THE BEVERAGES WE DRINK.

W. N. EDWARDS, F.C.S.

Symbol $H^6 C^2 O^2$ or C_2H_5OH

$1\frac{1}{2}$ ℥ absolute alcohol
for an adult
assimilable per diem

= 4 ℥ Brandy 75 up — 2 wine glassfuls

= 5 ℥ Whisky 75 up — $2\frac{1}{2}$ —

= $\frac{1}{3}$ of a pint Port 23% — 3 —

= $\frac{1}{2}$ pint Hock (15% or Champagne — 5 —

= $\frac{3}{4}$ pint 9% claret — 7 —

= $1\frac{1}{4}$ pint Beer 6% — 3 tumblers full

Average consumption per head
4 gals proof spirit yearly
or $1\frac{1}{2}$ ℥ per head daily
A(?)

W. H. Clark

THE BEVERAGES WE DRINK

BEING A POPULAR TREATISE ON THE VARIOUS KINDS OF DRINKS IN COMMON USE.

BY

WALTER N. EDWARDS, F.C.S.,

AUTHOR OF

"*Science Lessons—Chemistry*," "*Science Lessons—Physiology*," "*Medicated Wines and their Dangers*," "*Notre Laboratoire*," "*One Hundred Blackboard Outlines*," &c.

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Page 17
Impurities in Water

Lime
Chlorine
Sulphuric Acid
Nitric Acid
Ammonia
Hydrogen Sulphide
Magnesia
Salt

Organic Matter
Lead
Zinc

DEDICATED BY THE AUTHOR

TO

Mr. FREDERIC SMITH,

AS SOME SLIGHT RECOGNITION OF THE INVALUABLE WORK ON BEHALF OF THE BOYS AND GIRLS OF GREAT BRITAIN, THAT HE HAS ACCOMPLISHED DURING THE PAST FORTY YEARS.

INTRODUCTION

BY

NORMAN KERR, M.D., F.L.S.,

President of the Society for the Study of Inebriety.

THE chief intellectual want of the present generation is knowledge. There never has been so intense a thirst for Truth. Yet much of our present day instruction, especially on the true properties of our common articles of food and drink, is vague, indefinite, and defective.

On the innocence and wholesomeness of our every-day beverages, depends to a large extent the physical, mental, and moral health of our population. No inconsiderable proportion of disease has arisen from the wide-spread ignorance of the perilous influence of some of our most popular drinks. Especially has the traditional British superstitious false belief in the supposed strength-giving qualities of intoxicating liquors been the undoing of a host of the cultured sons and daughters of Britain, who have been absolutely ignorant of the dangerous properties of alcoholic inebriating liquids.

These truths, with many others concerning nutritious and wholesome beverages, are lucidly set forth in this interesting book by MR. WALTER N. EDWARDS, F.C.S., which I heartily commend to the reading and intelligent public.

NORMAN KERR.

19th November, 1898.

CONTENTS.

CONTENTS.

CHAPTER XIV.

CHAPTER XV.

CHAPTER XVI.

CHAPTER XVII.

CHAPTER XVIII.

CHAPTER XIX.

CHAPTER XX.

CHAPTER XXI.

4 | 154
38½
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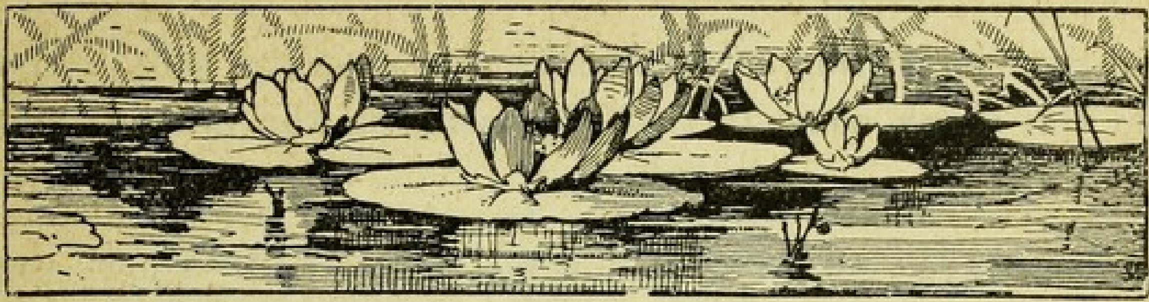


THE BEVERAGES WE DRINK.

WATER.

WATER AS A FOOD.

CHAPTER I.

OF all things necessary for the maintenance of life and of health, no other is so essential as water. We might elect to do without any particular kind of food. One, for instance, might say he would not eat meat, another might avoid fish, another eggs, but no one can decide to do without water. It is of all foods the most essential.

Nearly three-fourths of the entire weight of the body are water, hence the body of a man weighing one hundred and fifty-four pounds would contain about one hundred and four pounds of water. A small man weighing about 100 lbs. will contain about 70 lbs. of water or a little more. We may, therefore, speak of the body as a whole, as containing about 71 per cent. of water. This is distributed unevenly in the composition of the various tissues of the body, some in the bones, some in the skin, some in the muscles and so on.

Percentages of Water in the Tissues of the Body. The following tables will show the average percentages of water in the various tissues and in the different liquids and secretions of the body.

	per cent.		per cent.
Bones	22	Skin	72
Fatty tissues ..	30	Brain	75
Cartilage	55	Muscles	76
Liver	69	Lungs	79
Marrow	70	Kidneys	83

Blood	79	Intestinal juice ..	97
Bile	86	Tears	98
Pancreatic juice ..	88	Gastric juice ..	99
Chyle	93	Saliva	99½
Lymph	96	Sweat	99½

An average-sized man loses by means of the skin, the lungs, and the kidneys, from 80 to 100 ounces of water in twenty-four hours. The water thus lost by the perspiration, the breath, and the kidneys must be replaced, and to make the loss good some three and a half to five pints of water are needed daily. All foods, however, contain some water, even such dry substances as peas and maize. In this way the demand is partly met, but probably some two and a half or three pints of water in some form of beverage will be required.

Water Contained in Foods. The following table gives a list of various foods, and shows the average quantity of water contained therein :—

Table of Percentages of Water in Various Foods.

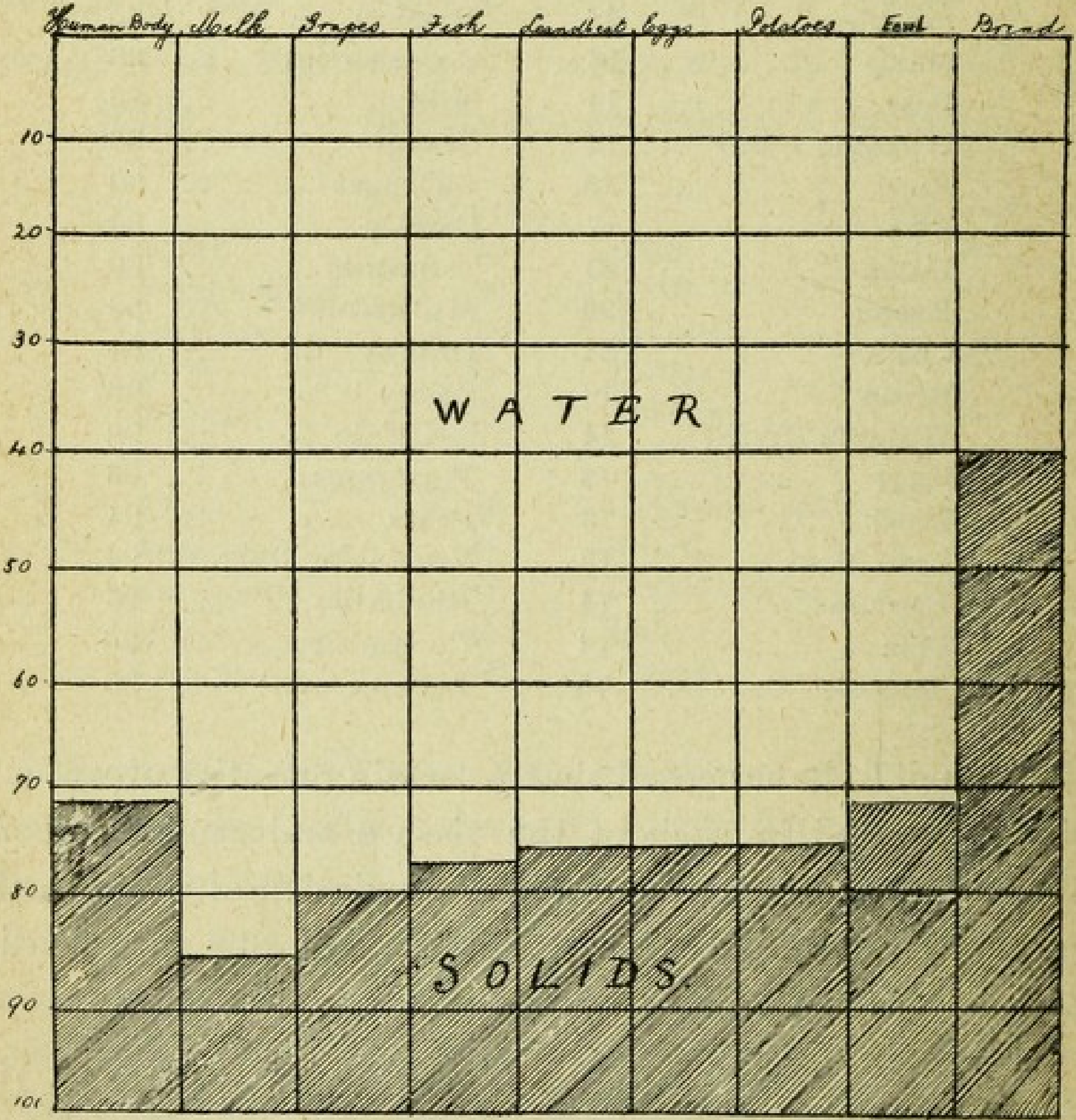
	per cent.		per cent.
Oatmeal	5	Grapes	80
Butter	10	Parsnips	81
Barley Meal ..	14	Beetroot	82
Haricot Beans ..	14	Apples	83
Lentils	14	Peaches	85
Maize	14	Gooseberries ..	86
Peas	14	Milk	86
Wheaten Flour ..	14	Oranges	86
Rice	15	Cabbages	89
Figs	17	Carrots	89
Dates	20	Tomatoes	89
Bacon	22	Mushrooms ..	90
Cheese	34	Onions	91
Bread	40	Celery	93
Walnuts (fresh) ..	44	Sea Kale	93
Eggs	72	Watercress ..	93
Fowl	73	Pears	94
Lean Meat ..	73	Vegetable Marrow	94
Bananas	74	Rhubarb	95
Fish	74	Cucumber.. ..	96
Potatoes	75	Lettuce	96

