state of things, and healthy competition would have killed the monopoly. But this was not allowed, and consequently prices were charged which had not only to cover the large profit put on the tea, but also to make amends for reckless

expenditure in China and at home through the absence of commercial rivalry. Such a system could not last on account of its injustice to the consumer and the special privileges it enjoyed. Gibbon describes monopolists thus:—"The spirit of monopolists is narrow, lazy, and oppressive. Their work is more costly and less productive than that of independent artists; and the new improvements, so eagerly grasped by the competition of freedom, are admitted with slow and sullen reluctance in those proud corporations above the fear of a rival and below the confession of an error."

Such a corporation had to work through servants; individuality was to a great extent lost, and the enterprise, courage, fertility of resource, and skill which are necessary to make the character of an able and successful merchant were clouded, if not destroyed, by the red tape system of a corporation mostly governed by men of small commercial experience of any kind, and of quite as little knowledge of the requirements of their Company; men apt to resent any overture of a novel kind, however good, desiring only to pursue the high and dry methods of business which had been in vogue for centuries, but which were already quite out of date when applied to modern commerce.

Extravagance in administration, and consequent high prices of goods sold under this monopoly, led some gentlemen to look into the business of the Company, with a view of seeing whether the extravagance of working did not eat up the profits on the sales, or rather what was charged over and above the continental importers' prices. This inquiry brought out the following curious result:—

	£
Profits realised by the Company in three years ending 1828	2,542,569
Average	847,523
Excess of price received for the Company's teas over the price of such teas sold at New York and Hamburg	1,500,000

There was, therefore, an absolute loss, through the monopoly, of £652,477 a year, in addition to the odium attached to a system which diminished trade, choked competition, and increased the cost of the necessaries of life.

When the time came for the renewal of the charter these facts were not forgotten, and the Act 3 and 4, William IV., c. 85, abolished the monopoly, made it lawful for all persons to import tea, and thus gave power to those who wished to open up a trade with China.

From the Table given below it will be seen that the monopoly of the East India Company enabled the Government to charge different rates of duty on the several classes of tea. Thus the duty was, on—

	Per lb.
Bohea	1s. 6d.
Congou, Twankay, Hyson Skin, Orange Pekoe, and Campoi	2s. 2d.
All other sorts	3s. 0d.

With the removal of the monopoly the classification was, as a matter of course, broken, and for fiscal purposes eventually abolished. The importer would at all times be anxious to obtain the highest price for his tea, but naturally would wish to pay the lowest duty. Evasions and wrong descriptions led the Government to adopt one rate, and from July 1st, 1836, the duty on tea was fixed at 2s. 1d. a lb.

An *ad valorem* duty, if it could be justly levied, would certainly be the most equitable, and the principle in the abstract has always been favourably entertained. But such a duty in its incidence has always broken down, and there are not wanting numerous illustrations from practical experience to prove to demonstration that the cunning of the manufacturer or importer will in time be more than a match for the most acute of revenue officials, and that in such matters legislation is practically powerless. We have seen in our first lecture on sugar what artistic evasions there were of the system of classification for duty, and how easy it was for slave-grown sugar to be bartered for goods of British manufacture, or paid for in sterling coin in defiance of the express Acts of the Legislature, and in the article of tea open competition speedily abolished *ad valorem* duties.

With the rapid growth of tea as an article of domestic consumption there has always been a desire to tax the lower qualities consumed by the poor less than the better descriptions consumed by the rich, but no practical method has yet been devised for carrying out this object. It was thought that the alkaloid (theine) present in tea might be used as the factor for so doing, but unfortunately the proportion of this alkaloid in tea bears no relation to its commercial value, and consequently the investigation was barren of results.

The quantity of low-priced tea consumed is now much larger in proportion to the total quantity cleared for home consumption than it used to be. The late duty of 6d. per lb. was therefore on this account more onerous than

formerly, and we may expect that when a Chancellor of the Exchequer has in any year a large surplus, we shall see the tea duties further reduced, if not abolished altogether. Such a step would be most popular, and as the agitation in favour of a free breakfast table has not died out, but is only slumbering till the money and the man can be found for effecting this

TABLE XXVIII.—Tea Duties.

Year.	Rate of Duty.			
1660-1689	8d. per gallon made and sold.			
1689	5s. per lb. (Excise).			
——1745	4s. ,, ,, and 14 per cent. ad valorem (Customs).			
1745	1s. per lb. and 25 per cent. ad valorem.			
1748	,, 30 ,, ,,			
1759-1784	65-120 ,, ,,			
1784-8	12½ ,, ,,			
	Great Britain.		Ireland.	
			Black.	Green.
1789-90	12½ per cent. ad valorem.		4d. per lb.	6d. per lb.
1791-4	12½ ,, ,,		4¼d. ,,	6½d. ,,
1795-6	20 ,, ,,		4¼d. ,,	6½d. ,,
	At or above 2s. 6d. per lb.	Under 2s. 6d. per lb.		
	Per cent. £ s. d.	Per cent. £ s. d.		
1797	30 0 0	20 0 0	4¼d. ,,	6½d. ,,
1798	35 0 0	20 0 0	4¼d. ,,	6½d. ,,
1799	35 0 0	20 0 0	5½d. ,,	7d. ,,
1800	40 0 0	20 0 0	5½d. ,,	7d. ,,
			All sorts.	
			At or above 2s. 6d. per lb.	Under 2s. 6d. per lb.
			Per cent. £ s. d.	Per cent. £ s. d.
1801	50 0 0	20 0 0	35 0 0	20 0 0
1802	50 0 0	20 0 0	38 10 0	23 10 0
1803	95 0 0	65 0 0	38 10 0	23 10 0
1804	95 0 0	65 0 0	84 14 0	51 14 0
1805	95 2 6	65 2 6	84 14 0	51 14 0
1806	£96 per cent.		84 14 0	71 14 0
1807-9	,, ,,		84 14 0	71 14 0
1810-13	,, ,,		£93 per cent.	
1814-18	£96 per cent. ad valorem.			
	Above 2s. per lb.		At or under 2s. per lb.	
1819-33	£100 per cent.		£96 per cent.	
1834 (April 22)	Cessation of ad valorem duties.			
1834-5	Bohea, 1s. 6d. per lb.; Congou, Twankay, Hyson Skin, Orange Pekoe, and Campoi, 2s. 2d.; all other sorts, 3s.			
1836-9	All sorts, 2s. 1d. per lb.			
1840-50	,, 2s. 1d. ,, with 5 per cent.			
1851-3	,, 2s. ,, ,, ,,			
1854	,, 1s. 10d. ,, ,, ,,			
1855	,, 1s. 6d. ,, ,, ,,			
1856	,, 1s. 9d. ,, ,, ,,			
1857-62	,, 1s. 5d. ,, ,, ,,			
1863-4	,, 1s. ,, ,, ,,			
1865-89	,, 6d. ,, ,, ,,			
1890 (May 1)	,, 4d. ,, ,, ,,			

By the Act 32 & 33 Vic., c. 103, s. 7, a warehouse charge of 5s. per cent. was imposed from Oct. 1, 1869.

object, the measure, on account of its immense popularity, will not be delayed beyond the bounds of prudence, and before long the tea, coffee, and cocoa duties may be abolished.

Mr. Goschen has taken a step in this direction by reducing the tea duty from 6d. to 4d. per lb. On a future occasion he may go further by making another sensible reduction. The popularity of tea as a beverage proves the wisdom and sound policy of such a proceeding, and in the cause of temperance it would be prudent to lower the rate, the increased consumption going far to recoup the Revenue from anticipated loss.

A copy of an East India Company's tea warrant is here introduced, which may be of interest, especially as showing the discount then allowed by the Company. The different rates of duty from the first imposition down to the recent reduction are also given in p. 50, in tabular form :—

Copy of Tea Warrant (now in the possession of Messrs. Holborn, of Mincing-lane).

Mr.

You are desired to Deliver to Mr. Joseph Lewin ——————— the following Goods: viz.:

No. 644.

	lb	s	
Fol. 34. N^{o} 5...1 Chest Bohea tea of	301	at 15/ ...	225 : 15 : -

C.B.

Sold him by the United *East India* Company in September Sale, 1720, he having Paid for the same £101 : 1 : 7, On Acco^{t} £110 : 0 : 0, Dis^{t} £14 : 13 : 5—for which he hath a Receipt of this Number and Date. London, this 20 day of March, 1720.

Jos. Micklethwait.

The Tea Plant.

The term "tea" is properly restricted to the numerous varieties derived from cultivation of the two species of *Thea—Thea chinensis* and *Thea assamica*. Hybrids of various degrees between these two form a great part of the plants usually grown. In the tea-garden the plant is kept down to 3 to 6 feet in height; in a state of nature it reaches 30 to 40 feet, with a stem 1 foot in diameter. The seed, which is enclosed in a hard, round shell, ripens about one year after the flower has faded. Planting is done either direct from the seed itself, or from nurseries where the young plants can be watched carefully and tended until they are strong enough to take their places in the plantation. When plants are to be raised direct from seed, the usual method is as follows:—Holes are dug, left for about two weeks, and then filled with surface soil. Two or three seeds are sown, six inches apart, in each hole, and about one inch deep, gently pushed down. In each hole the best plant is left, the others being transferred to vacancies. Tea grows on almost all soils, but one that is light, friable, and rich is necessary for complete success. Oak-bearing land seems to unite all essentials, and is much esteemed. Flat land is fair, but undoubtedly the best situation is the lower part of a slope near a good water supply. As regards the number of plants to the acre, close planting is recommended, viz., about 4 feet apart, equivalent to 2,722 shrubs per acre. On steep slopes the Chinese variety may be planted closer—2 feet by 3½ feet, or 6,223 per acre. A good deal of care must be devoted to pruning, with the object of keeping the shrub well spread, and at a convenient height for picking. A judicious system of manuring nearly doubles the yield of tea, improves its flavour, and increases its strength. An excellent manure is bush prunings, weeds, and general rubbish. Animal manures require care in using.

A tea plant is picked as the successive "flushes" occur. A "flush" of the plant is the throwing out of new shoots and leaves, the latter forming the tea of commerce. The average flushing period is seven to nine months, and the intervals vary from seven to fourteen days. The number of flushes ranges from eighteen (where no manure is used) to twenty-five (in good soil).

To a certain extent, the harder a tea plant is picked, the more it becomes stimulated to reproduce new shoots in place of those lost. When the season is over, the tea bush is from 3½ to 4 feet in height and about 5 feet in diameter; by pruning down, its height is reduced to 2 feet and its diameter to 3 feet. In this state it remains during hybernation. In the spring the buds at the base of the leaves develop into shoots, the buds of which in turn develop themselves in the same way. The first shoot from the branch becomes the nucleus of subsequent flushes on that part of the bush, and is therefore carefully preserved. It is not, however, left to grow *ad libitum*, as its faculty of throwing out new shoots is greatly enhanced by nipping off the leaves in such a way as to avoid injuring the young buds at their bases. The lines in the diagram on the wall indicate the points at which this operation should be performed.

The youngest leaves give the best tea, and the order of merit is as follows :—

a gives Flowery Pekoe ; *b*, Orange Pekoe, *c*, Pekoe. "Poco" means the white hair or down of the under leaves.

d gives First Souchong ; *e*, Second Souchong. Souchong means "small plant."

f gives Congou. Congou means "labour," expressing care required in the preparation.

a, *b*, *c* mixed give Pekoe ; *a*, *b*, *c*, *d*, *e* give Pekoe Souchong.

Hyson may be called the parallel of Souchong in black leaf descriptions ; the word means "before rain," or "flourishing spring." "Hyson skin" is the refuse of teas ; the native term for it is "tea skins ;" the coarser refuse is called in the vernacular "tea bones." These various classes are finally sifted and sorted.

In the process of manufacture the freshly-gathered leaves have first to undergo "withering," which is best done by spreading them in the sun, a superior method to any artificial one. When properly and perfectly performed, withering renders them pliable ; the stalks bend without breaking, while there is no crackling on compression. The withered leaves are next rolled by a line of men on each side of a table, who pass them one by one from one end to the other. The roll is ready to make into ball when it is soft and "mashy," and gives out juice freely. The juice is mopped up into the roll again and again in its passage up the table, and is finally left in the ball when made. Coarse leaves are carefully eliminated from the rolling process, in which many machines are now in use. The balls stand until fermented ; practice alone can afford reliable information as to the time this should take. It is stopped by breaking up the ball and spreading the loose leaf thinly on mats in the sun. When blackish it is collected and re-spread so that the whole may be equally affected. As soon as possible after breaking up the balls it is necessary to drive off the moisture, the least delay before "firing" being injurious. McMeekin's chest of firing drawers, now much in use, consists of drawers one above the other, the bottom of each tray being made of fine wire gauze. The heat is thus utilised through the whole series. In many cases hot air is used in place of the old charcoal fires.

When green tea is required, the fresh leaf is brought in twice daily ; that which comes in at 1 p.m. is partly made the same day, that brought in at evening is spread six inches thick till next morning. When necessary the leaf is dried, and when dry is put into pans over fires till heated to 160° Fahr., and vigorously stirred for about seven minutes. It is next rolled and dried in the sun, while the latter operation is proceeding it is rolled three times more, then it is replaced in the pans at the same temperature (160° Fahr.), and afterwards stuffed into bags and beaten heavily. Remaining in the bags through the night, the tea is next morning worked again at a temperature gradually falling from 160° to 120° Fahr. ; the green colour is retained in this way. The leaves of the Chinese plant make the best green tea, while hybrids are best for black.