It is not to be supposed that a certain quantity of water is simply located in each of the tissues and remains there. There is constant movement and circulation of water in the various liquids of the body, and it also forms an essential and integral part of every organ.

Water Necessary to the Body.

All things that live, whether it be the giant of the forest or the blade of grass, the mighty lion or a tiny insect, the bird in the air, the fish of the sea, or some lowly and microscopical fungi, all must have water, for it is an essential constituent of all living things, and so in the human body, it forms an essential part of living bone and muscle, of living blood and nerve, and consequently, water is as much a food as any of those which we call solids.

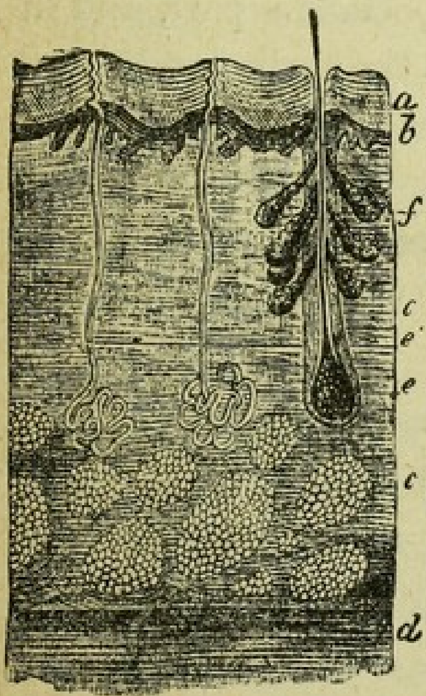
Diagram shewing proportions of Water and Solids in various Foods, and in the Body.



Another important part that water plays in the body is that of purifying and cleansing the human system.

As the daily work of the living body goes on, a great deal of waste matter is produced. Waste is material which has done its work and must now be got rid of. If it is not removed, it will begin to load the blood with useless and dangerous matter. Water renders important service in the removal of this waste. One of the forms of waste matter is known as Urea. In many of our foods we have nitrogenous substances, which are chiefly devoted to the building up of muscle and are therefore called flesh formers. In the work of building up muscle tissue the substance Urea is formed, and if it were allowed to accumulate in the blood, life would soon cease owing to a form of blood poisoning. The kidneys, however, have the power of removing Urea, and so the blood is constantly being cleared of it by these organs. But a great deal of water is necessary for this work, for together with about three pints of water about 1¼ oz. of Urea are daily removed from the body in this way.

Another waste material is carbonic acid gas which has been formed by the conversion of carbonaceous food into heat and force. This gas is exhaled from the lungs to the extent of about two pounds weight every day, but this is accompanied by about three quarters of a pound of water vapour, which has materially assisted in its removal from the blood.



THE STRUCTURE OF THE SKIN.

There is still a third way in which water assists in keeping the body healthy, and to carry off waste, and that is by means of sweat or perspiration. This is constantly going on if the skin is in good order. The process is known as insensible perspiration, when we do not feel it, and sensible perspiration when it is apparent. It is estimated that the total number of sweat glands in the human skin is over two millions. The length of a sweat duct or tube when fully straightened out is about $\frac{1}{4}$ of an inch, and it is calculated that the total length of tube devoted to the secretion of sweat, would be about ten miles. On an average the quantity of water that escapes from the skin as vapour is about two pounds daily. If the skin is not in good working order, more work is thrown upon the lungs and the kidneys. Just as good air is necessary for the lungs and the blood, so a plentiful supply of clean and wholesome water is necessary for the maintenance of the skin in good order.

Water in the Digestive Juices.

Besides this work of the removal of waste matter, in which we have seen water plays so important a part, and in addition to keeping the body moist and giving it roundness and plumpness of appearance, water has the important duty of aiding the solution of foods and their subsequent entrance into the blood stream. All the digestive juices very largely consist of water.

The saliva, of which between one and two pounds are produced from the blood daily, and which is of such extreme importance in the changing of insoluble starchy foods into soluble sugars, contains 9,940 parts of water in 10,000.

The gastric juice, which is concerned in the dissolving of nitrogenous foods, contains 994 parts of water in 1,000.

The bile juice, which aids in the emulsification of fatty foods, has 859 parts of water in 1,000: whilst the pancreatic juice, which has the important work of dissolving any parts of food which have escaped the other digestive agents, contains 980 parts of water in 1,000.

All this will help to show how important water is to the human economy, and this will be further impressed upon us when we remember that there is no substitute in nature for water.

Water the only Thirst Quencher.

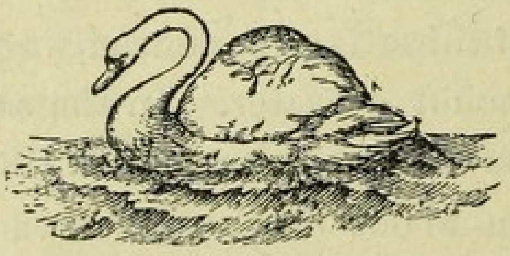
Whatever form of beverage we use, whether it be Tea, Milk, Coffee, Cocoa, Lemonade or any other of the many in use, the only part that quenches thirst and that which renders the most efficient service, is the water contained in them.

Undoubtedly simple water is the only natural and the only necessary beverage. All others could be dispensed with, and the body still remain healthy, and possibly be more free from ailment, than it is with the many kinds of beverages in common use.

The sensation of thirst is experienced when the body has lost a certain amount of water. In the case of a healthy and well-nourished body the feeling of thirst would come on definitely when about one sixth of the whole of the daily waste, or one pound of water, has been lost.

It is a curious fact that thirst may be more quickly allayed by injecting water into the veins, than by taking it into the stomach. This shows us that it is the body as a whole that needs the water, and not merely that the stomach and intestines are demanding it.

There are many causes for thirst. Violent exercise means a greater loss of moisture and therefore creates thirst, especially in hot and dry weather. A larger quantity of salt than is actually necessary will also produce thirst. Anything which makes the gastric juice and the other juices of the body flow faster, also means a consequent loss of moisture, and hence a desire for water. Savoury foods, certain mrdicines, alcoholic liquors, can all produce this sensation. A similar result may also be produced when we are out of health and the pulse is high, and the skin hot and dry. Whatever may be the cause of thirst, there is only one substitute that can quench and satisfy it, and that is water.



WATER—*continued.*

SOURCES OF WATER.

CHAPTER II.

IT is an important consideration as to where the supply of water is obtained. A comprehensive view shows us that water circulates over the earth in something the same way that blood circulates round the body. Practically there is a given and constant quantity of water in the world. Sometimes it is in one place, sometimes in another.

We might start with rain as being a source of supply. As it falls it flows down the mountains and hills and slopes in streams and brooks. These uniting find their way to the river, which in its turn flows on to the sea. But every moment of time, millions of tons of water are being lifted from the surface of ocean and sea, lake and river. From this water vapour, which is of course absolutely pure water, the clouds are formed which shall presently give water back again to the earth. The sea is therefore receiving all the impurities, dissolved out of rock and earth and in other ways gathered up by water on its way to the ocean. Although the water vapour is quite pure, the rain drop coming from it is not quite so. It is the purest form of natural water, but in its passage through the air it has dissolved some of the gases of the atmosphere, and these, together with particles of matter in suspension in the air, which are brought down with it, render it in some degree impure. Could the rain water be gathered at sea or in the open country it would be both safe and wholesome. An average degree of impurity when gathered in the country is 2 grains per gallon, whilst in large towns and cities it is much more.

The sources of water may be stated thus: rain, snow, ice, streams, springs, ponds, wells, lakes, and collected surface rain water.

Amount of Rainfall.

All these supplies of water were primarily rain, and some idea of the vast quantities of water descending upon the earth may be gathered from a study of the rainfall for any particular area. If all the rain and snow that fell in London during a period of twelve months remained where it fell it would have a depth of nearly twenty-five inches over the whole area. This, however, is not excessive, for on the Western Coast, in North Wales, and the North-West of Scotland, there are many places where the annual rainfall is more than seventy-five inches. An inch of rain would weigh about 100 tons for every acre of ground covered; every two square feet would contain one gallon of water. On an average the yearly rainfall in London would be 2,525 tons, or 565,600 gallons per acre.