The next important item in the manufacture is sifting and sorting. The sieves used are round, made of either brass wire or cane, and have wooden sides 3½ inches high. Before commencing to sift red leaf is carefully picked out.

The form known as brick-tea is of three kinds ; the first and largest is much used in West and North-West Siberia, and measures one foot long by seven inches wide, weighing about 3½ lbs.. These blocks are made in wooden moulds, and are pressed and dried by hand labour. A basket of 36 cakes costs about 28s. The next kind measures 8¼ inches by 5¼ inches, and weighs 1½ lbs. It is of a superior quality to the first-mentioned, a basket of 80 to 90 costing about 34s. It goes mostly to West and North-West Siberia. The third kind is made from black tea dust, now generally pressed together by steam machinery. The cakes are 6 inches by 8½ inches, and weigh about 2¼ lbs. They are packed in baskets of 64, costing 33s.

Tea and Tea-making.

In considering tea, as at present used as a beverage, from a physiological standpoint, it may be observed that there are three of its constituents which call for special observation, viz., the aromatic volatile oil, the alkaloid, and the tannin.

The volatile oil is the chief factor in imparting to tea its peculiar fragrance and characteristic taste, but the physiological advantages of these flavouring materials are somewhat counterbalanced by the effects of the tannin.

The alkaloid (theine or caffeine) is that principle to which tea chiefly owes its stimulating and invigorating properties. Its action is almost entirely limited to the nervous and

circulatory systems. The brain is at first stimulated, and thereby follow clearness of intellect, removal of languor, and supervention of sleeplessness. In very large quantities theine produces a species of narcotism, and when administered to the lower animals has been found to cause convulsions similar in kind to those induced by strychnine poisoning. In man muscular irritability is increased, but this is quite subsidiary to the effects upon the brain. After small quantities there is no well-marked stage of reaction, but long-continued indulgence in large quantities of strong tea is generally followed by very distressing symptoms of nervous irritability and depression. In some forms of megrim, or sick headache, the alkaloid will occasionally afford very great relief. The heart and respiration are temporarily stimulated, hence the refreshing effect of tea in ordinary conditions of fatigue. Habitual use greatly diminishes the stimulant without correspondingly diminishing the subsequent depressing effect of the alkaloid.

The tannin is the principle to which tea owes its bitter and astringent properties, and of which it is desirable to extract as little as possible while "infusing the tea," because tannin exercises a generally undesirable effect on the digestive system. In the mouth its astringent action and depressing effect on salivary secretion may in many cases more than counterbalance the stimulant effect of the volatile oil. It is in the stomach, however, that tannin exerts its most injurious influence, first by impairing the action of the gastric fluids, secondly by a combination with certain of the nitrogenous principles of food analogous to that which occurs in the manufacture of leather, and, thirdly, it diminishes the circulation in the mucous membrane, and thus interferes with its normal activity of secretion. The astringent effect of tannin is continued in the intestines.

We conclude, therefore, that tea quickly and freshly prepared, and taken in moderation, is a very valuable, agreeable, and stimulating beverage, but that large potations of badly prepared strong tea exert a very depressing action on the heart and nervous system, and are a fruitful source of dyspepsia and constipation.

Females who usually lead sedentary lives are the great consumers of tea, and very frequently, where many work together, the tea-pot is generally found on the hob, for supplying a cup whenever needed. Tea so made is stewed rather than infused, and, as a rule, whenever a fresh supply is wanted, a small quantity of fresh tea is put into the pot to the exhausted or partially exhausted leaves, and this is repeated during the day as often as occasion requires. The consequence is that the ill-effects arising from a sedentary life are heightened and aggravated by drinking large quantities of tea containing a maximum of tannin, and the results are well known to be very prejudicial to the health of our female population.

The Chinese, who may justly claim to be the inventors of tea-drinking, do not use tea-pots as a rule, but simply infuse the tea with water much below the boiling point in the cups from which it is drunk from the leaves without milk or sugar. It is true that the tea for home use is not cured in the same way as tea exported to foreign markets, but the beverage is so made as to contain a maximum of flavouring matter with a minimum of tannin extractive, and is not unpleasant to those unaccustomed to drink tea in such a novel fashion.

But the important subject of tea-making claims consideration not exactly on account of its difficulty—nothing could well be simpler—but because many persons habitually lose the fine flavour and aroma, and drink, day after day, a liquid which is neither nice nor refreshing. There is an overwhelming opinion, backed by the long experience of the great tea houses, in favour of the water being used immediately the boiling point is reached—the time of infusion being limited to five or six minutes. Sometimes a little boiling water is added to "draw" the tea, sometimes the tea-pot is warmed; these are more or less matters of detail which do not much affect the result. The important point is not to boil the tea, either by stewing the leaves or, as sometimes advocated, by re-heating the infusion. The best and fullest yields are obtained in five or six minutes, after that it would seem that the bouquet and flavour are greatly deteriorated. Tea should not be boiled under any circumstances; the leaves are practically exhausted in less than fifteen minutes, and to boil the tea is to deprive it of its most grateful and volatile characteristics.

Illustrations of badly-made tea are unfortunately not difficult to find, for notably at railway stations and coffee-taverns, the large tea-urn with a lamp underneath is a part of the stock in trade, and the tea from such a source is not refreshing, its flavour revealing at once that it has been more or less stewed,

and even the addition of sugar and milk does not conceal its defective qualities. Such tea being always ready for consumption is no doubt a convenience, and its cost is much less to the maker than tea freshly made for each customer, but the public taste has in this respect become more refined, and those individuals or companies who, at the sacrifice of some of their profit, have supplied customers with tea made at the time of ordering, in a separate pot, have commanded general confidence, and been favoured with a very large share of public custom.

The wholesale tea dealer who, as before observed, is so particular in making tea in the best manner for guiding his judgment as a buyer, has been equally anxious to take into account the effects of soft and hard waters upon tea, to enable him to sell to his customers in different towns tea best suited to the local water supply. It is notorious that tea which is suited to soft water infusions will not yield the same result with hard water. As a consequence, the intelligent wholesale dealer of to-day finds it worth his while to make tea analyses with the waters of different towns and districts which his travellers cover, and in this way he is able to assist the local distributor in his selection of tea, and give him sound and practical advice on the subject.

Undoubtedly the character of the water influences the amount of albuminoids extracted, a point well understood in the brewing trade, and as in the case of the brewer, the tea merchant must be able to sell single or blended teas which will yield with the local water supply the maximum of quality at the lowest price.

The results in Table XXIX. were obtained from the analysis of a Congou tea at 2s. 10d., and a young Hyson at 3s. per pound. They were selected as being fair representatives of black and green tea.

TABLE XXIX.—Composition of Tea.

	Congou.	Young Hyson.
Moisture	8·20	5·96
Theine	3·24	2·33
Albumin (insoluble)	17·20	16·83
,, (soluble)	·70	·80
Extractive by alcohol, containing nitrogenous matter	6·79	7·05
Dextrin or gum	—	·50
Pectin and pectic acid	2·60	3·22
Tannin	16·40	27·14
Chlorophyll and resin	4·60	4·20
Cellulose	34·00	25·90
Ash	6·27	6·07
	100·00	100·00

TABLE XXX.—China and India Tea.

Kind.	Specific Gravity of Standard Infusion.	Per-cent. Moisture.	Per-centage of Ash.			
			Soluble in		Insoluble in Acid.	Total.
			Water.	Dilute Acid.		
China—						
Hyson (young)	1013·67	6·90	3·82	2.52	1·13	7·47
Hyson	1012·35	7·25	3·82	2·37	·36	6·55
Congou	1009·88	9·22	3·55	2·12	·28	5·95
Pekoe (orange)	1013·31	7·70	3·99	2·27	·46	6·72
Souchong	1011·44	9·36	3·61	1·95	·29	5·85
Scented Caper	1013 50	6·63	3·47	2·23	·93	6·63
India—						
Hyson	1013·80	7·36	3·44	2·25	·43	6·12
Congou	1012·68	9·68	3·53	1·87	·26	5·66
Pekoe (orange)	1014·32	7·84	3·45	2·83	1·34	7·62
Souchong	1013·59	8·28	3·24	2·42	·62	6·28

Tea Analysis.

Complete analyses have been attempted, but with somewhat discordant results; for commercial purposes only the more important constituents are determined.

Oil.—The tea is distilled with water, the distillate filtered, saturated with chloride of calcium, and extracted with ether. Evaporation in a tared beaker gives the weight of the oil.

Theine.—In addition to the method recently given by Dr. Paul, there are two others of importance. The better may be thus described. A small quantity of dry powdered tea is mixed with calcined magnesia, boiled with strong alcohol and filtered. The residue is again boiled with alcohol, filtered, and then similarly boiled three times with water. From the alcoholic filtrates the spirit is removed by distillation, and any colouring matter by addition of water. The filtrates are now all united and brought to dryness, a little magnesia being added. Extracted with hot benzol, theine, crystalline and colourless, may be obtained by evaporation. Below

is a Table showing the per-centage of theine in a number of different teas.

Tannin.—None of the methods are wholly satisfactory. Perhaps the best is a modification of Löwenthal's, which depends on the deoxidising action of tannin on potassic permanganate.

The albumen, pectin and pectic acid, dextrin, cellulose, chlorophyll, and resin, call for no special remark.

The ash may be conveniently estimated by burning at a low temperature, and not allowing the tea whilst being carbonised to burst into flame. This precaution practically obviates any loss of chlorides, especially as the ash of genuine tea is always alkaline, the chlorides being thus comparatively stable. The alkalinity of the ash is an important point in tea analysis, and the determination of the alkalinity should always be made. The quantity of nitrogen present in tea was found by early investigators very much higher than was represented by the theine extracted. This difference has, however, been modified through the discovery of more perfect methods for extracting the theine.

		Per cent. of theine.
Mulder found in	Green tea	0·43
,, ,,	Black tea	0·46
Graham ,,	Congou	2·09
Stenhouse ,,	Himalaya black ..	2·05
Peligot ,,	Hyson	2·2 to 3·4
,, ,,	Gunpowder	2·2 to 4·1

And in the Inland Revenue Laboratory, when determining whether theine could be made the basis for charging the Customs duty on importation, the following per-centages were obtained :—

	Per lb. s.	d.	Per cent. of theine.
Bohea	1	7	3·31
Congou.....	2	6	2·93
Young Hyson	3	2	4·29
Gunpowder, low.....	2	6	3·18
,, good	5	0	4·98
Assam, low	2	8	3·03
,, good	4	6	4·83

Dr. Paul has lately made a large series of experiments on teas (chiefly Pekoe) obtained from different plantations in Ceylon and India, and recently published his results. They are interesting as dealing with tea which is steadily superseding China, and are therefore given in the following Table :—

TABLE XXXI.—Tea (*Theine*).

	Elevation at which grown.	Moisture per cent.	Theine per cent.	
			Original Tea.	Dry Tea.
Ceylon.	Feet.			
Penhros.....	2,500	6·8	4·56	4·89
F. L. C.	—	6·0	4·56	4·85
Nahalma	300	5·6	4·54	4·80
Hairs from leaves.....	—	6·6	2·40	2·57
Hardenhuish Pekoe.....	3,500	3·8	4·08	4·24
Woodstock Pekoe Souchong.....	4,200	3·6	3·44	3·57
Radella Broken Pekoe ...	4,800	4 6	4·10	4·30
Morton Pekoe	400	4·2	3·98	4·15
Penhros Broken Pekoe ...	2,500	6·4	4·64	4·96
Strathellie Orange Pekoe	2,000	5·4	4·10	4·33
Nahalma Orange Pekoe...	300	5·4	4·06	4·29
Venture Orange Pekoe ...	4,300	5·4	3·74	3·95
St. Leys Pekoe Dust	4,600	5·6	3·46	3·66
Venture Pekoe Souchong	4,300	4·8	3·40	3·57
Venture Broken Orange Pekoe	4,300	6 6	3·98	4·26
Calsay Pekoe Souchong...	5,000	6·2	3·22	3·43
Venture Pekoe	4,300	5·6	3·48	3·68
St. Clair Orange Pekoe...	4,200	4·6	3·90	4·09
India.				
Pekoe tips, picked out.....	—	7·56	4·27	4·62
Broken Pekoe.....	—	7·00	4·48	4·81
Pekoe	—	6·40	4·16	4·44
Orange Pekoe	—	4·80	4·66	4·89
Pekoe	—	5·60	4·48	4·74
Broken Pekoe	—	4·80	3·76	3·95
Pekoe	—	5·40	3·66	3·86
"Weak" tea	—	6·80	4·06	4·35
"Strong" tea	—	5·80	4·18	4·43
Mixture	—	6·00	3·64	3·87

The results given, ranging from 3·22 to 4·66 per cent. of theine in tea as imported, are considerably higher than have been obtained by experimenters using more imperfect methods for the separation of the alkaloid, and at the same time it is obvious, from the results obtained, that the theine present could not be used as a factor for fixing the commercial value of tea, although the physiological value of the tea itself is mainly dependent on the quantity of the alkaloid present.

The professional tea taster, when judging the value of tea, is mostly guided by the colour, uniformity, and age of the leaf, and the bouquet, flavour, and pungency of the infusion, which characteristics are largely due to the quantity and quality of the volatile oil the tea naturally contains.