London Water Supply. London obtains its water supply from various sources. The daily quantity required at the general average of 29·60 gallons per head reaches nearly 200,000,000 gallons, supplied by the following eight companies :

Water Companies.	*Source of Supply.*
East London	Thames above Sunbury, and the Lea
West Middlesex ..	Thames above Hampton
Grand Junction ..	Thames near Hampton
Southwark and Vauxhall	Thames near Hampton
Lambeth	Thames near Moulsey
New River	The Lea, and springs, and deep Wells
Chelsea	Thames near Moulsey
Kent	Deep wells in chalk

Although London is fairly well off for its water supply in a year of average rainfall, there is somewhat of a dearth in certain districts in an unusually dry year. The quality of the supply is also fair, and will compare favourably with that of many other towns and districts, but is not so good as that of places which draw their water from Loch Katrine in Scotland, or Lake Vyrynwy in Wales.

As rivers are supplied by rain water which has flowed over pasture land, cultivated land, and inhabited places, it follows that it must be very impure, and when in addition to this, street washings and sewage are allowed to flow into it, the water becomes quite undrinkable and highly injurious to health. There is, however, a natural process of purification constantly going on which to some extent renders the water less dangerous. The air in contact with the surface of the water and the free oxygen which is absorbed into it, both have the effect of destroying much of the decaying organic matter.

The process of settling and filtration adopted by the various Water Companies continues this good work so that as it reaches the consumer the water is fairly potable and wholesome.

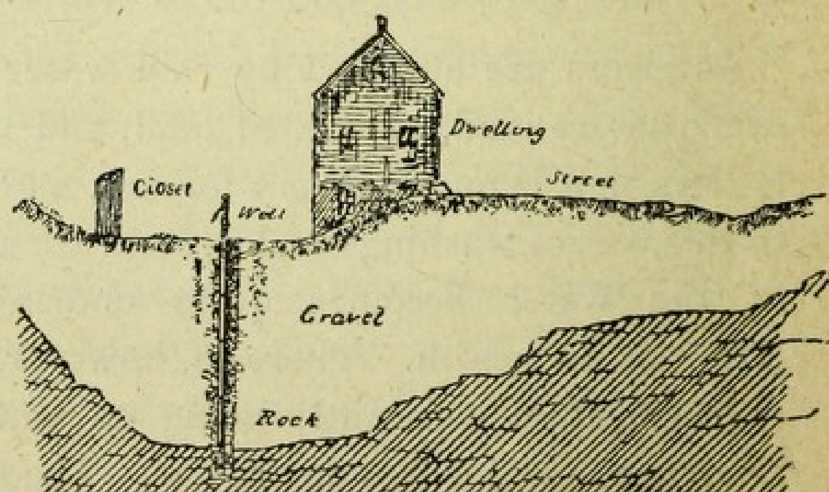
A great deal depends on the storage of the water in the house. This should be strictly avoided wherever possible by adopting the constant service supply, so that all water used for drinking or for cooking should be drawn direct from the main. Where this is not possible, the tank should be in an accessible place, not connected with any closet or drain, should be kept covered, but not so that air cannot reach the water, and should be kept strictly clean by frequent scrubbing.

When the slightest doubt exists as to the quality of the water, recourse should be had to boiling.

Water in Country Places.

In country places the dangers of bad water are greatly intensified.

The illustration shows the condition obtaining in many country villages. We have here what is known as surface well water. There is a thin substratum of earth and the well which has been sunk near the house contains water that has simply soaked through this. The plan is convenient,



it gives a water supply close at hand, but the dangers are obvious. If river water is impure, how much more so, where the water in the well, as in this case, must flow over the ashpit, the cesspool, and the soil everywhere surrounding the house. The water may be clear, sparkling, cool, and yet be deadly. It may be that the water from the well is used year after year without anything fatal occurring, but every now and then there will be outbreaks of scarlet fever, diphtheria, and other like diseases. The only possible safeguard to health where water cannot be obtained from any other source than such a well is to boil every drop that is to be used for drinking purposes or for the preparation of food. In some districts where there is running water in the loose sandy soil under the ground, the dangers will be considerably lessened, but even then the precaution of boiling should be taken.

Water from a mountain stream is generally good, providing that no overflow from cesspools or drains contaminates it at a higher point. The water may hold matter in suspension which can be removed by filtration, but as a potable water it will be infinitely superior to that of the shallow or surface well.

Deep well water as a rule is very good, although where the wells are in chalk it will be very hard, but as far as organic impurity is concerned it will be of a very high standard of purity.

The following comparison will illustrate this point :—

Rain Water	4·7	Parts of Organic matter in 100,000.
Surface Water	10·1	,, ,, ,, ,, ,,
Deep Well Water	3·4	,, ,, ,, ,, ,,
Spring Water	4·3	,, ,, ,, ,, ,,

Spring waters are generally good and wholesome, some of them exceptionally so. The Rabate Fountain at Balmoral contains only one grain per gallon of dissolved matter, while the average of the springs of the Lias shows 25½ grains.

Classification of Water.

In the Sixth Report of the Rivers Pollution Commissioners the following classification as to wholesomeness, palatability, and general fitness for drinking and cooking is given :—

Wholesome	1. Spring Water	Very Palatable.
	2. Deep Well Water	Very Palatable.
	3. Upland Surface Water	—Moderately Palatable.
Suspicious	4. Stored Rainwater	—Moderately Palatable.
	5. Surface Water	—Palatable.
Dangerous	6. RiverWater to which sewage gains access	Palatable.
	7. Shallow Well Water	Palatable.

Classified according to softness, for washing, etc.

1. Rain water.
2. Upland surface water.
3. Surface water from cultivated land.
4. Polluted river water.
5. Spring water.
6. Deep well water.
7. Shallow well water.

The above refers to what may be called the natural supply, and does not take into account any process of purification and filtration. Thames water, which gives the greater portion of the supply for London, would, in its natural condition, come under number 6 in the first of the two tables, but after it has passed through the various methods of purification adopted by the water companies, it would be placed in the category under 1, 2, or 3.

Standard of Quality.

Good drinking water should be sparkling, and have a pleasant palatableness, but no decided taste. If there is a brackish, or any decided taste, the water should be looked upon with suspicion.

It should be free from odour of any kind. If after being stored in a vessel for a time there is any faintness or smell arising from it, the water should be regarded as unfit for drinking.

Good drinking water when held up to the light in a glass should be bright and clear. If it is hazy or presents a cloudy appearance, or if stringy matter or particles are floating in it the water should be rejected.

WATER—*continued.*

TESTING AND PURIFYING.

CHAPTER III.

IF it is so essential that water, the best and most natural of all beverages, should be of good quality, the question arises, what simple tests are there, to ascertain the purity of the liquid, and how can this purity be ensured.

In a physical examination of water the following points should be noted—colour, clearness, sediment, lustre, taste, and smell.

Colour may be judged by allowing the sample of water to settle, and pouring off the clear water above any sediment, into a tall tubular glass at least twelve inches high (or better still twenty-four inches high) standing upon a sheet of white paper, and compared with a second tube placed alongside containing pure distilled water. The observation must be made by looking through the water from top to bottom. The best waters will have a greyish or bluish appearance. If greenish the colour will probably be due to an harmless variety of the *Unicellular Algæ*. If yellow or brown the water should be rejected unless it is obtained in a peat country, when such a colour is usually due to harmless impurities. The yellow and brown tints in other cases will indicate animal organic matter, probably sewage.

Clearness may be judged by the same method as colour, but the water must be first shaken so as to ensure the equal spreading of the particles held in suspension.

The character of sediment, unless the sample is very bad indeed, can only be judged by a microscopic examination.

Lustre is to some extent an indication of the aeration of the water. The different degrees may be noted as nil, dull, vitreous, adamantine.

Taste.—The pleasantness of water to the palate, which may come under the heading of taste, is due to the gases dissolved in the water, hence distilled water and boiled water are flat and insipid compared with the sparkle and briskness of good natural water.

The odour of decaying matter in water can best be detected by warming the water.

Tests for Water.

It is not the province of this work to enter upon laboratory methods, or even to give a description of the elaborate work necessary to analyse water, and to get a quantitative estimation of it, but we may indicate some simple methods that anyone may adopt to find out the principal characteristics of the water they are using.

The following are among the common impurities of water :—Lime, Chlorine, Sulphuric Acid, Nitric Acid, Ammonia, Iron, Hydrogen Sulphide, Organic Matter, Lead, Zinc, Magnesia, Salt. Although the whole of these are spoken of as impurities, this is so only in the strictly chemical sense. In potable waters the quantities of most of the substances mentioned are infinitesimal, and may be neglected for general purposes. Cases are not uncommon however of lead poisoning, and the greatest danger of all is that arising from organic matter, animal or vegetable.

If a quart of water is evaporated down in a china dish or basin we shall get a residue, and a simple test will indicate whether the solid particles forming the residue are dangerous or not.

Evaporating means boiling down, and the method to be adopted is to have a thin basin that will just fit into a small saucepan without going right in. Into this the quart of water is to be placed a little at a time, and the water in the saucepan brought up to a boiling point. The heat from this will gradually cause the water in the basin to evaporate, and in time the whole of the quart will be driven off, leaving behind any solid particles that were in the water. The basin should be small, the water being renewed from time to time until the operation is complete. The amount obtained will be very small. A gallon of water weighing 70,000 grains or 10 lbs., and measuring 8 pints, should not yield more than 30 grains solid residue. In Thames and New River water the amount averages 21 grains per gallon.