Chemical analysis has never been used as a factor for determining the commercial value of tea, and apart from the chemical analysis, a little consideration of the subject shows there are special reasons why it never can be so used. Broken leaf will produce as much theine as the whole leaves of the same description of tea, but commercially such imperfect leaves always command a lower price, as the size and appearance of the leaves are important elements in fixing their trade value. As before stated, chemical experiments have been carefully made with the object of seeing whether there is any relation between the chemical and commercial value of tea, but the results obtained were, as might have been expected, anomalous, and gave no encouragement for further investigation in the same direction. Tea hairs, sometimes imported as flower of tea, contain theine, but not in such large proportion as the leaf from which they have been detached. It has been stated that the smaller quantity present is due to the fact that the alkaloid does not exist in the hairs, but in the portion of leaf attached thereto, but this statement is not correct, as the hairs themselves contain theine.

The quantity of theine present in tea as drunk is about two grains in eight fluid ounces, if the tea is of the strength of the infusion made by commercial tea tasters, viz., the weight of a sixpence (43½ grains) in 3½ fluid ounces of water, put on the tea at a boiling temperature. Twenty per cent. of the total extract is thus obtained, and may be safely computed to contain 50 per cent. of the total theine.

Tea in India and Ceylon.

Tea would appear to have been known in India for more than a hundred years. In 1780, a resident in Calcutta, named Colonel Kyd, had the tea plant growing in his garden, and other instances are also on record of its existence in India, where the question of its acclimatisation began to be discussed. Warren Hastings, then Governor-General of India, writing in 1780 to Mr. G. Boyle, "sends him some seeds of Hyson tea to aid his benevolent plan of introducing the luxuries and excellencies of our world into that of Bhootan." Colonel Kyd also, writing in 1782 to Sir Joseph Banks, says "the tea plants received from Canton have thriven well, although in most unsuitable soil and climate; the supercargoes are to be blamed for having sent only the worst sort (which are never prepared for the European market), and refusing to procure native cultivation at the request of the Bengal Government." Later on, in 1788, Sir J. Banks, on behalf of the East India Company, submitted to the authorities a statement containing information and guidance on the subject of tea and several other agricultural products, in the cultivation of which much improvement was desirable. On December 27, 1788, a communication was sent from London to Bengal, in which the authorities there were invited to give their earnest attention to a subject "both political and commercial." The Bengal Government consulted Colonel Kyd, and that gentleman found himself in thorough agreement with Sir Joseph Banks. The Government, however, while noting Colonel Kyd's views, seem to have refrained from adding any views or sentiments of their own. As the subject indicated a possible rival to the China tea trade (in which the East India Company had a monopoly), it is possible the matter was discouraged. The lull, too, in the question, after Colonel Kyd's death seemed to accentuate the reserve on the part of the East India Company, but a few years later the discovery of indigenous tea in Assam gave the subject new prominence. The Society of Arts also endeavoured to encourage the cultivation of tea wherever possible, for in 1825 they offered their gold medal "to the person who shall grow and prepare the greatest quantity of China tea, of good quality, not being less than 20 lbs. weight," in the East Indies and other British colonies. This prize, however, remained unclaimed for some years, till in 1839 a Mr. C. A. Bruce, who was in command of a division of gunboats in the first Burmese war, and to whom—whether rightly or wrongly—the discovery of tea in Further India is attributed, was awarded the medal, "for discovering the indigenous tea tracts, and successfully cultivating and preparing tea in the British possessions in India." The credit of this discovery has been claimed, however, for one or two others—a native named Moneram Dewan, and a Captain Charlton, of the Bengal Army; the latter disputed Bruce's title on the ground that he himself had drawn attention to the existence of the tea plant in Assam in 1832—in fact, he received a medal from the Calcutta Agricultural Society for the discovery. The matter had then succeeded in engaging the attention of the authorities for, in 1834, a committee sat to inquire into the possibility of

cultivating tea in India; and in the following year the Government first tried to establish a tea-garden at Lakhimpore, which, although in Government hands, failed, and the plants were taken to Jaipore. The garden established there was purchased in 1840 by the Assam Company, then only about a year old, and the first Indian tea company formed. Its early existence was not a great success for several reasons. Indian tea, as a novelty, had to fight its way up; India itself was too far off, as travelling was then; and the public were very little informed about Assam. It was ten years or more before tea-gardens became numerous. In 1853 tea was found growing in Cachar, and in 1856 in Sylhet; by 1864 Kumaon, Darjeeling, Chittagong, &c., were planted, and more recently, Chota Nagpore and Ceylon, about 1872.

Once attempted, the growth and manufacture of tea in India was soon a *fait accompli*. About 1839 the Council of the Society of Arts was asked to report on samples received through the East India Company. In this matter Messrs. Thompson and Twining, names still well known in the tea trade, kindly volunteered their opinion and experience, and the teas were pronounced of superior quality, the infusion being of a deep rich red, of pungent flavour, and resembling the Pekoe of China. The following year further samples were submitted to the Society, and elicited the following report:—"Indian tea possesses all the richness, strength, and flavour of the finest kinds imported from China. The preparation now excels every expectation that could have been formed of the improvement in so short a time, and India unquestionably possesses every requisite of soil and climate for producing teas of the finest quality." From this commencement the enterprise grew apace; too fast, in fact, for the eagerness of the public to invest caused estates to fetch many times their value, and this artificial inflation soon brought about the inevitable crisis. Huge profits and dividends had been made, not so much from tea manufactured as from seed sold, seed growing being comparatively easy, and necessitating less labour. Of course, temporary success led to extravagance, not to say fraud, company promoters having been known to sell land which had no existence.

The Indian tea industry is now, however, well established, and the number of acres devoted to it can be counted by thousands.

Ceylon Tea.

As stated, the coffee plantations in Ceylon were almost entirely destroyed by disease in 1868, and the planters, being driven to their wits' end for an alternative crop, grew cinchona—a plant included in the coffee family—and tea. The tea produced is one possessing some of the good qualities of both India and China teas, and as it can be used without blending, it has grown greatly in public favour, its consumption in the United Kingdom last year being upwards of 30,000,000 lbs. Its keeping qualities are not always satisfactory, and much of it deteriorates rapidly on exposure to the air. The following Table of imports will be interesting:—

TABLE XXXII.—Imports from Ceylon.

	lbs.		lbs.
1873 ...	23	1881....	500,000
1874....	492	1882....	750,000
1875....	1,400	1883....	1,500,000
1876....	757	1884....	2,250,000
1877....	2,000	1885....	3,750,000
1878....	20,000	1886....	7,000,000
1879....	100,000	1887....	11,250,000
1880....	150,000	1888....	20,500,000

Last year 32,516,682 lbs. were exported from the island.

The foregoing brief *résumé* of the progress made in growing tea in India and Ceylon indicates the marvellous success which has attended this industry. Great as this success has been, the fact must not be overlooked that many Indian tea-gardens are even now worked at a loss, and that some of the successful ones are not doing what might be accomplished if quality as well as quantity were made a factor in the preparation of tea for the British and other markets. The planters deserve the greatest praise for what they have done, but in their competition with the Chinese tea growers, they have really been greatly protected by the action of the Chinese Government, who levy heavy duties on the tea exported. In the losing race, the Chinese Government may be tempted to remove this export duty, and if they do so in time, the Indian planter will have much greater difficulties to encounter in the future to ensure continued success. The Chinese are keenly alive to the loss of trade by present fiscal regulations and change of fashion, and as the Government is doing what it can to improve the quality of tea exported, the next step will probably be the substitution of other taxation for that now imposed on tea exported.

The following facts taken from the last report of the Commissioners of Chinese Customs at Canton will show that the condition of the tea industry has become a burning question, and in face of what may be done in the immediate future to relieve the tea grower and exporter, it would be prudent on the part of our growers to produce the better qualities of tea, and cure it so thoroughly as to remove the present complaint of its uncertain keeping qualities. Uniformity of quality is always a safe factor in trade competition, and up to the present time this fact has not had sufficient weight with the Indian tea grower.

The Canton Commissioners thus review the condition of the tea industry:—

The inland transit dues in the Canton province amount to about 10 per cent. of the export value, and export duties to 19 per cent., making 29 per cent. in all; the total sum derived from the export duties alone being, in 1888, over £1,000,000. On the other hand, Indian teas are quite unburdened in these respects, and in view of this fact the feasibility of the removal of these duties by the Chinese Government has been much discussed. The Commissioners think even this heroic measure insufficient to avert the continued displacement of Chinese by Indian tea. Bulk for bulk, the latter is the stronger, its distinctive flavour is well liked, and scientific methods of production and distribution, unknown in China, are in common use in India. In short, the future of the Chinese trade is very gloomy, so much so, indeed, that if the most energetic measures of reform, embracing even the permission to foreigners to establish themselves as in India, be not soon adopted, the practical extinction of the Chinese tea trade is considered to be only a matter of time.

TABLE XXXIII.—OF EACH 100 LBS. IMPORTED.

	China contributed	India contributed	Ceylon contributed	Other countries contributed
1864	92·55	2·84	—	4·61
1865	93·00	2·50	—	4·50
1866	93·74	3·88	—	2·38
1867	91·81	6·07	—	2·12
1868	91·77	5·89	—	2·34
1869	90·85	8·07	—	1·08
1870	89·06	9·17	—	1·77
1871	88·25	8·91	—	1·84
1872	86 80	8·89	—	4·31
1873	83·81	11·28	—	4·91
1874	81·90	10·12	0·30	6·90
1875	86·31	12·87	0·08	0·74
1876	84·03	14·99	0·05	0·93
1877	82·65	16·50	—	0·85
1878	80·88	17·29	—	1·83
1879	76·94	20·76	0·07	2·23
1880	76·43	21·81	0·08	1·68
1881	77·33	21·66	0·08	0 93
1882	72·88	25·43	0·24	1·45
1883	70·27	26·66	0 90	2·17
1884	67·22	29·55	1·03	2 20
1885	65·84	30·35	2 00	1·81
1886	62 99	31·85	3·10	2·06
1887	54·00	38·15	5·89	1·96
1888	47·46	40·34	10·10	2·10
1889	39·88	42·93	14·70	2·49

In this connection Table XXXIII. will be of interest.

It should be pointed out that of the China tea imported a large quantity is re-exported, while the bulk of the East Indian tea is retained for home consumption; and further, that this preference for India and Ceylon tea increases, notwithstanding the considerably higher price—averages for 1889 showing China tea to cost about 7½d. a lb., India 10½d., and Ceylon 11d.

TEA IN JAPAN, NATAL, FIJI, AND PARAGUAY.

The tea plant not being indigenous to Japan was first introduced from China. Although known in Japan for more than a thousand years, tea has only gradually become the national beverage, attaining this position so late as the 14th century. Its first introduction may with justice be assigned to the early part of the 8th century (A.D.); then for a space of four hundred years its use seems to have dwindled almost completely away. A revival took place about 1200 A.D., by the planting of China tea in the island of Kiushiu, a spot particularly suited in soil and climate to its growth. Until about 1570, the tea-leaves were, immediately after picking, immersed for a moment in boiling water, and after having been dried in the sun converted into powder; "firing" came into notice about this time, and presently became general. About 1857, the Chinese methods of preparing "black" and "green" teas were adopted.

In Japan green tea in leaf is universally used. Powdered, or "flat" tea, which is the finest kind, and is at present a most expensive luxury, is reserved for rare and very special occasions. It is prepared by infusing the powder, and the liquor is drunk with the powder in suspension. According to a recent work on "Tea in Japan," by Mr. Y. Kozai, of the Tokio Chemical Laboratory, the method of making tea in that country would appear to vary with the quality and description.

Superior teas, by which are meant those costing there 5s. to 7s. a lb., are used by infusing the leaves for two minutes at a temperature of 120° to 150° F., the water having previously been boiled, and then allowed to cool in a separate vessel. Those called "medium" teas, which are probably the best we get from Japan, are treated with boiling water, and allowed to infuse one minute. The leaves are renewed for every infusion. Thus prepared, Japanese tea is of the colour of pale sherry or Sauterne, and constitutes a most refreshing and reviving beverage. Milk and sugar are not used with the best kinds, being liable to spoil the delicate aroma, but with the rough, inferior kinds both milk and sugar are taken to cover the unpleasant roughness.

It is considered an unpardonable breach of good manners to omit to offer tea to a visitor immediately on his arrival. Even in shops the customer is served with tea before the goods are displayed to him, and this does not by any means oblige him to make a purchase.

As pointed out above, only the lower qualities of tea are exported, and these, according to Mr. Kozai, are often slightly sophisticated, being "faced," or else mixed with other plentiful and harmless leaves. None of these substitutes, however, contain theine, though some have tannin in their composition. The Japanese and Chinese do not consider Europeans connoisseurs on the subject of tea, and much prefer their own growths to those of India or Ceylon; but no doubt the diminished exports convince them that their views of what constitutes good tea will not have any effect on those who have come to the conclusion that Indian tea is preferable.

Natal.—In 1884, over 50,000 lbs. were produced and disposed of in the local markets The samples shown at the Health Exhibition were indicative of future success. They were well made, and betokened careful supervision, but perhaps they were a little too highly "fired."

Fiji.—Excellent tea has been produced; however, the industry is yet quite undeveloped and beyond growing specimens for comparison with other growths, nothing has been done to make the growth of tea a branch of commerce.

The name "tea" has been popularly applied to many other plants, the principal being:—

Abyssinian or Arabian (leaves of *Catha edulis*).
Appalachian ..... (,, *Vibernum cassinoides*).
Australian ..... (,, *Leptospermum*).
Tasmanian .... (,, *L. lanigerum*).
Malay ..... (,, *Glaphyria nitida*).
Bourbon ..... (,, *Angræcum fragrans*).
Brazilian ..... (,, *Stachytarpha jamaicensis*).