When all the water has been completely evaporated, the dry residue must be heated over a flame, making the dish practically red hot. If the residue darkens and gives out fumes, and eventually blackens, organic matter is present, and if there is an odour like that of burnt feathers, then it is certain that the organic matter is of animal origin, and is all the more likely to be unwholesome.

A somewhat simpler test for organic matter is that of permanganate of potash, a substance which can be purchased in small quantity of any chemist. To make a solution, add a few crystals to some distilled water; they will quickly dissolve, and a very dark, rich colour will be produced.

Decaying organic matter in water has a great attraction for oxygen, and permanganate of potash has a supply of oxygen that it very readily parts with, and in so doing it changes colour.

Place some of the water to be tested in a glass standing on a sheet of white paper, add to it a few drops of weak sulphuric acid, and stir with a slip of clean glass. Now add a few drops of the permanganate of potash solution until the whole is of a rich ruby colour, cover the vessel, and let it stand for a few minutes. If the colour disappears much organic matter is present, but if the water can stand ten or twelve hours without change of colour, then we may be quite sure that it is not contaminated. It must be borne in mind that in the presence of iron salts or peaty matters this test cannot be relied upon, as both these classes of substances produce the same effect upon the permanganate as the injurious organic matters do.

The presence of lead in water may be detected by making the suspected water acid with a few drops of hydrochloric acid, and then adding a solution of sulphuretted hydrogen, or better still, letting sulphuretted hydrogen gas bubble through the water. If it assumes a brown tint then lead is present. Rain or soft water from leaden roofs, cisterns, or pipes, is very likely to contain lead.

Ammonia is an impurity which should be present only in the slightest possible trace. Its presence may easily be discovered by what is known as "Nessler's test." This may be bought already prepared. Fill a tall, clean glass with water, and stand it on a sheet of white paper; add a few drops of Nessler's solution. If any shade of buff or brown darker than the palest straw colour appear, it must be taken as a bad sign, for the ammonia is produced from decaying organic matter.

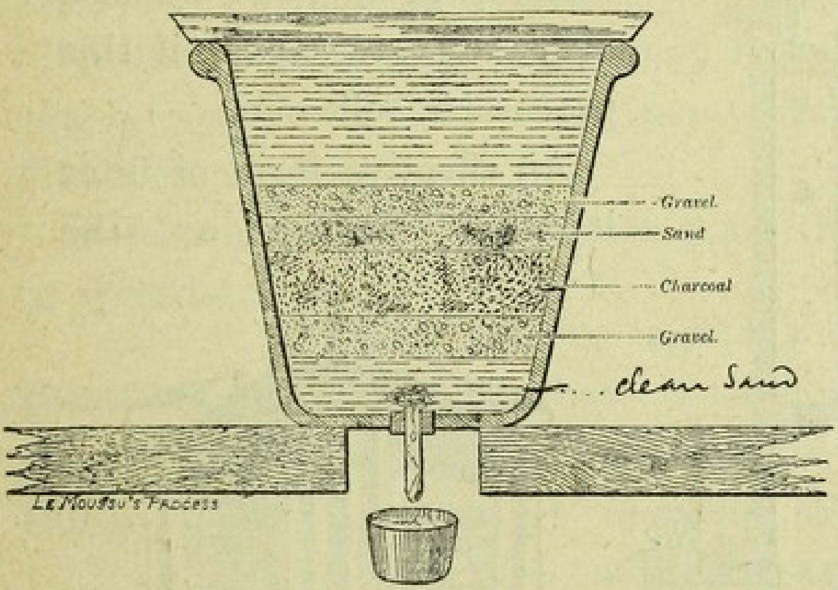
Common salt is in itself harmless. In all places excepting those near the sea, or where the water has come through salt-bearing rocks, there should only be a trace of it present, and if there is more it is a pretty sure indication that the water is contaminated with sewage. The following test may be applied. Fill a glass with water, add a few drops of nitric acid, and then five or ten drops of a solution of nitrate of silver, and agitate. A bluish-white cloudiness indicates that the water may pass, the quantity of salt present not being in excess, but if a solid, curdy-looking substance is formed, the water should be rejected.

Hardness of Water.

The hardness of water sometimes renders it unfit for domestic use. Where the hardness is due to the presence of calcium and magnesium carbonates, it can be got rid of by adding lime to the water. The proper proportion of lime is added to the water, and the whole is allowed to stand for twelve hours' settlement. The process not only softens the water, but it removes, to a great extent, objectionable organic matter that may be present. The waters of Kent and all chalk and limestone districts have to be so softened. Small quantities of water may be effectually softened by boiling for about an hour and a half.

Purification of Water.

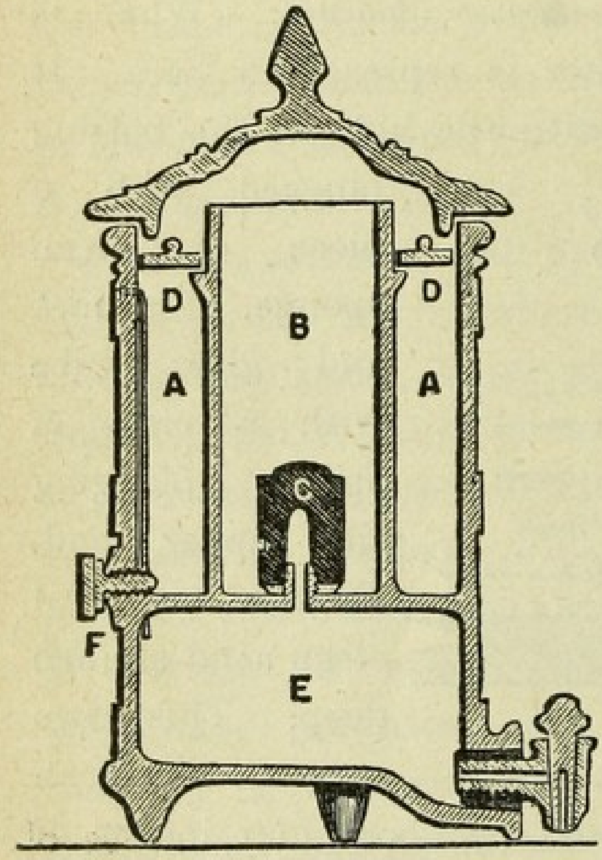
All solid particles may be removed from water by the use of some form of filter. It is not always the most expensive filter that is the most effectual. What is known as the poor man's filter is represented here. It consists of a large flower-pot with the hole at the bottom plugged with a piece of clean sponge, or a cork and glass tube with a piece of sponge plugging the upper end. First a layer of clean sand an inch deep. Then two inches of clean washed gravel. This is covered by about four inches of animal charcoal, then another layer of sand, and at the top one of gravel.



It will be an advantage to separate the various layers by strips of glass. These not only separate the different substances, but have the advantage of preventing the water running through too quickly. The filter can be covered with a wooden lid, or better still, by a large earthenware plate.

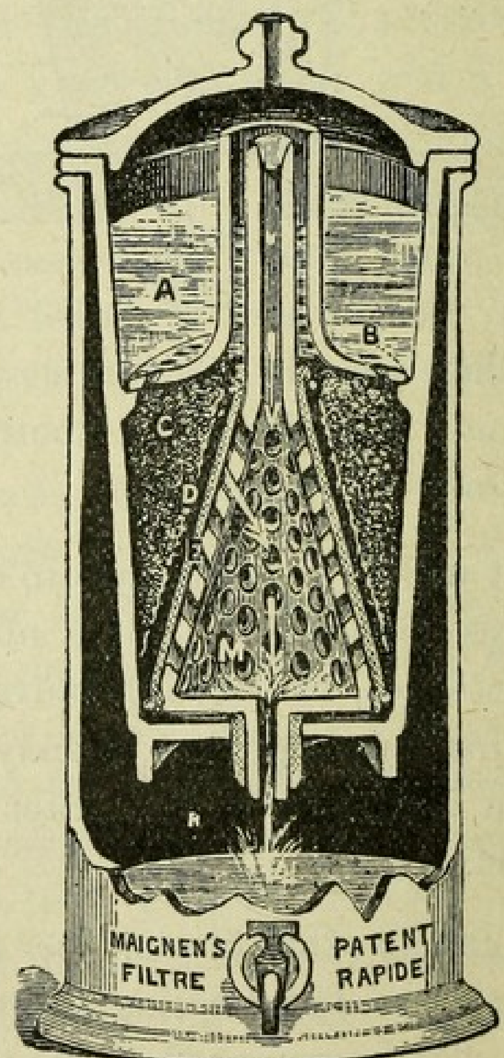
Like all other filters, after a time this will become non-effective. The filtering agents will have become choked by the matter removed from the water, and when in this condition a filter may be a positive source of danger, and thus prove the reverse of what it was intended to be.

When this occurs the substances may all be renewed, with the exception of the charcoal, which should be first boiled, and then thoroughly baked at a good high temperature. The charcoal, which is the most important of the filtering agents, can be used over and over again if this process is followed.



GRANULAR CHARCOAL FILTER.

An effective form of filter is that known as the Granular Charcoal Filter, manufactured by Messrs. Doulton and Co. The filtering medium is a carbon block (C), through which water is filtered into the reservoir (E). After a time the pores of the carbon block get choked, and the filter is no longer doing its work. The block can now be unscrewed, thoroughly scrubbed, boiled, and then baked, as in the case of the charcoal in the poor man's filter.



A very effective filter is that known as the Filtre Rapide. The sketch shows the general arrangements. The filtering material is shown at C and D, and consists of what is known as Maignen's Patent Carbo Calcis. This filter will require cleansing from time to time, and this is accomplished by removing the used-up Carbo Calcis, and replacing it with a fresh quantity. Another most excellent filter is that known as the Spongy Iron Filter. These are simply given as typical of the many various and effective filters on the market.

In securing a filter the following are the principal points to consider :—

Qualities of a Filter.

The filtering agent must be of such material that it cannot possibly impart anything from itself to the water.

It must be able to remove organic impurities as well as any suspended particles in the liquid.

It must not be so complicated that the user cannot readily take it to pieces for cleansing and readjust it.

The gravel and sand remove all suspended matter, whilst the charcoal removes a large quantity of dissolved organic matter as well as mineral salts. It is, however, only thoroughly effective in doing this when fresh and clean, hence the necessity for frequent removal and washing and drying.

Spongy iron has similar properties to the charcoal.

Properties of Water.

Without going into the general properties and characteristics of water, it will be interesting to note a few of them and their contrast with alcohol, from which it will be seen that the two liquids, whilst very much alike in appearance, are the antipodes of each other in many of their properties.

Water.	Alcohol.
Boils at 212°.	Boils at 172°.
Freezes.	Does not freeze.
Will not burn.	Burns easily.
Puts a fire out.	Makes the fire burn more fiercely.
Has no odour.	Has etherial odour.
Has no taste.	Has burning taste.
Cools and refreshes the skin.	Burns and inflames the skin.
Necessary to life.	Unnecessary to life.
Makes a seed to grow.	Kills the seed.
Softens all foods.	Hardens all foods.
Is itself a food.	Is a poison.
Will not dissolve resin.	Easily dissolves resin.

The Way in which Water should be Used.

A great deal depends on the way in which water is used, for the effects vary according to the manner in which it is drunk. If a large quantity of cold water be swallowed at a draught, it is very likely to produce ill results, and copious drinking should always be avoided. Thirst can always be better assuaged by drinking slowly very moderate quantities, and the best method is to sip water. Experience and experiment both teach that sipping is a powerful stimulant to the circulation. A glass of water quietly sipped will have the effect of quickening the heart's beat, increasing the circulation, and increasing the flow of the bile.

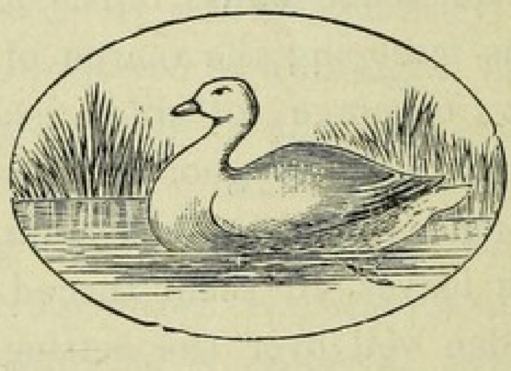
From the medicinal point of view water is of value, for it is found that in cases of faintness, palpitation, stomachic pain, and colic, relief is almost certain if water either alone or sweetened be taken as hot as it can be conveniently swallowed, but in this case it must not be taken at a draught, it is essential that it should be sipped.

Paul Denton on Water.

We cannot do better than close the chapter with the following poetical utterance by Paul Denton: "Where is the liquor which God the Eternal brews for all His children? Not in the simmering still, over smoky fires, choked with poisonous gases, and surrounded with the stench of sickening odours and rank corruptions, doth your Father in Heaven prepare the precious essence of life—the pure cold water. But in the green glade and grassy dell, where the red deer wanders, and the child loves to play; *there* God brews it. And down, low down in the deepest valleys, where the fountains murmur and the rills sing: and high upon the tall mountain-tops, where the naked granite glitters like gold in the sun; where the storm-cloud brews, and the thunder-storms crash; and away far out on the wide wild sea, where the hurricane howls music, and the big waves roar; the chorus sweeping the march of God: *there* He brews it—that beverage of life, health-giving water. And everywhere it is a thing of beauty—gleaming in the dewdrop; singing in the summer rain; shining in the ice-gem, till the leaves all seem turned to living jewels; spreading a golden veil over the setting sun, or a white gauze around the midnight moon.

Sporting in the cataract; sleeping in the glacier; dancing in the hail-shower; folding its bright snow curtains softly about the wintry world; and weaving the many-coloured iris, that seraph's zone of the sky, whose warp is the rain-drop of earth, whose woof is the sunbeam of Heaven; all chequered over with celestial flowers, by the mystic hand of refraction.

Still, *always* it is beautiful, that life-giving water; no poison bubbles on *its* brink; *its* foam brings not madness and murder; no blood stains *its* liquid glass; pale widows and starving orphans weep no burning tears in *its* depths; no drunken, shrieking ghost from the grave curses *it* in the words of eternal despair; speak on, my friends, would you exchange it for the fiery alcohol?"



MILK.

SOME PROPERTIES AND CHARACTERISTICS.

CHAPTER IV.

WHILST the consideration of milk forms a proper part of a study of the beverages in common use, it might equally well form a part of the study of foods, for milk is more than a beverage, it is one of the best and one of the most perfect of foods.

All varieties of milk, whether human, from cows, asses, goats, camels, etc., possess the same general properties. The quantities and qualities of the constituents vary with each kind ; indeed, there are immense variations in different samples of the same kind, but still they all possess the same general constituents.

Prior to the year 1600 milk was said to be composed of three substances only, serum, butter, and curd. In 1619 a fourth substance was discovered by a chemist named Bartoletus, which he called the manna of milk. A much more complete investigation of the properties and constituents of milk was made by a celebrated chemist named Boerhave, in the early part of the eighteenth century. Further investigations were made by Votelenus in 1779, and by Schoepft in 1784, and continuously up to the present time investigators have been at work throwing more light upon this important study. At the present day the complete and thorough analysis of milk shows it to be an extraordinarily complicated substance, for whilst consisting primarily of fat, casein, milk sugar, mineral salts, and water, these in turn are composed of at least twenty-nine different substances. For instance, the milk fat is found to be made up of oleine, stearine, palmitin, butyrin, caproin, capyrilin, and rutin in definite and measurable proportions, whilst the mineral salts consist of potassium oxide, sodium oxide, calcium oxide, ferric oxide, phosphoric acid, chlorine and magnesium oxide.

It is not our province to enter upon a scientific study of so complicated a substance, and the fact is only mentioned to call attention to the marvellous way in which food substances are constituted, so that they may be of service to our equally marvellous and complicated bodies.

Quantity of Milk used.

When it is remembered that milk, besides being used as a beverage pure and simple, forms some part certainly of two meals and often of a third, the importance of knowing a little about it becomes apparent. The great majority of people use milk at breakfast and tea, and it enters very largely into the dinner meal in the shape of milk puddings, etc., and often finds a place on the supper table. It is evident that a vast quantity of milk must therefore be used every day to supply the millions of families requiring it. The value of the milk consumed in the United Kingdom reaches the enormous total of £35,000,000 per annum, or about £607,300 per week. One of the greatest wonders of modern times is the vast and complete organization by means of which the cows are fed and tended, the milk obtained and measured, and the transit carried out to dealers and distributors, who in their turn, with unfailing regularity, deliver it at the doors of the consumers.

Dr. Edward Smith, in writing on this question, says:— "That although the quantity of milk consumed in this country as a whole is considerable, it is small when compared on the basis of population, and even milk-consuming people like those of Cheshire, take little as compared with the inhabitants of many other countries. The peasantry of Sweden and Norway, of Switzerland and the Tyrol, the Bedouin of Arabia, the people of Kurdistan and other mountainous countries of the East live in a great part on milk, and are said to take from four to seven pints a day per man, whilst the same is true of the wandering people found on pasture lands bordering the great Sahara. The inhabitants of the Western States of America, as of all newly-peopled countries, take it largely, whilst it is found that the weekly consumption of the labouring classes in the United Kingdom amounted to only 32 oz. in England, 85 oz. in Wales, 125 ozs. in Scotland, and 135 ozs. in Ireland, or from one quarter to about one pint per head per day."

One of the best evidences of the value of milk as a nourishing food is the constant and growing use of it in our hospitals, and resulting in a constant lessening in the use of malt liquors and other alcoholic beverages. In twenty-two of the London hospitals the total milk bill reaches the immense sum of considerably over £10,000 per year.

Constituents of various kinds of Milk.

Average samples of various kinds of milk on analysis do not show very wide differences, and it might at first be thought that any kind would be as good for use as another. Taste and flavour and general suitability however must be taken into account, and when this is done, it is found that for general purposes of every day use, the milk of the cow stands unrivalled. It is agreeable to the taste, and has none of the disagreeable qualities that may be present in other varieties. It has a fuller flavour than the milk of the mare or the ass, and it lacks the strong flavour of that of the buffalo or the goat, whilst it is less surfeiting than that of the sheep.