TABLE XXXIV.—TEA.—UNITED KINGDOM

Year.	Imports. British East Indies.	China (Hong Kong and Macao).	Other countries.	Total.	Consumption. Lbs.	Pounds per head.
	lbs.	lbs.	lbs.			
1873..	20,326,882	133,307,196	8,710,317	162,344,395	132,022,155	4·1
1874..	18,440,494	131,669,998	11,492,918	161,603,410	137,422,563	4·2
1875..	25,784,866	170,966,836	1,525,570	198,277,272	145,458,120	4·4
1876..	28,126,854	155,897,192	1,674,144	185,698,190	149,131,779	4·4
1877..	30,957,295	154,996,561	1,561,428	187,515,284	151,275,237	4·5
1878..	35,563,503	166,190,545	3,707,235	205,461,283	157,691,762	4·6
1879..	39,236,433	141,435,474	3,838,472	184,510,379	160,652,187	4·6
1880..	45,530,728	158,195,142	3,245,700	206,971,570	158,570,334	4·5
1881..	46,054,392	164,541,989	1,866,196	212,462,577	160,225,789	4·5
1882..	53,927,998	154,081,777	3,070,587	211,080,362	165,079,881	4·6
1883..	60,994,402	156,170,385	4,840,732	222,005,519	170,812,697	4·8
1884	66,084,947	144,410,328	4,716,839	215,212,114	175,097,983	4·6
1885..	68,635,100	139,838,344	3,901,927	212,375,371	182,455,982	5·0
1886..	80,987,351	145,111,596	4,796,345	230,895,292	178,894,151	4·9
1887..	97,830,117	119,739,116	5,194,054	222,763,287	183,635,885	4·9
1888..	113,004,692	105,424,271	5,189,515	223,618,478	185,556,214	4·9
1889..	127,160,409	88,848,574	5,593,677	221,602,660	185,621,800	4·9

TABLE XXXV.—China Teas.

	Leaf.	Liquuor, Flavour, &c.
Kaisows	Rather curly, reddish-black colour.	Bright, with rather deep colour, rich, fresh, good life. Finest falling off for some years; this year there is a revival, and they are arriving in considerable quantities.
,, Ching-Wo	Not so red, blacker, more curly ..	Bright, paler in colour, more flavour, but cools down thin and often weak also.
,, Saryune	More open than two previous, and redder.	Clear, bright liquor, deep in colour, thick with good strength; rather rich flavour, difficult to describe, but well known in the trade.
,, Siftings, or Broken Leaf	Reddish-black	Thick, dark, full, more or less dead. Used for giving "body" to blended teas.
Moning	Greyish-black, curly, more or less "tipped."	In new season often pale and clear; in old seasons and according to class (Ning-chow, Oonfa, Keemun, and Kintuck) much darker, but bright. Full, more syrupy than Kaisow, smooth silky flavour. Very slight inclination to malt or tar flavour in some seasons.
Souchong (Lapsang)	Almost dead black, large, loose in make, slight curl.	Clear, bright, thin, delicate (slightly tarry) flavour. Finest (difficult to obtain for years past); are very pleasant by themselves; they are finest and most delicate of black leaf teas. Used also to flavour high priced and delicate blends.
Moning Siftings, or Broken Leaf.	Greyish-black.....	Dark, thick; soft smooth flavour, but dead—only used for giving body to blends.
Paklin	Small, reddish-black, tightly twisted and curly.	Clear, bright, fair body; fine fresh, rather delicate flavour, a pretty tea in appearance, pleasant by itself.
Hoyune	Rather small, curly, with a greyish-black to black colour.	Dark and thick (rather a deep red), very strong pungent tea; often a coarse, strong, and very tarry flavour—used for blending.
Oolong	Rough, coarse in make, with a somewhat greenish appearance.	Very clear and pale, strong, pungent, slightly bitter. In England used in small quantities solely for blending purposes, but in China the finest quality is extensively used by itself.
Scented Orange Pekoe (Canton).....	Long spider leaf. Small curly leaf. } Dark green.	Very clear, pale, almost a light straw colour; very strong, with full scented flavour; used only in blends. Scent imparted in process of curing mostly by use of a flower called Qui Fà, resembling English jasmine.
do. (Fow-Chow)		
Scented Caper	Small, shotty, some black and glazed, others greenish-black.	Clear, rather pale, strong, full scented flavour, not quite so pungent as Scented Orange Pekoe, and often coarser; used solely in flavouring. Scent imparted.
Hyson	Rather long, slight curl, fairly well twisted silvery-green leaf.	Clear, pale, pungent, with sharp strong flavour, a little coarse; used for giving "life" and flavour to black teas. Now little used in England.
Young Hyson	Small, tightly twisted, curly; lightish green colour.	Clear, pale, straw colour, pungent, and more delicate in flavour than a Hyson.
Gunpowder	Small, short, tightly rolled, good green colour.	Clear, pale, straw colour, pungent, with rather a sharp delicate flavour, just inclined to be a shade bitter. Used for mixing with black teas.
Imperial	Large, often rather tightly rolled leaf, sometimes loose in make; green, or bluish-green.	Similar to last, pungent, coarser in flavour. Used for mixing with black teas.
Twankay.....	Rough flaked, green, lowest kind of "green" tea.	Rather muddy or dirty straw colour, pungent, with coarse common flavour. Used to mix with common kinds of black tea.

Indian Teas.

	Leaf.	Liquor, Flavour, &c.
1 Flowery Pekoe 2. Orange do. 3. Pekoe.	1 and 2 are smaller and much more full of tips and more curly than 3; from a grey black to black, more or less covered with white or orange tips.	Bright rich colour; great strength and sharp pungent flavour. The two first are more delicate, not so rasping as a Pekoe. These three are often used by themselves, but more frequently for giving life, sharpness, and flavour to China teas.
Broken Pekoe	Often more full of tips than previous three.	Much darker in colour than a Pekoe or full-leaved tea, and thicker—more body—very full in flavour, but without the strength or life of the previous lot. Used to give body to blends.
Pekoe Souchong	Not well enough made for a Pekoe, and coarser; the tips and tight twist place it above Souchong.	Clear, bright, strong, sharp, but a little coarse. A useful tea for "fetching up" medium teas—China teas especially.
Souchong	Large, coarse, rough; dead grey black colour.	Clear, strong, rough, rasping flavour, used only in blends—especially with China and Ceylon teas.
Broken Souchong. Pekoe Fannings. Dust.		Dark, thicker than from a full leaf, but not so strong; more or less coarse, and common in flavour.

Ceylon Teas.

Orange Pekoe. Pekoe.	Rather smaller than Indian tea of this class, with a more dead black colour, and the tips more orange or golden.	Bright, rich colour, thick, full, rather fruity flavour, delicate and pleasant to drink by themselves; also largely used for flavouring blends.
Broken Pekoe	Siftings and broken parts of Pekoe and Orange Pekoe.	Dark in colour, thick in liquor, full fruity flavour—not the "life" ("point") of the former. Used for giving body and flavour to blends.
Pekoe Souchong & Souchong	Curly, almost dead black colour, not so much tipped as Pekoe.	Bright and clear (fairly), not so much body as Pekoe or Broken Pekoe, but more pungent and sharper in flavour, more life, but coarser. Used largely for drinking by themselves, and also for blending.

Darjeeling Tea.

Orange Pekoe & Pekoe	Small, curly, tightly twisted, brownish-black colour, rather deep orange-tipped.	Rather a deep, rich colour, bright, fairly thick; smooth flavour, but rich, with an inclination to a nutty taste very delicate and pleasant to drink by itself. Also used for giving flavour to blends.
Pekoe Souchong & Souchong	Larger and looser than former, with a brownish-black to black colour; more or less orange-tipped.	Rich, bright, good body, full, nutty; softer in liquor than the Assam Souchongs. Used by itself; also for giving body and flavour to blends.
Broken Pekoe	Siftings from Orange Pekoe and Pekoe; brownish, often full of deep orange tips.	Deep, rich colour, fairly bright, soft drinking; full rich nutty flavour. Gives body and flavour to blends.

Paraguay Tea (or *maté*) is an infusion of the leaves of *Ilex paraguayensis*, and probably *I. gongonha* and *I. theezans*, which are prepared by roasting the branches on hurdles over a wood fire, and then beating the leaves to powder with sticks on a hard floor. Three kinds are distinguished—"caa-cuys" (the half-expanded leaf buds), "caa-miri" (leaf deprived of midrib), "caa-guaza" (whole-leaf and small branches roasted). The consumption reaches more than 8,000,000 lbs. yearly in South America.

Tea.—Consumption per Head in Various Countries.

1884-1885 (generally)	lbs.
Australian Colonies	7·66
New Zealand	7·23
Tasmania	5·35

	lbs.
Great Britain	5·02
Newfoundland	4·38
Canada	3·69
United States	1·30
Holland	1 05
Cape Colony	·90
Natal	·76
Russia	·61
Denmark	·37
Argentine Republic	·30
Persia	·13
Portugal	·12
Switzerland	·10
Norway	·09
Germany	·07
Morocco	·06
Belgium	·03
Sweden	·03
Austria	·02
Spain	·01

Brief Description of the Principal kinds of Commercial Tea.

China.—Kaisows and Monings are not so pungent and full flavoured as Indian teas.

Kaisows have more life than Monings, and are altogether fresher in the cup.

Monings are soft, smooth drinking teas, and, in some seasons, have a slight inclination to a "malty" or "tarry" flavour.

Oolongs are pungent, faintly "herby" or bitter, and in small quantities give life to blends.

Scented Orange Pekoe and Scented Caper both give a pale strong tea, used solely in flavouring blends.

Souchongs are perhaps the finest of black leaf teas, possessing a really delicate flavour, and suitable for use alone or in blends.

Gunpowder, Hyson, Young Hyson, Imperial, and Twankay, are all green teas, used for giving flavour and life to blends.

Assam or Indian are much more pungent than China teas, rougher in flavour, and are principally of use in mixing with the milder teas of China and Ceylon.

Darjeelings are powerful, but softer in flavour than Assams, and more delicate; very suitable for drinking by themselves.

Ceylons, fairly thick; as a rule they have not the strength and pungency of Indian teas. They possess a rich fruity flavour, and are extensively used both blended and alone.

Broken-leaf teas of all kinds are always darker in liquor, thicker (more body) than full-leaf teas. They are not so fine in flavour, and have not the life of whole-leaf tea.

China teas keep, and retain their flavour, much better than Darjeelings and Ceylons.

The keeping quality of Ceylon tea is generally very bad. It cannot be relied upon from one month to another; and on account of its being imperfectly cured, it is desirable that after a chest is once opened the tea be at once mixed off or used as quickly as possible.

Tea of all kinds quickly absorbs and retains the flavour of anything it comes in contact with, and always ought to be kept by itself and as air-tight as possible.

The tarry flavour so pronounced in several of the varieties is not to be looked upon as a natural characteristic of the tea itself, but rather as taking its origin in the process of drying, where in many cases the smoke from the fire permeates the moist leaves; in like manner the scented teas derive their odours from extraneous perfumes.

LECTURE IV.—DELIVERED MAY 19, 1890.

COCOA: ITS NAME.

The family from which cocoa is derived was called by Linnæus, *Theo-broma*, derived from the Greek Theos (God) and Broma (food), as showing his great appreciation of the nourishing drink derived from it. The Mexicans and Spanish called the tree and the seeds yielded by it cacao, but this word has now been corrupted into cocoa, and I am unable to trace the successive steps of this change. The word cocoa introduces an element of confusion on account of the fruit of the cocoa palm (*Cocos nucifera*), which is well known here, being called by the same name, and some have thought in consequence that the origin of the cocoa-nut and the cacao was the same. To prevent this confusion of ideas, the fruit of the cocoa palm has sometimes been spelt coker, and in some official and commercial documents this spelling can be found. The words cacao and chocolate are of Mexican origin, and it has been surmised that as the latter word was given to mixtures of cocoa with sugar and spices, it was derived from "chocolatl," the nearest approach to an expression in letters of the sound made by the mortar and pestle during the preparation of the mixture.

It is certainly easier to use the word cocoa than cacao, and though the latter is strictly correct, the former by usage has become the popular word to identify the preparations of the seeds of the *Theobroma Cacao* of Linnæus, although officinally the latter name appears.

The opinion Linnæus formed of the qualities of this drink was certainly a very high one, and in sketching the history of our subject it will be seen that there is an air of romance surrounding it, and we shall feel that others besides Linnæus held cocoa and its preparations in esteem almost approaching veneration.

COCOA, OR CACAO: ITS COMMERCIAL HISTORY.

Cocoa being obtained from the seeds of a tree which is a native of tropical America and indigenous to Mexico it follows that for oru first knowledge of it we are indebted to the discoverers of America, and especially to Hernando Cortez, who afterwards conquered Mexico in 1521. As Mexico thus became a tributary of Spain, cocoa was introduced into Europe long before either tea or coffee, and the manufacture of preparations of cocoa was carried on secretly in Spain, and distributed afterwards for consumption in neighbouring countries. The Mexicans appear to have used the seeds or nut of the cocoa as coins, and Peter Martyr gave them, on this account, the name *Amygdalæ pecuniariæ*. Cocoa was also used as a food, and the beverage produced by infusing the broken seeds, or nibs, was much esteemed, one writer going as far as to say that it was "deeply appreciated by the Mexicans, with whom it was held in religious veneration." Cortez, when settled in Mexico, sent home to his master, Charles V., the most important commercial products of the country he had subjugated, and in this consignment cocoa occupied a very prominent position. Its virtues were set forth with minute detail, and the medical men of the day who became acquainted with it were not slow to extol these virtues and to recommend it to those patients possessing wealth enough to obtain it.