The following table shows the general properties of the various kinds :—

Kind of Milk.	Water.	Total Solids.	Nitrogenous Compounds.	Sugar.	Fat.	Salts.
Goat	86·51	13·49	3·51	3·69	5·68	0·61
Sheep	83·23	16·77	6·97	3·96	5·13	0·71
Mare	90·43	9·57	3·33	3·29	2·43	0·52
Ass	89·01	10·99	3·56	5·04	1·85	0·54
Woman ..	88·98	11·02	3·92	4·31	2·66	0·13
Cow	86·41	13.59	5·52	3·8	3·61	0·66

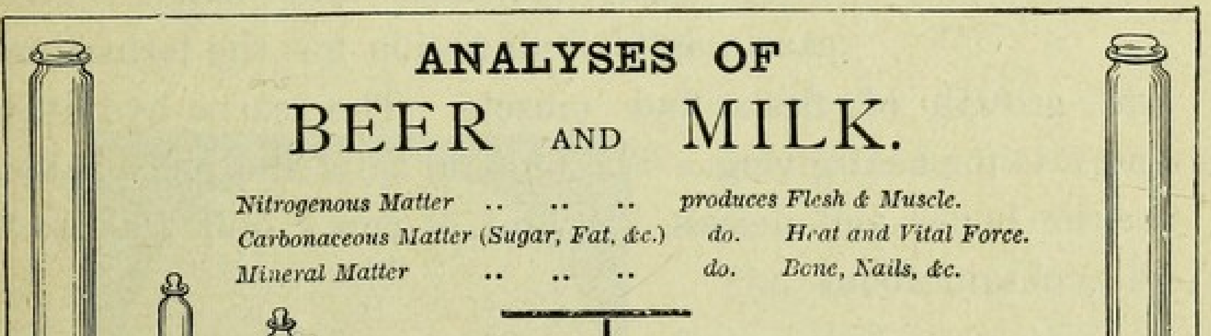
One of the most noticeable things in this table is the superiority of cow's milk over woman's milk in the matter of mineral salts. It may be interesting to see what these salts consist of.

In one hundred parts of salts from cow's milk there are :—

Potash	18·82
Soda	11·58
Lime	22·97
Ferric Oxide	·06
Chlorine..	16·23
Magnesia	3·31
Phosphoric Acid	27·03
	100·00

Milk and Beer compared.

It is astonishing how mistaken public opinion may be in regard to the value of the substances in general use. Take for instance the immense reputation that beer and malt liquors have with large sections of the populace, and the vast quantities of them that are consumed in comparison with milk. As nutritious articles,



beer and other malt liquors are hardly worth consideration. A reference to the pictorial analysis here given will show at a glance the respective values of beer and milk. The proportion of water in each may be taken as the same. The food value of the alcohol in the beer is *nil*, so that the contrast lies in the other constituents, and it will be seen that whilst milk is well off for nutrient quality, in about the proper proportions for use by the body, the beer is sadly lacking in that respect. If more good milk were used and less beer, we might hope to see a nation growing in stature and physique, as we should certainly see a marked diminution of poverty and disease. Nothing perhaps can present a more degraded picture than a beer-sodden man, and nothing can be more pitiful to see than the weak and puny offspring of parents who are addicted to its use.

Food Value of Milk.

Milk contains all the four classes of aliment necessary to health—proteids, fats, carbo-hydrates, and salts. The casein and albumenoids for the formation and growth of flesh and muscle. The carbo-hydrates and fats for heat-giving. The mineral salts and phosphates for the bones and nerves. A pint of cow's milk (20 ozs.) will contain about

	350	grains of	Casein.
	324	,,	Fat.
	420	,,	Milk Sugar.
	61	,,	Salt.
Total ..	1,155		

This amount would be equal to 2½ ozs. of water-free food, and as an average adult requires 23 ozs. of such food per day, about nine pints of milk would be necessary to give this amount of nourishment.

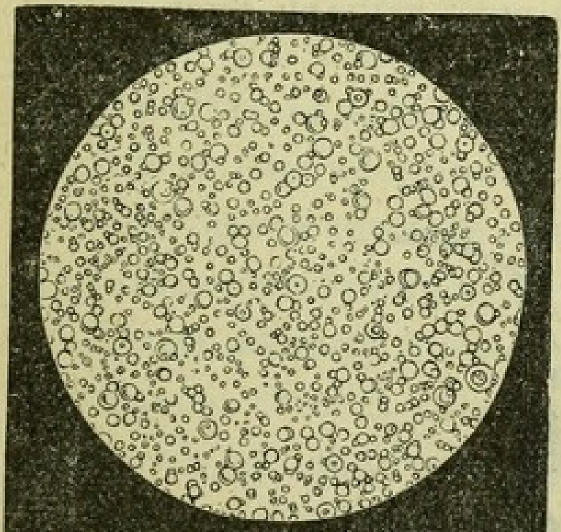
A comparison between the food values of milk, cream, and skim milk will be an advantage as showing the manner in which the constituents are altered.

	Water.	Proteids.	Fats.	Carbo-Hydrates	Salts.
Milk	86·8	4·0	3·7	4·8	0·7
Cream	66·0	2·7	26·7	2·8	1·8
Skimmed Milk ..	88·0	4·0	1·8	5·4	0·8

A standard daily diet for a man weighing 150 lbs. in ordinary work has been calculated by Moleschott as follows :—

Proteids	4·59 ozs.
Fats	2·96 ,,
Carbo-Hydrates	14·26 ,,
Salts	1·06 ,,
Total	22·87 ,,

This would give a total of nearly 23 ozs. of water-free food.



X 100

THIN LAYER OF MILK MAGNIFIED, SHOWING BUTTER GLOBULES.

The fat in milk is in a form that can be most readily digested. It is an emulsified fat as compared with the fats contained in solid foods.

When a very thin layer of healthy milk is examined by the microscope, the milk fat can alone be seen and appears in innumerable globules, the number of course depending on the richness of the milk. It has been estimated that a cubic millimetre of milk may contain as many as 2,000,000 globules of fat. The disadvantage of using skimmed milk, although it may be perfectly sweet and good, is that a large proportion of the fat has been removed, and the food value of the milk is lessened accordingly.

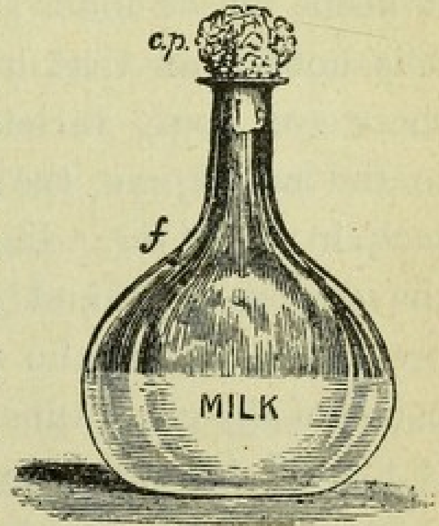
Calculations have been carefully made of the value of foods. Just as the engineer calculates how much heat may be got from coal, and how much force and energy in the shape of steam may be obtained from each pound of coal used, so similar calculations have been made in regard to food. Ten grains of new milk when consumed in the body produce sufficient heat to raise 1·64 lbs. of water 1° F, which is equal to lifting 1·266 lbs. one foot high. One ounce of new milk when oxidised in the body will develop sufficient energy to raise 27 tons one foot high. We may rest assured that if the milk supply be good and sufficient, that it is not only a highly desirable form of beverage, but in addition, it is a most valuable food.

MILK—*continued.*

PRESERVATION OF MILK.

CHAPTER V.

IT has long been ascertained that the principal factor in the turning sour, or the fermentation of substances is the action of something which falls upon, or enters the substance and there sets up putrefactive action. The experiments of Pasteur, Tyndall, and many other investigators, all point to the important fact, that if we can adopt some means of preventing the entrance of any germs and ensure the killing of all the germs that may already have entered the substance, then it can be preserved in a sound and wholesome condition for an indefinite period. Such a process would be called sterilization. As an illustration of this; if some milk is placed in a flask and is then brought up to boiling point and whilst still at this temperature,



f. FLASK.
c.p. COTTON PLUG.

a plug of cotton wool or of asbestos fibre, is somewhat loosely placed in the neck of the flask, it will be found that the milk may be kept sweet for several years. The cotton wool or asbestos must have also been heated to a high temperature for some time and plugged into the flask whilst still hot. The milk will thicken, owing to the evaporation of water, the longer it is kept, but there will be no putrefaction so long as the liquid is preserved from infection of the germs.

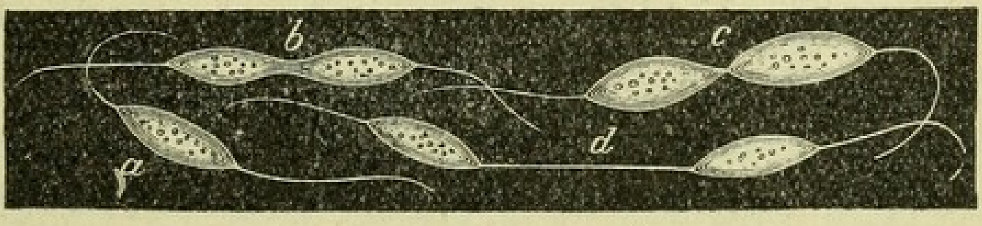
Another Method of Preservation.

The same result may be obtained by placing some milk in a flask with a long thin neck drawn out in the shape of the letter N, or any crooked form, and boiling. On allowing the milk to cool under proper precautions so as to prevent any germs being sucked in as the liquid cools, the milk may also be kept for a very long time.

In both these cases air has access to the milk, but as it keeps sweet under these circumstances it is proved that it is not the air that is the putrefactive agent. In the air there are many varieties of germs. They are invisible to the naked eye, the largest being less than $\frac{1}{4000}$ of an inch in diameter. In the first case, they are caught in the cotton wool and so their entrance to the liquid is prevented, and in the second case, they are caught in the bends of the glass tube. In both cases the air that enters is filtered from the fermenting agent.

These germs may be compared to seeds, they have no activity, or motion, or growth, or propagation until they enter a suitable medium. In the wool and in the glass tube they are inert and stationary, but once they are allowed to enter the milk they spring into life and activity and propagate at a wonderful rate.

Fermenting Germs. There are two distinct organisms which are capable of producing fermentation in milk. They are known as the *Bacterium lactis* and the *Bacterium butyricus*. The air of any dairy would be crowded with the *bacterium lactis*, so that all milk in the ordinary way



BACTERIUM LACTIS, WHICH CAUSES SOURING IN MILK.
a, *b*, *c*, *d*. STAGES OF DIVISION.

has already received a supply of the agent which, in a few hours more or less according to temperature, will ensure its turning sour. A curious thing about these two ferments is, that they prevent the growth of one another, so that if a large number of one be present it is impossible for the other to take effect. Neither of these germs are directly associated with disease. They simply act chemically upon the milk with the formation of Lactic acid or Butyric acid, both of which render the milk unfit for food.

Objectionable Preservation. As some lapse of time must occur between the milking of the cows and the delivery at the doors of the customers, it is not surprising that in warm weather when the fermenting agents act more rapidly than in cold weather, the keeping of milk sweet creates a great difficulty. To overcome this and to prevent the great loss of milk that might otherwise take place, many antiseptic preparations are in use. They are all, however, objectionable. It is true that in the presence of such preservatives the work of the fermenting agents is retarded and the milk is kept sweet, yet their addition renders the milk hurtful to the consumer. Many of these antiseptics have for their base such substances as boric acid, salicylic acid, benzoic acid, cinnamic acid, formaline and others, all of which are prohibited under the Foods and Drugs' Act and are noxious adulterants. They are difficult of detection, as neither the colour, odour, or the taste of the milk is affected by them. In a recent case before the Birmingham Court, in which a dealer was fined, the analysis showed that the milk he was serving to his customers contained 20 grains of boric acid to the gallon.

A much more constant examination of milk supplied during the summer months should be made, and dealers should be rigorously punished for using any of these preservatives to the detriment of the user.

Proper Preservation.

For the comparatively short time necessary to cover the period from milking until the milk reaches the consumer, no artificial preservative is necessary if proper precautions are taken to keep the milk perfectly cool. Just as meat may be preserved for a long period without actually being frozen, so milk can be kept for some time, certainly longer than that necessary for its transit in the ordinary way by the application of cold.

Condensed Milk.

The consumption of condensed milk has assumed gigantic proportions. The Board of Trade returns for 1896 show that the total in that year was 611,335 hundredweights, of a value of £1,170,352. The Anglo-Swiss Condensed Milk Company is said to use the whole of the milk supply of 40,000 cows. It is computed that London alone uses 10,000,000 tins of condensed milk annually.

There are a variety of condensed milks on the market at the present time; some use the milk of cows and others of goats. Some have the addition of sugar, and others not, and whilst there may be slight differences in the methods of manufacture, there is one great principle underlying them all. They are dried in vacuo up to a certain point, and then heated to a high temperature, in some cases mixed with cane sugar, and sealed hermetically in tins.

Otto Hehner gives the following comparative analysis of the constituents of various condensed milks :—

Name of Milk.	Water.	Fat.	Albuminoids.	Milk. Sugar.	Cane Sugar.	Ash.	Milk Solids not fat.
Anglo-Swiss	24·94	8·90	9·68	13·29	41·24	1·95	24·92
Norwegian	28·85	9·21	8·98	14·14	36·74	2·08	25·20
Helvetia	25·29	7·19	11·73	13·01	41·04	1·74	26·48
Gerber & Co.	23·68	9·74	9·80	12·93	41·80	2·05	24·78
Nestlé's	15·30	8·85	9·98	13·62	50·08	2·17	25·77
Mean of 10 Analyses of American Condensed Milk (no cane sugar) made by C. F. Chandler	48·59	15·67	17·81	15·40	—	2·53	35·74

It will be at once seen that these various productions are in themselves good, especially when it is remembered that the process of manufacture ensures a freedom from many of the dangers of contamination that are necessarily present in the case of ordinary milk.

How Condensed Milk Should be Used.

The proper use of condensed milk is but little understood by the vast majority of those who use it for the purpose of feeding infants. Very many mothers, especially of the poorer class, have an idea that a tin of condensed milk has enough food for an infant for a week. Now, roughly speaking, a tin of condensed milk contains an amount of fresh milk equal to about three pints of ordinary milk to which has been added about six ounces of cane sugar. To obtain from this tin a fluid of the same nourishing value as ordinary milk, at most two and a half pints of water should be added, or for infant feeding double that amount. Generally, however, a spoonful, and often less, is used to half a pint of water, resulting in a dilution that is absolutely a starvation diet.

If this happens with a good brand of milk, how much worse is it with an inferior brand. It is no uncommon circumstance in cases of children dying from want of nutrition for the coroner to be told that the child was fed on condensed milk, and whilst the foolish mother has thought she was feeding the little one she was really starving it. The cheaper brands of milk are prepared from milk that has been skimmed, and has therefore lost a large amount of its nutrition, and after its further extreme dilution before it reaches the child, it is hardly possible for life, certainly not for healthy life, to be sustained.

Uses and Limitations of Condensed Milk.

Dr. C. Gilmore Kerley, Attending Physician to the Babies' Hospital of New York, who has made a study of this question, has arrived at the following important conclusions in regard to the use of condensed milk:—

1. In the artificial feeding of infants, always determine as exactly as possible the percentages of the food constituents.

2. Condensed milk alone is an indifferent substitute for mother's milk, no matter what the age of the infant may be.

3. Condensed milk alone should not be given after the third month.

4. Condensed milk, fortified, may be made an acceptable diet for infants; alone, it is a food upon which a certain number of children exist until age or changed conditions allows of a better diet; and inasmuch as there is nothing to take its place among the very poor, its value to them is inestimable.

Children as a rule, that are wholly brought up on condensed milk are found to lack stamina, and whilst they appear to thrive and to be thoroughly healthy, they succumb far more readily to attacks of the various diseases of childhood than children fed on mother's milk or cow's milk.

Dr. Daly, in a letter to the *Lancet*, giving his experiences, says: "I have observed in a number of cases, carefully watched during the past eighteen months, that whilst condensed milk fattens and children apparently thrive upon it, the vitality of the child is below par to a dangerous degree. As far as my experience goes, it has been invariably the case that children fed upon condensed milk and attacked with diarrhœa at all severely, almost immediately get into a semi-collapsed state. I have observed the same in regard to other diseases, as for instance, measles, whooping cough, and bronchitis."

MILK—*continued.*

DANGERS FROM MILK.

CHAPTER VI.

Fermented Milk.

WHEN milk turns sour lactic acid is formed, but at the same time there is always a very small quantity of alcohol produced. But alcohol cannot be formed directly from either cane sugar or milk sugar; these must first be changed chemically into glucose or grape sugar. Under certain conditions this change can be brought about and consequently milk may become fermented with the production of alcohol.

Koumiss.

The best known of these fermented milks is that called *Koumiss,* prepared by the nomad population of Asia, especially by the Tartars. The Arabians have a somewhat similar preparation known as *Leban*, and the Turks another called *Yaoust.*

A simple preparation of Koumiss is as follows:—Ten parts of fresh warm milk, with a little sugar, are added to one part of the milk which is already sour, and the whole is stirred together, then allowed to rest, and stirred again in succession for three hours. Chemical changes occur, resulting in a partial decomposition of the sugar into lactic acid, alcohol and carbonic acid gas.

The following is an interesting comparative analysis of different kinds of Koumiss:—

Component Parts.	Mean of ten Analyses by König.	Koumiss from Mare's Milk by Fleischmann.	Koumiss from Cow's Milk by Fleischmann.	Koumiss 48 hours old by Wanklyn.
Water	87·88	91·53	88·93	87·32
Milk Sugar	3·76	1·25	3·11	} 6·60
Lactic Acid	1·06	1·01	·79	
Caseine..........	2·83	1·91	2·03	2·84
Milk Fat	·94	1·27	·85	·68
Alcohol..........	1·58	1·85	2·65	1·00
Carbonic Acid....	·88	·88	1·03	·90
Ash	1·07	·29	·44	·66

It will be seen that the preparation contains some proportion of nutriment, and is not of great alcoholic strength, containing, as it does, less alcohol than the weakest beers in use in this country.

Kephir. The mountaineers of Tartary have a special beverage made from cow's milk called *Kephir*. In some respects it resembles Koumiss, but differs from it in the fact that an outside fermenting agent is used, just as a brewer uses yeast in the making of beer.

Kephir is prepared in the following manner:—They fill a leather bag, *burdjuk*, with fresh cow's or goat's milk, and throw in some of the Kephir grains. The bag is tightly tied up, and is exposed to the rays of the sun. From time to time the bag is shaken up. Every passer by deems it his sacred duty to kick the bag, and the children, as a rule, use it as a ball. In from twenty-four to forty-eight hours, according to the season, the Kephir is ready for use. The bag is emptied and filled anew, the same grains being used over and over again. The amount of alcohol produced is generally not more than 1 per cent., and the preparation is looked upon as a nourishing food, and is valued highly by the inhabitants.