Hoffman treated of it in a monograph entitled "Potus Chocolati." He considered it very beneficial in many diseases, and pointed out that Cardinal Richelieu had been cured of a dangerous disease by its use. The cure of so august a patient by means of cocoa was a good advertisement for the new remedy, and as it was both pleasant and popular, it soon grew into use as a medicine and also as a food.

The Spaniards conquered Peru in 1533, and from Prescott's "History of the Conquest of Peru" we learn much respecting the country at the time of the conquest, especially that cocoa was in cultivation before that event,

and also the impression made on the mind of Pizarro and his soldiers as they sailed along the coast. "They saw broad patches of cultivated land disclosing hill-sides covered with the yellow maize and potato, or chequered in the lower levels with blooming plantations of cacao."

The same writer, in his "History of the Conquest of Mexico," dwells upon the use made of cocoa by the Mexicans, and though the account must be greatly exaggerated, yet there is no doubt that both in Mexico and Peru, and also in the countries lying between, cocoa was extensively used, and in Mexico it was a royal drink. Prescott says, "The emperor was exceedingly fond of it, to judge from the quantity, no less than fifty jars or pitchers being prepared for his own daily consumption." This statement is evidently made on the assertion of another writer (Bernal Diaz), who records that "What I myself saw was that they brought him upwards of fifty great jars filled with good cacao with its froth, and of which he partook." Such words will bear the meaning that this quantity was made for the Emperor and his court, and even this liberal rendering must convey the idea that the statement was a gross exaggeration.

Evidence is available to prove that different towns and cities of the empire paid cocoa as tribute. Thus, one city is said to have supplied "20 chests of ground chocolate;" another "80 loads of red chocolate;" a third "200 loads of chocolate."

The historian Torquemada gives, on the authority of the royal account-book which came into his possession, the annual consumption of cocoa in the palace at Mexico as 2,744,000 fanegas. A fanega weighed 110 lbs. Spanish, and is therefore equal to about an English hundredweight. Humboldt estimated that in 1806 from six to nine million pounds of cocoa were consumed in Spain, and from fourteen to seventeen million pounds in the remainder of Europe. A comparison of these figures brings out the extraordinary fact, that the quantity of cocoa alleged to have been consumed in the Emperor's palace was thirteen times more than that consumed in Europe 250 years afterwards. Evidently exaggeration abounded in the statements derived from Mexican sources, but whether they were made by the Mexicans or their conquerors is difficult to decide.

It is apparent, however, that the Mexicans did not confine themselves to the use of cocoa without other admixture; and from the materials used by them it can be gathered that they had to surmount the same difficulties as presented themselves to the cocoa manufacturers of modern times, and had to modify the strong flavour of the cocoa as well as cover the flavour and physical characteristics of the fat.

The beverage which was called chocolatl was "cocoa flavoured with vanilla and other spices, and so prepared as to be reduced to a froth of the consistency of honey, which gradually dissolved in the mouth, and was taken cold." This beverage was served to Royalty "in golden goblets, with spoons of the same metal, or of tortoise-shell, finely wrought."

In Rees' Cyclopædia (1819), it is stated that the South American Indians and early Spanish settlers prepared the chocolatl, or chocolate, for use by using the cocoa-nut with maize and raw sugar, as expressed from the canes, with a little annatto to give it a colour. "Of these four drugs ground between two stones, and mixed together in a certain proportion, they made a kind of bread, which served them equally for common food and for drink; eating it dry when hungry, and steeping it in hot water when thirsty. The Indians, to one pound of the roasted nuts, put half a pound of sugar dissolved in rose-water, and half a pound of flour, or maize."

The Spaniards, who settled in the countries they had conquered, soon accustomed themselves to the manners and habits of the natives, and cocoa, and preparations into which it entered, became popular articles of diet; and the mother country was soon a large user of the cocoa, either as such or when mixed with other ingredients. The monks are credited with introducing it into Germany from Spain, and afterwards into France and other countries of Europe. A German, named Joan Franz Rauch, wrote against its use in 1624.

In 1657, cocoa, under the name of chocolate, was publicly sold in London. An advertisement appeared in the *Public Advertizer* of Tuesday, June 16th, and for the six following days, that "In Bishopsgate-street, in Queen's Head-alley, at a Frenchman's house, is an excellent West India drink called chocolate to be sold, where you may have it ready at any time, and also unmade at reasonable rates." A few years later other houses were opened for the sale of cocoa and preparations of cocoa, and with coffee and tea it soon became a favourite with the rich and fashionable. Chocolate paste was sold in 1660 at

from ten to fifteen shillings a pound. Imitations of the best qualities of chocolate were sold at cheaper rates; and in 1662, "at the coffee-house in Exchange-alley," "chocolatta" was sold by retail, the ordinary pound boxes at two shillings each.

The habits and fashions of life of the Restoration led the people to think less of home and more of club life; consequently any business which pandered to the development of this new idea became more or less popular, and the cocoa and coffee-houses of Charles II.'s reign were important institutions. The fashionable made them their regular lounging places, and the lovers of novelties patronized the new foreign drinks. The result was that these houses soon became mixed up with politics, and certain of them became identified with political parties during the 18th century. The chocolate house known as the "Cocoa Tree," in St. James'-street, was one of the most important, and was frequented by the Tory party. Defoe says, "A Whig will no more go to the 'Cocoa Tree' or Ozinda's (another chocolate-house in the neighbourhood) than a Tory will be seen at the coffee-house of St. James'." Clubs were formed having distinctive names, and the members met at these cocoa-houses. A famous one possessed the name of the "Cocoa Tree Club," and Byron was a member of it. At this period gambling became associated with the clubs, and it is recorded by Horace Walpole in 1780 that "within this week there has been a cast at hazard at the 'Cocoa Tree,' the difference of which amounted to an hundred and fourscore thousand pounds." Fortunately for these non-intoxicating beverages, club life developed more exclusiveness, while tea and coffee-houses continued to be places of resort for refreshment. Politicians, humourists, and others who had used these houses became more exclusive, and established club houses of their own, in which persons possessing certain distinctive qualifications could be admitted to membership, and thus they were able to meet together for a common object. This phase of club-life received a fresh development after the termination of the great French war, ending with Waterloo. Military and naval officers were not needed, and many of them were therefore placed on half-pay. On such diminished incomes they found it difficult to live, and in these circumstances a movement was started to establish clubs to cheapen the cost of living. This was carried out, and the modern club has become more intimately associated with the supply of food and intoxicants than with cocoa, tea, and similar beverages. As time went on, these non-intoxicant stimulating drinks were looked upon as necessaries of life, and, on account of the public demand for them, constituted part of the ordinary food of the people; their sale has therefore passed into the hands of the grocer, and they are almost entirely divorced from their improper alliance with the club and fashionable life of the last century. Their common use in the public dietary of this country has caused the political economist to make a grand distinction between them and the ordinary intoxicant as regards the fiscal duties which they should bear. Every politician of the last generation has made it a part of his financial policy to tax spirits to their utmost capacity, and to reduce the duties on tea, coffee, cocoa, and sugar. The effect of this policy has been to cheapen these necessaries of life, and to raise the price of intoxicants, with the result given in the Table at the end, which demonstrates the fact that cocoa has, under such a system, largely increased in consumption, whilst intoxicants have either remained stationary or diminished. It is mainly due to this policy that cocoa has so largely increased in consumption during the last fifty years, for this article of commerce has gone through many vicissitudes, being, in 1793, charged with a duty of twelve guineas per cwt., coupled with a further Customs duty of 11s. 11½d. per cwt. (Now it is 1d. per lb. on cocoa, 2s. per cwt. on husks, and 2d. per lb. on chocolate.) Such a tax was prohibitive, and it not only stopped its importation into England, but also acted as a deterrent to our Colonies from engaging in growing cocoa. The result has been that, in those Colonies where the cocoa tree would grow it was allowed to die out, and the sugar industry was made the one stock crop. When ruin overtook the sugar-grower through fiscal changes and European competition, the cocoa plantations had disappeared through neglect, and at the present time, with the exception of Trinidad and Grenada, our West India Islands do not practically produce cocoa as an article of commerce, although cocoa growing is now being carried on on an experimental scale. Martius states that a distinct species of cocoa, known as *Theobroma Sylvestre*, was found wild in Jamaica; and two hundred years ago cocoa cultivation had got a firm hold on the island. Long, in his "History of Jamaica" (1774), narrates the

extent of the cultivation of the cocoa, and says that in 1671 there were sixty-five walks in bearing, and many new ones in cultivation. Some time afterwards these trees were destroyed by a hurricane which visited the island, and new planting was neglected. It is likely that the English, who took Jamaica from the Spanish in 1655, did not look upon cocoa cultivation with favour, on account of their ignorance of its qualities, and of not having the same outlet for it as an article of commerce; but from whatever cause the abandonment of the cultivation arose, it has been a serious loss to Jamaica, and indirectly so to ourselves. Efforts are now being made to restore cocoa cultivation, especially as cocoa commands a good price, and is every year in greater demand in Europe and the United States. This popularity is no doubt mainly due to the progress made in the preparation of the article for consumption.

Cocoa in its natural state contains a large proportion of fat, so that it cannot be taken by those suffering from weak digestion. Moreover, the presence of so much fat prevents the easy solution of the naturally soluble portions of the cocoa, which are more or less locked up in the fat. This difficulty was encountered and overcome by the Indians and Mexicans in the same way as our cocoa manufacturers first overcame it, viz., by adding to the cocoa in a powdered condition sugar and starch, and thus diluting the cocoa to an extent which permits of its use even by the delicate. Another method is to remove by pressure a large quantity of the fat, and by subsequent treatment, which is generally a secret process, to make the cocoa thus deprived of a portion of its fat more soluble in hot water. When treating of the composition of cocoa, it will be seen that it is a very nutritious article of food, and modern chemical analysis has shown that the estimation in which cocoa was held as a food by the inhabitants of the countries in which it was first produced rested on scientific as well as on practical grounds. It would appear that our cocoa manufacturers are now working on the same lines as the natives of Central America did 300 years ago, and though good machinery and manipulative skill give great advantages to the modern manufacturer, yet the addition of sugar and starch, and the flavouring with vanilla and other spices, are only imitations of what was done in early times to make the cocoa more serviceable as a food, better suited to our requirements as an ordinary beverage, and adapted for consumption as a condiment or sweetmeat by the young and old.

The Plant and its Cultivation.

The cocoa and chocolate of commerce are made from the seeds of a tropical evergreen shrub, belonging to the order *Byttneriaceæ* or *Sterculiaceæ*. The family to which it belongs is, as I have stated, called *Theobroma*, and the particular species most esteemed and cultivated is the *Theobroma cacao*. Originally a native of tropical America, it is now grown in the tropics of both hemispheres, in order to furnish a supply equal to the large demand which its valuable properties have created. In height this shrub grows from 15 to 40 feet, its average being about 25 feet; in plantations, however, it rarely exceeds 18 feet. It flourishes nearly up to altitudes of 2,000 feet, and in any latitude not exceeding 25° from the equator. The bark is of a rich brown colour, which becomes darker with age. The branches are almost void of leaves except at the ends; there the leaves are alternate and stalked, and in size about 8 by 2½ inches. The leaves, when young, are exceedingly delicate, and of a light pink colour. The flowers are small, odourless, and of a saffron or pink colour. The quantity of blossom is much greater than the amount of fruit which might be expected from it, as many flowers fall off. They are often found growing thickly on the old wood of the shrub where before leaf-axils have been. The fruit is a pod in shape like a pear, but somewhat elongated, and grows singly or in clusters; as a rule, one pod is obtained from each cluster of flowers. They measure from 5 to 10 inches in length, and vary in colour from lemon to purple, according to the variety. The pod is rather thick, and has no taste; its surface has generally ten shallow grooves down its length, with blunt rounded ridges, the latter often warty. The pericarp, in which the seeds lie, has five cells, the exterior of which is tough, fleshy matter about ½ to ¾ inch thick. The seeds are rather closely packed in pulp, and lie in tiers in these cells; they are ovate, flattened, about the size and shape of haricot beans or olives, and covered with a thin greyish brown or red friable shell. The seed has a light and agreeable smell; its taste is bitter, oily, and rather rough, though not unpleasant. The pulp surrounding the seeds is a rose-coloured, spongy substance, something like the flesh of water-melons. Each pod contains from 20 to 40 beans, disposed in

five rows or tiers, as above stated. The variety grown in Central America contains sometimes as many as 50 seeds, while that cultivated in the West Indian Islands and Demerara only yields 10 to 15. On cutting a seed longitudinally, it is found to consist of (1) the cotyledons, a crumpled, pale crimson or purple mass, divided into several unequal portions adhering together but easily separated, and constituting the bulk of the seed; and (2) of a small elongated white body nearer the thicker end of the seed—the embryo.

The species *T. cacao* can be now subdivided into a great number of varieties—the result of centuries of cultivation and selection. These varieties have each special characteristics, with which the planter should be well acquainted; systematic cultivation, to be successful, must take into account such points as crop-bearing capacity, size of trees, particular soil and situation necessary, required degree of shade, and the final product, *i.e.*, the character and flavour of the bean. The finest variety is that known as the "Creole," or, as the Spanish-Americans call it, "criollo," and is grown chiefly in Venezuela. It has small pods, and the beans are almost spherical. In taste, the latter are somewhat bitter, but soft, oily, and pleasant. On an average, ten or twelve of these pods yield a little over a pound of cocoa.

Another variety under culture in Venezuela is the "Caracas," which is much esteemed by many; its pods are red—those of the "Creole" are yellow. The beans are more spongy than those of the "Creole" kind—fourteen to sixteen pods yielding about 1 lb. of cocoa.

There is another variety known as the *Cacao forastero*—forastero meaning "foreign"—more robust and hardy, and chiefly grown in the West Indian Islands. There are some twelve or thirteen forms of this variety, each existing in two kinds, red and yellow—from the colour of the pods.

In planting cacao, two methods are employed, according to circumstances. Where good and new land and plenty of seed are available, the seeds are sown direct. In other cases, nurseries are kept to supply young plants for transplantation to the projected cocoa-field. The nursery must be a piece of choice, moist ground, and the seeds carefully selected; when the plants are 12 to 18 inches high, they are removed to the cocoa-field, which must be flat, rich land, and easily watered. A gentle slope, affording shelter from cold winds, is best. The necessary shading is produced by planting coral-bean, plantain, coffee, or manioc. In the second year, blossoms appear on the young cocoa trees, but these are stripped off, the trees not being allowed to bear till the fourth or fifth year. The average number of trees per acre is 900, each of which, in a state of maturity, yields 4-6 lbs., though three times this amount has been known in single cases. A healthy tree will bear for forty or fifty years.

Cocoa: Harvesting and Preparation for the Market.

The cocoa tree bears fruit all the year round, but the chief seasons for harvesting are in the months of May and June, and again in October and November. In Venezuela these two periods give the names "St. John's" and "Christmas" respectively to the crops. At the time of harvesting great care is taken that only the ripe pods shall be gathered, and that in removing these pods no damage shall be done to the trees. The reason for gathering only ripe fruit is obvious, for as the commercial value of cocoa mainly depends upon uniformity of the colour and size of the beans, and as this uniformity can be best secured by gathering the ripe pods only, the careful grower uses every precaution to gather the pods only when the seed is ripe. The colour of the pod will generally reveal the condition of the seed, but the fruit growing within reach of the gatherer is gently tapped to see if the seeds have shrunk from the pulp in which they were embedded and become detached. If so, they are in a fit state to be harvested.

These pods are removed by severing the stalk with a sharp instrument. The portion of stalk adhering to the tree eventually dries up and falls off, leaving the tree sound. The pods are attached to a soft point in the tree which was originally the axil of a leaf, and from such soft points all future flowers will spring. If, however, the pod is torn away, this soft tender part is bruised, and the injury causes the tree to become afterwards sterile at the particular point damaged.

The pods when cut off are collected into heaps, and as soon as it is convenient (generally the next day) persons are told off to the duty of separating the beans from the pulpy husk containing them. This operation is generally done by the pods being cut open with a cutlass, and by the removal of the seeds from the adherent tissue in which they are embedded. Great care is taken to separate all black, unsound, or unripe beans, and when

this has been done, the seeds are removed to the "sweating" or curing house.

This operation, which requires great skill and care, is one on which the commercial value of the finished beans chiefly turns.

The three points aimed at in conducting the sweating operation are—

1. The loosening of the adherent pulp.

2. The removal or the modification of the bitter principle of the bean by fermentation.

3. The colouration of the beans to a rich mahogany tint.

The beans have to be put together to ferment to a given temperature, and the method of procedure is modified to suit the requirements of each individual case. In large plantations there is a house set apart for sweating the seeds, but in small places movable vessels are requisitioned for the purpose, or the seeds are put into a trench, and covered with plaintain leaves to keep up the temperature during the incipient stage of the fermentation. The saccharine matter of the pulp soon commences to ferment, but this fermentation must be kept under complete control, or the beans will be done either too much or too little. The weather has a good deal to do with the fermentation, and during a time of rain there is a tendency for the fermentation to become violent, and then the seeds will assume a dark or black colour. A juice runs out from the pulp, and this is often collected and converted into a common kind of vinegar. The floor should, however, be kept sweet and clean, for the nibs have a tendency to acquire any particular flavour of the sweating-house. The duration of the fermentation is regulated by circumstances, but it generally lasts from two to seven days.

When the fermentation is complete, and the coverings removed, it will be noted that the mass of cocoa remains hot, the pulpy matter surrounding the seeds has become more or less slimy, and can be readily removed. The bean itself has also altered in character. Its bitterness has become distinctly modified, and the bright reddish colour has changed to a deep brown. The beans are then carefully removed from the pulp and are covered with red earth or sand, and heaped together for further fermentation. Next day they are again dusted with earth and allowed to cool. The red earth dries the mucilage adhering to the bean, and by careful and systematic rubbing the beans put on a nice appearance, and have a colour which is certainly not quite natural.

Red earth is not always used for drying and colouring, but it is generally employed in Trinidad and Jamaica. When the cleaning and rubbing processes are completed, the beans are spread out on a tray to dry, and every part of the bean is sytematically exposed to the light. This operation is repeated till the seeds are properly air-dried and in a condition suitable for shipment.

Cocoa which is prepared without undergoing fermentation is distinguished by its pale skin, and this skin will not readily separate from the seed which it envelops. Its bitter taste only renders it suitable for use as cocoa in the cocoa mixtures containing starch and sugar. Its flavour and character unfit it for use in chocolate-making, and, as a matter of course, it commands a low price, as compared with fermented cocoa.

The cocoa industry has now become a very important one in this country, and great attention is therefore given to the selection of cocoa best suited to the class of trade carried on by each maker. The British manufacturer is not now satisfied to make the ordinary cocoas, and permit the French and Swiss manufacturer to flood the market with chocolate, creams, and other sweetmeats now in general demand. He has entered the field to produce all kinds his customers may require, and his success can be measured by the increased quantity of cocoa (raw) imported, as compared with the manufactured cocoa imported. The trade is generally in the hands of men who can command the capital required to conduct their business on the ready-money system. Such men buy in the best market; and as they use only the best of material, combined with first-rate knowledge of the manufacture of the articles in demand by the consuming public, they not only hold their own, but increase their trade, and the British cocoa trade has become a large and very lucrative industry. Cocoa is made up in all kinds of fancy forms and designs to attract the public taste and appetite, and it is not surprising that when presented in such forms and in such variety as at the present time, the industry should have increased by leaps and bounds, and become one of first importance as a home industry,

Cocoa: its Manufacture.

Cocoa as imported is not in a fit state for consumption without further treatment, and whatever may be the form it is made to assume as an article of commerce before passing into the hands of the public, the operation of roasting the seeds has to be

performed on all alike. This roasting causes the husk enveloping the bean to become loose, develops a distinct aroma, and causes the seed to be friable. The process is one requiring great care and skill, and the workmen conducting the roasting must be men of wide experience, capable of acting on their own judgment as to the exact moment the bean is cooked. The roasting apparatus is in good establishments so closed in that the temperature inside can be registered on a thermometer, and thus the roasting can be carried out with greater exactness than when only dependent on the judgment of the roaster. The cylinders containing the beans during the roasting are made to rotate to ensure uniformity of cooking, but it has been found that this uniformity is more perfect if the beans in one roasting operation are of uniform size. To secure this object the beans are made to pass over sieves having apertures of different dimensions, and thus by a simple mechanical arrangement the beans are assorted according to size, and conveyed to suitable receptacles. Assorting and cleaning are effected in one operation, and the beans are afterwards roasted. After they are roasted—which is done between 500° and 600° F.—and cooled, they are conveyed to a machine, generally fixed at the top of the factory, which is employed to break down the seeds by fracturing the crisp husk, and pressing the beans sufficiently to make the sections of them part from one another, and become the "cocoa nibs" of commerce. The husk and nibs are carried down to a winnowing machine, in which the husk is effectually separated from the nib, and the nibs fall by their own weight into a sorting machine, which separates them into classes of nibs, each of uniform size.

This sorting is found useful in the operation of grinding, as the perfection of grinding consists in bringing the ground cocoa to a condition of smoothness which renders it free from grain or grittiness, and as uniform in consistence as it is possible to be. This grinding is done by millstones, so constructed that the nibs must pass constantly between them till they are thoroughly disintegrated, and if the nibs are to go into consumption as ground nibs in powder, the stones are kept cool during the operation.

As, however, nearly all the cocoa ground is afterwards made up into rock or flaked cocoa, chocolate cakes, or sent into consumption after having been deprived of a large portion of its at, under such names as "extract" or "essence of cocoa," it is usual to keep the stones heated during the grinding. The heat causes the fat to melt, and in a very short time the crisp nibs become soft, and at last are reduced to a liquid state, which the uninitiated sometimes think has been caused by the addition of water. The composition of the natural nib indicates that heat only is required to bring about this condition of things, for a substance containing half its weight of pure fat melting at a temperature of about 84° F., can only require warmth to bring it into a liquid form when in a condition of fine disintegration.

As cocoa fat has no tendency to become rancid, the finely ground cocoa paste is, after the first grinding operation, run into blocks of suitable size, where it is allowed to cool. These blocks of pure cocoa are kept as stock for subsequent treatment, or are sold as such.

At the Admiralty victualling yards cocoa has for a very long time been prepared for the use of the Navy. About the year 1825 it was introduced as a substitute for gruel for breakfast. Then, and for seventeen years subsequently, the husk or shell was ground in with the nibs, as is now very often done in commerce, but as it was believed to have a bad effect on those who habitually used cocoa, in 1842-4 the shell was not ground in with the cocoa, and it is now sold to dealers for purposes which may be easily enough conjectured. Its market price is about £11 per ton, and as it contains some of the most valuable ingredients of the cocoa nib, it lends itself to adulteration, and very few samples of ordinary ground cocoa are free from it.

Navy cocoa being roasted, ground, and prepared in the victualling yards, is kept free from husk; and being, like many other manufactured foods entering into the sailor's dietary, home-made, the ingredients are of first-class quality.

Although this prepared cocoa, which is made up in two varieties, is called cocoa, both of them are doubtless chocolates. The first is mixed with 20 per cent. of good Demerara sugar, and the second with 20 per cent. of refined sugar and an equal amount of arrow-root. The first is called ordinary, and the second soluble, cocoa.

The materials employed to produce these preparations undoubtedly furnish the Navy with an excellent article of diet, and it is gratifying to know that our sailors, who do so much to protect us and keep our homes free from foreign invasion, have food which is good in quality and also carefully prepared.

The operations principally carried on at a modern cocoa factory are chiefly for the purpose of giving the cocoa more solubility than it possesses when in the form of nib, either whole or ground into powder, and the successful attainment of this object promotes the present demand for cocoa and its derivatives. Those who have tried to make a beverage from the nibs themselves, will fully understand the difficulty encountered in carrying out this object. The long simmering, the quantity of fat separated, and the apparently weak extract obtained, all tend to make such a drink unpopular. The cost, too, is considerable, and, as a consequence, cocoa in the form of nib has, in the pure state, never been popular.

The manufacturer who first presented to the public the cocoa in powder, mixed with starch and sugar, and sold under the name of soluble cocoa, indirectly conferred a benefit of the highest value, because a typical, agreeable drink was thus prepared; and it has been through this channel that cocoa has become popularised, and the improvements in the manufacture so marked. As before stated, cocoa naturally contains too much fat to render it a suitable food for the dyspeptic, and those who prepared cocoa from the pure nib had either to let the infusion cool and take off the fat from the surface of the liquid, or else consume more fat than they could digest. The soluble, or homœopathic cocoa was made to meet these two difficulties. The cocoa was diluted by the addition of Iceland moss, or some form of starch and sugar. The sugar sweetened the liquid, and the starch, which was usually of a kind whose granules burst at a comparatively low temperature, formed a gelatinous menstruum in which the finely-ground cocoa was suspended. Such a mixture was said to be "soluble cocoa;" and because the cocoa was small in quantity, and did not readily settle at the bottom of the cup, the public believed that such was the case. The price at which these cocoas were sold must convince the most sceptical that the public had to pay very dearly for the sugar and starch present in them, and the eagerness with which cocoa manufacturers entered into this branch of trade showed it was a very profitable manufacture.

Further on is a Table containing the analyses of a number of these samples which were made in the Inland Revenue Laboratory, and their composition will demonstrate to you that from the small quantity of cocoa present in them there was no danger of any bad effects being felt by those who used them, from taking too much cocoa fat.

The mucilage from the starch or moss present in them led people to believe they possessed very nutritious properties, but their composition, when it became known, was not satisfactory to medical men, and an effort was made to produce a prepared cocoa which, being free from foreign ingredients, should contain less fat and be more soluble than ordinary cocoa. Both British and foreign manufacturers were keenly alive to the value of such a preparation, and tried to produce it. They have succeeded in doing so by removing, by heat and pressure, a considerable portion of the fat from the pure cocoa paste, and making the residual cocoa more soluble either by the addition of a small proportion of an alkali, or by further heating this residue. Almost every manufacturer of repute has a specialty of this kind, and from the enormous sale of these extracts, it is apparent that, although comparatively costly, they supply a public want.

Being specialties, each manufacturer has a secret method of his own for their manufacture, but this refers rather to the problem of increasing their solubility in boiling water than to the abstraction of the fat. The fat is abstracted by placing the pure cocoa paste in strong canvas bags and submitting them to hydraulic pressure of from 1,200 to 1,400 lbs. to the square inch. The cocoa butter escapes through a proper orifice, and the cake of pressed cocoa is turned out in a nearly dry condition, and is either subjected to heat or chemical treatment, as before stated.

The following Table shows the composition of some of these specialties:—

TABLE XXXVI.—Commercial Cocoa.

Kind.	Per-centage of					
	Moisture.	Fat.	Non-fatty Cocoa.	Ratio of fat to non-fatty Cocoa	Starch (added).	Sugar (added).
Finest Trinidad nibs	2·60	51·77	45·63	1 to ·8	None.	None.
Cocoa extract (No. 1)	3·52	23·98	72·50	3·0	,,	,,
Chocolatine	4·40	29·60	66·00	2·2	,,	,,
Cocoa extract (No. 2)	5·76	29·50	64·74	2·1	,,	,,
Flake	5·49	28·24	66·27	2·3	,,	,,
Rock	2·58	22·76	24·90	1·09	17·56	32·20
Prepared	4·95	24·94	27·89	1·1	19·19	23·03
Iceland Moss	5·47	16·86	23·74	1·4	24·70	29·23
Chocolat de Santé	1·44	22·08	13·27	·6	2·00	61·21

Kind.	Per cent. of—		Amount of ash soluble in cold water.
	Ash.	Cocoa soluble in cold water.	
Trinidad nibs	2·86	10·58	2·44
Cocoa extract (No. 1).	6·81	18·00	3·95
Chocolatine	6·14	18 50	4·50
Cocoa extract (No. 2).	5·14	16·72	4·36
Flake	5·39	18 10	4·00
Rock	1·56	36·70	0·90
Prepared	1·52	31·66	1·17
Iceland Moss	1·83	40·80	1·06
Chocolat de Santé	1·76	65·60	1·16

It will be observed that there are two distinctive variations in composition, viz., the fat and the ash. Some contain much more fat than others, but from the same Table the proportion of ash naturally present in cocoa can be seen, and after making proper allowance for the reduction in the quantity of fat, the quantity of mineral matter which has been added in the process of manufacture for imparting colour and solubility to the extractive can be easily deduced.

Of the different descriptions of commercial cocoa now before the public, it is only just to the manufacturers to say that no kind has during the last few years so advanced in public estimation as this which has been deprived of the greater part of its natural fat and made more soluble by special processes. It is not my duty to direct attention to the production of any special manufacturer, but it is right that I should point out that cocoa so prepared is a very valuable article of diet, and is the best of the many preparations of cocoa submitted to the public. As the nitrogen is increased by the removal of the greater portion of the natural fat, it has become richer as a flesh-former than when in its natural state, and being made more soluble the inconveniences inseparable from ordinary cocoa preparations have been greatly modified. Cocoa does not suit every constitution, but to those who can take it and prefer it to tea or coffee, there is no doubt that the modern preparation now under consideration is of very great value. It has none of the objections of the so-called soluble cocoas, and yet is very soluble and nutritious, being strongly recommended by the medical profession in cases of debility as a partial substitute for tea and coffee.

Those manufacturers who use an alkali to increase the solubility of the cocoa are careful to use such as are wholesome. By this means the solubility is increased considerably, and such a cocoa appears to please the public.

The average ash of raw cocoa is from 2·5 to 3·2 per cent , that of fat-reduced cocoa is from 4 to 5 per cent., and cocoa treated with alkali

TABLE XXXVII.—Ash of Nibs and Husk.

Constituents.	Guayaquil Nibs.	Surinam Nibs.	Grenada Nibs.	Finest Trinidad Nibs.	Finest Trinidad Husk.
Sand	—	—	—	—	5·12
Silica	·15	—	—	—	2·87
Chloride of Sodium (NaCl)	·46	·53	·57	·65	·44
Soda (Na_2O)	·46	·63	·57	·83	·94
Potash (K_2O)	23·35	28·00	27·64	29·30	37·89
Magnesia (MgO)	19·18	20·66	19·81	18·23	13·04
Lime (CaO)	3·24	4·38	4·53	6·51	7·30
Alumina (Al_2O_3)	·10	·04	·08	·08	·55
Protoxide of Iron (FeO)	·21	·38	·15	·10	·63
Carbonic Anhydride (CO_2)	·69	3·31	2 92	4·19	10·80
Sulphuric ,, (SO_3)	2 77	4·29	4·53	3·91	3·25
Phosphoric ,, (P_2O_5)	49·39	37·78	39·20	36·20	17·17
	100·00	100 00	100·00	100·00	100 00

gives an ash as high as 8 per cent. The principal constituents of the ash to which alkali has been added are potash and phosphoric acid, two important and valuable mineral substances required for building up the bones and tissues of the body.

The Table XXXVI. shows which of the cocoa extracts or essences have been treated with mineral salts; and by comparing the proportions of ash present we have a ready way of satisfying ourselves of the presence of added alkali.

Cocoa: Chemical Composition.

In chemical composition, cocoa, like coffee, differs from tea, in having a large proportion of natural fat—in this respect standing much above coffee; by reason of this, too, and of a small per-centage of starch, it ranks higher than coffee altogether as a nutritious beverage. It differs, also, from both tea and coffee with regard to astringent constituents: while free from the high proportion of tannin found in tea, it appears to contain an astringent principle in rather larger quantity than that of the caffeic (or chlorogenic) acid in coffee.

The following analyses will convey an idea of the average composition of cocoa:—

TABLE XXXVIII.

Analysis of Raw Trinidad Nibs. (Inland Revenue Laboratory.)		Analysis of Shelled, Fresh Cocoa-beans. (Boussingault.)	
Moisture	5·23	Water	7·6
Fat	50·44	Fat	49·9
Starch	4·20	Starch and starch sugar	2·4
Albuminous matter—			
Soluble	6·30	Albumin	10·9
Insoluble	6·96		
Astringent principle	6·71	Tannin	·2
Gum	2·17	Albumin (gum)	2·4
Cellulose	6·40	Soluble cellulose	10 6
Alkaloids	·84	Theobromine	3·3
Cocoa red	2·20	——	—
Indefinite organic matter (insoluble)	5·80	Undetermined	5·3
Ash	2·75	Ash	4·0
——	—	Tartaric acid	3·4
	100·00		100 0

The fat, or cocoa-butter, which is present in such a remarkably large proportion, constituting half of the weight of the bean, is a yellowish-white, odourless solid, having about the same consistency as tallow. As is seen, however, from the methods of manufacture, this large per-centage is never present in forms of cocoa as sold—either the fat by itself has been partly eliminated by pressure, or the proportion of cocoa as a whole has been reduced by addition of starch, &c.

The analyses of commercial cocoas in the Table preceding, show the average quantity of fat to be about 25 per cent.; all preparations should contain at least 20 per cent.

Starch appears to exist in cocoa to a smaller extent than was formerly supposed. When seen under the microscope, its granules can be distinguished from those of the starches usually added during the manufacture.

There is but a trace of true tannin in cocoa; the astringent portion of the bean is of the same nature, however, but has hitherto been little investigated, owing partly to its want of stability, which makes its estimation rather difficult.

The principal alkaloid of cocoa (theobromine) is not identical with that of tea and coffee, though bearing a close chemical relation to it. Chemists have found somewhat varying quantities of it in their analyses of cocoa; the foregoing Tables give the highest, and one of the lowest, values we have seen—the average seems to be about 1·2 per cent. A Table is given elsewhere, showing some different estimations of this constituent. In the same Table are also shown the quantities in the same samples of a second alkaloid, distinct from theobromine, and which crystallises like theine. It contains less nitrogen than either theobromine or theine—a complete investigation of it, however, has yet to be made.

The ash, or mineral constituents of cocoa, ranges from 2·3 to 4·5 per cent. Its most noteworthy feature is its great solubility—one half being soluble in water—and the small proportions of soda, carbonates, and chlorides. The estimation of the ash affords a useful method of confirming the presence of foreign matter in preparations of cocoa; on the one hand, as previously mentioned, an abnormally high per-centage of ash is indicative of added mineral salts to increase the solubility of the article—on the other, an unusually low amount of ash serves to show the amount of true cocoa present in commercial mixtures.

The quantity of albuminous matter in cocoa seems constant at 13-14 per cent.—proportions which place cocoa between tea and coffee with respect to this constituent; but a far larger part of the total albumin in cocoa is soluble than is the case with the two rival beverages.

TABLE XXXIX.—Per-centages of Theobromine and Theine-like Alkaloid.

Cocoa.	Per cent. Theobromine	Per cent. Theine-like Alkaloid.
Guayaquil	0·54	trace
Grenada	0·91	,,
Surinam	0·78	0·02
Trinidad	0·59	0·25
,, husk.....	1·02	0·33

TABLE XL.—Per-centage of Moisture and Total Ash with the Relative Solubility of Ash.

Kind of Nibs.	Per cent of moisture.	Ash from 100 grains—dry.			
		Soluble in water.	Insoluble in water, but soluble in dilute hydrochloric acid.	Insoluble in dilute hydrochloric acid.	Total.
Guayaquil	5·06	2·04	1·59	none	3·63
Surinam	4·55	1·26	1·64	,,	2·90
Grenada	5·71	1·37	1·45	,,	2·82
Finest Trinidad ...	4·47	1·28	1·47	,,	2·75
,, ,, husk	10·19	4·74	3·38	0·51	8·63

TABLE XLI.—Per-centage of Ash Soluble and Insoluble in Water and Dilute Hydrochloric Acid.

Name.	Soluble in water.	Insoluble in water, but soluble in dilute hydrochloric acid	Insoluble in dilute hydrochloric acid.
Guayaquil nibs	56·20	43·80	none
Surinam ,, ...	43·45	56·55	,,
Grenada ,, ...	48·58	51·42	,,
Finest Trinidad nibs	46·55	53·45	,,
,, ,, husk	54·92	39·17	5·91

Cocoa: its Properties.

When compared with tea and coffee, cocoa is found to be somewhat deficient in those aromatic principles which have an exciting effect on the nerves of taste and smell. The alkaloids of cocoa are equal in amount to the alkaloid found in coffee, but they do not exert an equally stimulating effect upon the central nervous system.

Cocoa is, on the other hand, especially rich in some of the elements of a perfect food, viz., fat, albumin, and starch, and has nearly twice the mineral salts found in tea.

By referring to the various Tables of analyses of commercial cocoa, it will be observed to what extent the original constituents of cocoa as existing in the beans have been either removed or supplemented during manufacture, in order to adapt the finished article to individual tastes and digestive capacities. These remarks apply especially to the fat. During the process of digestion, fat practically undergoes no change until it has passed the stomach, and becomes mixed with the secretions of the liver and pancreas. During the time cocoa butter remains in the stomach it is liable to give very undesirable evidence of its presence there. Whether this be due to personal idiosyncrasy or to some peculiar physiological action of the cocoa butter cannot be determined with accuracy.

To obviate these unpleasant effects, and to render cocoa more suited to the wants of the masses, a large proportion of fat is frequently removed, as stated elsewhere, during the process of manufacture. The fat which is allowed to remain, and the albuminous and amyloid constituents, undergo the usual changes in the body. It is evident that the quantity of these food-stuffs in a cup of cocoa is comparatively insignificant when contrasted with the amount of the same substances derived from other articles of food consumed during an ordinary meal.

When deprived of the excess of fat, cocoa yields a bland, easily digested, and slightly stimulating beverage, generally free from any subsequent unpleasant effects.

It must not be forgotten that cocoa, in one or other of its many commercial forms, is consumed as a food, and sometimes as a condiment; we can scarcely argue dryly whether, when so taken, it is a cheap or a dear food. It is not taken as such, but more as a substitute for sweets by the young; on these lines it is perfectly safe to state that it is an improvement on the use of an inordinate quantity of sugar, and the use of cocoa as "sweets," in the form of chocolate or a chocolate cream, should be encouraged rather than condemned. It nourishes rather than fattens, and though it may be somewhat expensive as an article of diet, it is wholesome, and being easily obtained and stored for use, children consume large quantities of it in place of sugar. The increased consumption of cocoa, to which I shall subsequently refer, is a proof, if proof were needed, of the favour bestowed upon

cocoa and its many preparations; and now the British manufacturer is employing skilled talent in improving its preparation, and making what the public appreciate, there will be an increased demand for it, and a likelihood of cocoa taking its proper position amongst the non-intoxicating beverages in common use.

Chocolate: its Manufacture.

The chocolate as known to us is in the solid state, and made up into many distinctive forms. In this condition it is largely used as a sweetmeat, and consequently the cocoa used in its preparation must be of the best quality, free from objectionable flavour and bitterness. Unfermented cocoa is very unsuitable, being objectionable both in colour and flavour, but a bean like the fermented Trinidad is eagerly sought after, and consequently commands a high price. The commoner kinds are used in the preparation of chocolate and chocolate creams of low quality, into which large quantities of sugar, farina, and flavouring matter enter, and thus disguise the quality of cocoa used.

The large blocks of cocoa, which have been very finely disintegrated at a high temperature, are thoroughly incorporated with suitable proportions of pure white sugar in a mill specially designed for the purpose. When this has been done, starch and flavouring matter are frequently added, and the mixture is then either made into sticks, cakes, or other forms for consumption.

Good chocolate should turn out from the moulds quite clean and bright; it should not acquire a bloom by keeping, but should remain of a brown chestnut colour even after being long in store. It should melt quickly in the mouth, and leave no roughness or astringency on the tongue. The Spanish, French, and Swiss place cocoa on the market chiefly in the form of chocolate or chocolate creams, whilst the Dutch eat and drink it as cocoa, and the English both as cocoa and chocolate.

These practices have an effect on the consumption of cocoa fat, which is pressed out of the cocoa made to be sold as pure cocoa deprived of a portion of its fat, and which, as before stated, is very extensively manufactured in this country and Holland.

In the manufacture of chocolate for covering the creams it is necessary to introduce an extra quantity of cocoa fat to give covering power and smoothness to the chocolate used. Cocoa butter can therefore be obtained from the cocoa manufacturing countries for this purpose, and Holland notably is a large exporter. Cocoa butter of excellent quality and purity is frequently sold by our cocoa manufacturers for pharmaceutical and other purposes, and in its place they get a darker-coloured butter equally suitable for their requirements, but which is of a lower commercial value. The colour appears to be due to the effects of the high temperature at which the cocoa is pressed, and not to any defect in the butter itself. Cocoa-nut oil stearin is sometimes used as a substitute for the true cocoa butter. This is made by pressing cocoa-nut oil of commerce at a temperature ranging from 68° to 72° F. The liquid portion, which on pressure escapes through the bags containing it, leaves behind a solid body (cocoa stearin), and this substance is now largely used in the manufacture of chocolate creams.

The chocolate, when prepared, is either poured over the creams, or the creams are dipped into the chocolate. Frequently the girls who perform this work use their fingers for holding the cream, and, as a rule, the impression of the finger can be traced on every such cream. Others use a wire for the purpose, so that the chocolate on the face of the cream is uniform without depression. The cream is made either by heating powdered loaf sugar till it melts, or a mixture of powdered sugar and glucose. The cream, after a while, granulates into a stiff mass, but is easily soluble, and for making creams is poured in a liquid condition into little moulds which have been made in starch flour. The chocolate is poured over them after they have been moulded, and is frequently spread uniformly by the motion of the table on which the operation is conducted, this motion being imparted by mechanical means, and in different directions, to effect the intended purpose.

Chocolate creams and other fancy preparations of chocolate now manufactured are very numerous, and embrace many descriptions which can be roughly classified for illustration. Thus the cream used is flavoured with different materials, or it may be mixed with fruit extracts for flavouring or for taking away or modifying the sweetness of the sugar.

Extracts of malt, coffee, or tea are sometimes introduced, and in this way the cocoa is made a vehicle for bringing into notice its rivals tea and coffee.

Sometimes, also, burnt almonds and other seeds are used for interior flavouring. The domain of medicine has also been invaded by the enterprising chocolate maker, and we can obtain in the ordinary way of trade pectoral

and medicinal chocolates. The number of the different preparations is legion, as will be evident from the fact that on three trade-lists I have studied, one manufacturer enumerates 221 assortments, the second 244, and thethird 253.

The increase in cocoa consumption has during the last few years been considerable, and without taking too sanguine a view, we may expect this increase to steadily progress, on account of the attractive and pleasant forms in which cocoa can be obtained, either as a drink or as a food.

In bringing this series of lectures to a close, it will be of public interest to note how the three non-intoxicating beverages—tea, cocoa, coffee and coffee substitute—fare with the intoxicating drinks, spirits, wine, and beer, as regards their general consumption.

During the thirty-three years ending December, 1888, the quantity of spirits and wine consumed per head of the population increased from 1·26 to 1·29 gallon at proof, and beer from 22·6 to 26·8 gallons per head. Even this comparison shows that the public taste had, during the period referred to, gone in the direction of the weaker and more harmless intoxicant, beer, and this change is encouraging to those who desire to see the people of this country become a more sober nation.

When we turn to the consumption of non-intoxicants, the picture becomes much brighter, for the quantity consumed increased from 3·64 lbs. to 6·58 lbs. per head. This increase has been greatly aided by the facilities now given to obtain tea and coffee at coffee taverns and other good refreshment bars The accommodation thus given is greatly appreciated by the public, and even the tavern-keeper is following in the same direction by offering his customers the choice of non-intoxicants as well as of intoxicants.

On all sides there is a strong desire to bring down our intoxicating drink bill, and we who live in the metropolis and are compelled to see what is going on amongst the masses, must cordially welcome any change in public opinion and taste which tends to promote sobriety and rational enjoyment, and inclines the bread-

TABLE XLII.—Cocoa (lbs.).

	Imports.					Consumption.	
Year.	British Possessions.	Ecuador.	Brazil.	Other Countries.	Total.	Total.	Per Head.
1873..	8,538,327	4,353,908	1,065,585	5,703,427	19,661,247	8,311,023	·26
1874..	6,822,678	6,044,012	563,377	4,423,885	17,853,952	8,863,579	·27
1875..	6,414,065	4,765,790	994,967	3,696,429	15,871,251	9,973,926	·30
1876..	10,425,547	4,578,522	1,917,064	3,461,175	20,382,308	10,428,675	·31
1877..	8,171,088	3,707,976	1,460,925	3,636,453	16,976,442	10,060,637	·30
1878..	10,711,141	1,655,867	2,518,703	3,127,128	18,012,839	9,980,162	·29
1879..	14,139,451	6,281,886	669,209	5,254,215	26,344,761	10,111,526	·29
1880..	11,454,813	6,000,414	554,524	5,531,406	23,541,157	10,566,159	·30
1881..	12,305,313	4,181,158	1,151,804	4,730,253	22,368,528	10,897,795	·31
1882..	12,189,128	3,342,037	859,406	2,599,870	18,990,441	11,996,853	·34
1883..	13,824,208	3,231,961	1,876,248	3,700,277	22,632,694	12,868,170	·36
1884..	15,150,324	3,006,619	1,553,277	2,959,048	22,669,268	13,963,891	·38
1885..	14,608,359	2,548,308	1,625,187	4,637,542	23,419,396	14,595,160	·40
1886..	13,590,164	6,032,874	447,634	5,315,767	25,386,439	15,165,714	·41
1887..	13,548,376	4,565,881	1,711,898	7,633,345	27,459,500	15,873,698	·42
1888..	19,167,230	3,046,653	879,598	6,473,066	29,566,547	18,227,017	·48
1889..					26,735,274	18,464,164	·48

winner of the family to seek for home pleasures instead of the temptations and allurements of the tavern, or bogus club, and the baneful associations connected therewith.

The lines in the chart (p. 76) representing the population and the consumption of the different articles enumerated on it require careful and attentive study, and will amply repay the student who takes the trouble to learn the lessons the chart teaches.

The line of population is one of steady and fairly regular increase, not marked by any exceptional developments during the thirty-three years to which it relates.

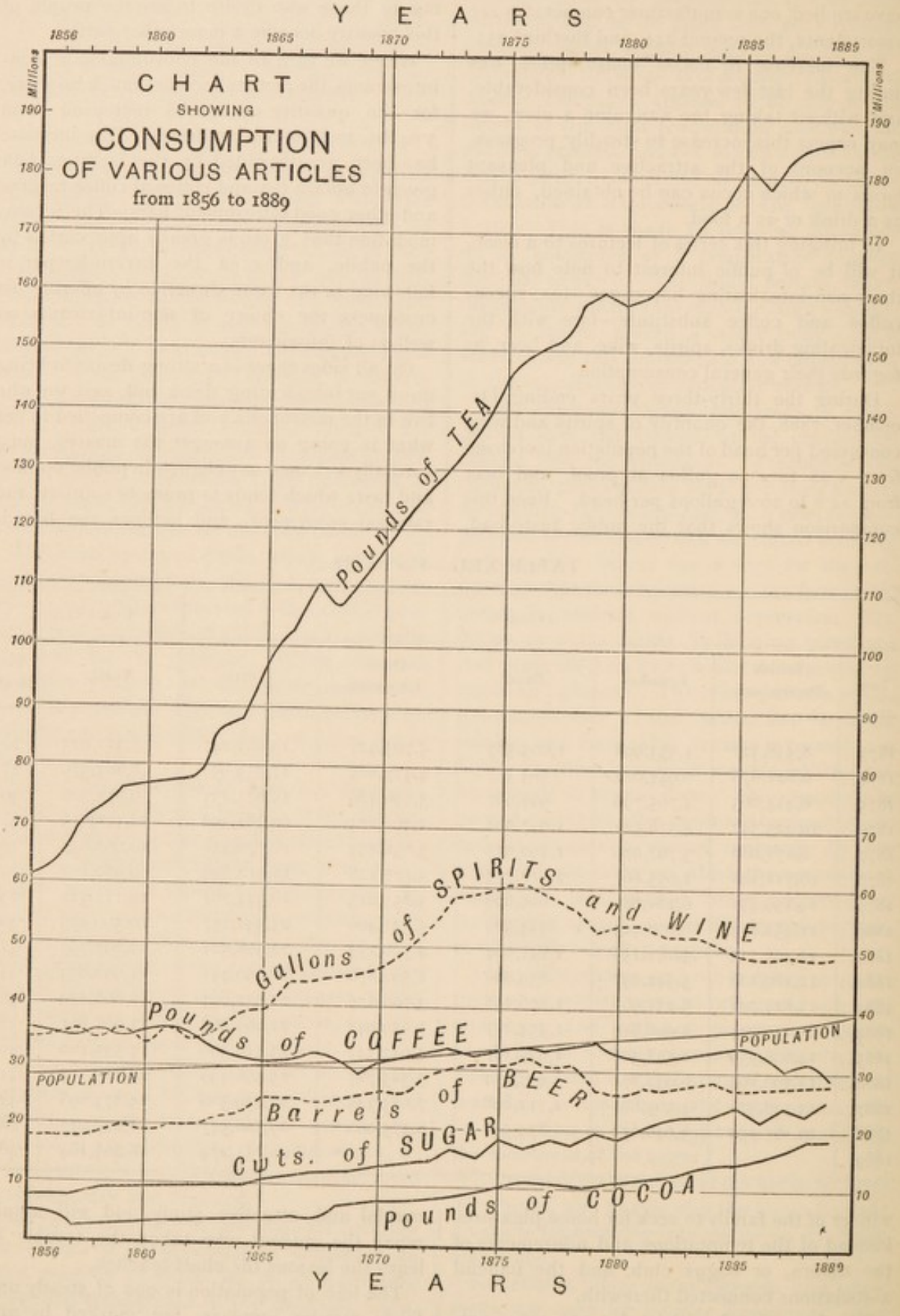
YEARS
1856
1860
1865
1870
1875
1880
1885
1889
CHART
SHOWING
CONSUMPTION
OF VARIOUS ARTICLES
from 1856 to 1889
Millions
Pounds of TEA
Gallons of SPIRITS and WINE
Pounds of COFFEE
POPULATION
Barrels of BEER
Cwts. of SUGAR
Pounds of COCOA
YEARS

TABLE XLIII.—Consumption per Head.

Year.	Non-intoxicants	Intoxicants.	
	Tea, Coffee, Cocoa, and Chicory.	Spirits and Wine.	Beer.
	lbs.	gallons.	gallons.
1856	3·64	1·26	22·6
1857	3·76	1·26	22·6
1858	3·92	1·20	23·6
1859	3·98	1·25	24·8
1860	4·01	1·16	23·8
1861	4·38	1·23	24·3
1862	4·07	1·16	24·1
1863	4·53	1·20	25·5
1864	4·59	1·29	26·7
1865	4·84	1·34	29·8
1866	4·95	1·45	29·5
1867	5·24	1·44	28·2
1868	4·04	1·48	28·2
1869	5·08	1·46	29·2
1870	5·32	1·50	30·2
1871	5·44	1·57	29·3
1872	5·58	1·67	32·3
1873	5·72	1·79	33·3
1874	5·81	1·79	34·1
1875	6·05	1·82	33·4
1876	6·13	1·83	33·8
1877	6·10	1·74	32·4
1878	6·21	1·67	32·2
1879	6·32	1·54	27·9
1880	6·17	1·54	27·0
1881	6·13	1·52	28·2
1882	6·22	1·48	27·1
1883	6·38	1·46	27·5
1884	6·41	1·42	27·5
1885	6·64	1·35	26·4
1886	6·45	1·32	26·9
1887	6·50	1·32	26·9
1888	6·58	1·29	26·8

Coffee has had a singular history, and therefore it must be looked upon as having had, from special causes, a career very different from its competitors. The fluctuation in consumption has been very great, but the tendency has always been downwards, till during the last three years the falling off has been most marked. Why this has been the case has been shown in the second lecture, and it seems as if there were no hope that this article, though particularly wholesome, will ever advance in public favour as a national beverage, on account of the difficulty and cost of its preparation.

Through the efforts made to prepare cocoa as a food as well as a drink, the consumption has greatly increased, for it has been seen that by taking out portions of the natural fat, or by adding starch in one form or another, to absorb it, the natural difficulties of using cocoa have been modified or overcome. Again, in chocolate and chocolate creams the public have a nutritious food as well as a sweetmeat, and many a toiler or holiday seeker has been braced up to continued endurance by eating a few creams or other cocoa preparations.

The most marked development in consumption has taken place in tea. It has increased by leaps and bounds, and the probability is that if India and Ceylon teas, which are stronger than China growths, had not so largely increased in consumption, the chart line would have shown still greater progress. It will be seen that the prosperous years of 1870-75 had no effect in diminishing the consumption of tea and cocoa, and this fact must be taken as proving that tea and cocoa are ranked amongst life's necessaries, and used as regular articles of diet in the family.

Beer and spirits seem to keep pace in consumption, at any rate within certain limits, with the wage-earning power of the working classes, and as soon as wages fall the consumption of beer and spirits falls also. It is apparent from such facts that the working classes are the large consumers of intoxicants, and the elevation of the lines on the chart representing alcoholic drinks reads a silent lesson on the large amount of money uselessly spent in strong drink, which would have been better employed in the purchase of home comforts, or as an investment for sickness or old age.

As before stated, there is an improvement in the habits of the nation as regards sobriety, but, at the same time, the rate of progress is very slow, and disheartens many who are vain enough to expect that nations can become changed in their habits without difficulty, and can turn from drunkenness to sobriety apparently without any effort. Such a rapid change cannot take place, but the past is bright with promise, and if rational recreation, wholesome food, and non-intoxicating, inviting drinks can be provided for the masses, drunkenness will receive a rude and a permanent shock, and as the surroundings of our wage-earning population are improved we may confidently expect a corresponding improvement in their habits, and a more marked preference shown for non-alcoholic as against intoxicating drinks.