As milk forms a part of the daily dietary of the great mass of the community, it is necessary that every precaution should be taken to secure its freedom from contamination. It is one of those substances that can readily become a channel of disease, instead of a sustainer of life as intended by Nature.

There are three great classes into which contaminated milks may be divided :—

1. Those in which the dangerous micro-organisms which are introduced into the milk are conveyed from the body of the cow, such as tuberculosis, anthrax, and acute enteritis.

2. Those in which the micro-organisms are introduced from some other source after the milking has taken place, as cholera, typhoid, scarlet fever, diphtheria.

3. Those caused by milk containing poisonous agents developed by bacterial growth.

As milk is often from between twenty and thirty hours old when it is delivered to the consumer, there is ample opportunity for the milk to become thoroughly contaminated by the growth of the bacterial agents, if it in any way becomes infected.

There is no doubt that care and stringent measures can, to a very great extent, meet this danger, and the greatest possible attention should therefore be paid in the selection of the dairyman or farmer who is to supply the milk. Too often milk is simply left at the door of a house without the slightest knowledge on the part of the consumer of the conditions of the dairy or other place from which the milk has been obtained.

The following remarks of Dr. R. G. Freeman are to the point, and are worth our best consideration :—

" The houses invaded are often widely distributed, and not restricted to some particular part of the town. The houses of the rich are apt to be more seriously invaded than those of the poor, because the poor, as a rule, use little milk. The houses invaded often have the best hygienic surroundings. The special milk-drinkers in each family are most liable to become affected. In more than half of the epidemics, cases of the diseases have occurred among the handlers of the milk prior to the outbreak. A study of the reported epidemics teaches that in cases of communicable infectious diseases inquiry should be made into the source of the milk-supply; milk-traffic should be separated from houses where people live; the dairy should be at least one hundred feet away from the house, barn, or privy, and on a higher level, and should have a pure water supply of its own ; nobody should be allowed to enter the barn or dairy, or handle the milk, who has come in contact with a sick person, the sickness not being positively known to be non-contagious; all persons connected with the milk-traffic should be required to notify the authorities on the outbreak of any disease in their respective abodes, and to abstain from their work until permission to resume is given by the authorities notified; cities should accept milk only from dairies regularly inspected, and where all the cows have been proved by the tuberculin-test to be free from tuberculosis; all tuberculous cows should be killed, and the premises where they have been kept should be thoroughly disinfected; milk should not be kept for sale or stored in any room used for sleeping or domestic purposes or opening into the same."

Adulterations of Milk.

Water is the most common, and generally speaking, the only adulterant of milk. There are two ways in which milk, as used by the consumer, may have more than its proper share of water. First, by the addition of water to the milk. Second, by the abstraction of cream. The milk is rendered not only of less value in point of nutrition, but if the water used is obtained, as it may often be, from unsanitary sources, good milk may be rendered dangerous by the addition of bad water.

Starch has sometimes been added in order to mask the thinness and bluish colour produced by the addition of water, but this is not common. Annatto, glycerine, chalk, soda carbonate, salt, have all been discovered in samples of milk by analysts, but they too are not common.

A practice in vogue amongst unprincipled tradesmen is to separate the cream and add condensed milk to the skimmed milk to give it a body and then sell it as genuine milk. Such a method is called "faking" milk.

The "Foods and Drugs" Act is framed to protect the consumer against these devices, which not only compel him to pay for something that he is not getting, but inflict a great injury on infants and invalids, and others taking milk food, because, instead of getting the nourishing article they require, they are getting something very deficient in that good quality.

A year or two since the *British Medical Journal* made a very exhaustive enquiry into the London milk supply, and the result arrived at was that "unsophisticated milk is practically unknown." Doubtless the conditions that apply to London also apply to other large towns, and if this is so some strong legislative measure is necessary in order to cope with the danger.

There is an enormous temptation on the part of dairymen and dealers to use the various antiseptics that are put upon the market.

In the first place, these preparations are always described as harmless, and secondly, those who use them feel such confidence in their ability to kill bacteria that they do not pay that extreme and close attention to the cleanliness of the dairies, the vessels, and the surroundings, which is necessary, and in the third place, not only the dairyman, but the agent, and the town distributor, may all, to save themselves from the loss of the value of the milk, add a little more of the same antiseptic, or some other.

Dr. Otto Hehner on Antiseptics.

Dr. Otto Hehner, Past President of the Society of Public Analysts, has given a vast amount of attention to this subject, and has spoken some very weighty words that should command the attention of every one interested in the purity of our food supply. He says, " The indiscriminate addition of chemical substances which exert a poisonous action on bacterial and other organisms cannot safely be left in the hands of more or less ignorant vendors of food. It is evident that substances which interfere with the growth of fungoid organisms like bacteria, must have some action upon the complicated human animal ; and even if exuberant health and abundant gastric secretions may be capable many times to overwhelm the effect of the antiseptic, the effect itself must remain and detract from the efficiency of the human organism. The effect is evidently a question of quantity. The absolute quantity may not be sufficient to show itself palpably upon a body weighing, say, $1\frac{1}{2}$cwt., but it must be there all the same. As a matter of fact, good milk can be sold without antiseptics, and has been so sold, until sham science came in and taught the dirty and careless producer how to evade the natural punishment of dirt and mismanagement. I object to be physicked indiscriminately by persons not qualified to administer medicine whilst I am in health. I object still more when I am ill; I object still more to have my children physicked in their milk, or their bread, or their butter. It is no consolation to me to know that the physic is not immediately fatal or even violently injurious."

Colonel Mr. Charles C. Cassal, a Fellow of the Institute of Chemistry and a Public Analyst, has met with cases where a mixture of boric acid and borate of soda has been employed in the proportion of at least seven grains of the solid substance to one pint of milk, and he points out that the medicinal dose of the acid, as laid down in the British Pharmacopœia, ranges from five to thirty grains, and two and a half grains would be a suitable dose for a child under one year. It is quite possible that a strong healthy child taking a quart of milk daily might absorb as much as twenty or twenty-five grains in the time.

A much more rigid and exact inspection of milk is imperatively required to guard the public health, for whilst boiling the milk will effectually kill bacterial growth and thus preserve the human body from that danger, the boiling has no effect on these antiseptics, and there is no safeguard to the consumer against them.

at Lambeth Police Court in a prosecution re Colmans Rice Cornflour the magistrate said "I cannot think why this witness was ever called." Col Cassal has since died!

TEA.

HISTORICAL NOTICE AND FACTS.

CHAPTER VII.

"The Muses' friend, Tea, doth our fancy aid
Repress those vapours which the head invade,
And keeps that palace of the soul serene."

EDMUND WALLER.

OF all the beverages in common use tea is certainly one of the most important. Not only on account of the extraordinary development of its use and of the remarkable place it takes in the commercial and social relations of everyday life, but also because of its chemical and physiological properties is it deserving of our consideration. It seems a little astonishing perhaps, when we learn that tea and coffee may be classed with alcohol and foods containing volatile oils, but such is the case. They all have constituents which act upon the nervous system, and hence they are classed as food substances acting upon the nerves. The important point to remember is that they do not all act in the same way. As a matter of fact tea and coffee are antagonistic to alcohol, for whilst the latter acts upon the nerves as an excitant, and promotes excessive action, tea and coffee act upon the same nerves in an entirely opposite manner, namely that of soothing and quieting. In other words they are sedatives, and produce a sense of repose without being depressing.

Historical Notice.

The mighty nations of old, Egyptians, Assyrians, Persians, Jews, Romans and Greeks, knew nothing of tea, and prior to the seventeenth century it was entirely unknown as an article of diet in Europe. The Dutch seem to have the credit of first bringing it from the East in 1610, and mention is made of its having been used in England on very rare occasions prior to 1657. About that time the use of tea seems to have been adopted amongst the wealthy and to have gradually spread to the gigantic proportions of the present day, when it is estimated to be in use by at least a fifth of the population of the world.

Samuel Pepys, in his famous diary, records the fact that he tasted his first cup of tea on the 25th September, 1660, and we may judge something of its rarity and of its being a great luxury by the fact, that it was sold at that time at prices varying from £6 to £10 the pound. In the same year an Act of Parliament was passed levying a duty of 8d. on every gallon of tea that was made and sold.

The East India Company finding a growing demand, took up the trade and began to import it in 1669, when the price had come down to about 60 shillings the pound. We do not hear of green tea until 1715, and a few years later in 1728 the use of tea had so much grown that its price was further reduced to 13s. to 20s. the pound for black tea and 12s. to 30s. the pound for green tea.

It was the duty imposed on tea in the British Colonies of America, in 1767, that occasioned a few years later the destruction by the people of 17 chests at New York and 340 chests at Boston, in December, 1773, and ultimately led to the American War.

The first tea plant was brought to England in 1768. In 1779 tea dealers were obliged to have sign boards fixed up announcing that they were licensed sellers of tea. These licenses were abolished in the year 1869.

The duty on tea which rendered its use almost prohibitive in 1784 was gradually reduced until in 1836 it stood at 2s. 1d. per pound. In 1857 a reduction was made to 1s. 5d. per pound, in 1865 to 6d. per pound, and in 1890 to 4d. per pound, at which it stands at the present time.

Consumption of Tea.

The East India Company in 1664 ventured to give an order for two pounds two ounces of tea for presentation to His Majesty the King. In 1667 they ventured upon the large order of 100 lbs., but in 1678 the demand had become so great that they imported in that year 4,713 pounds.

In 1830, in evidence given before the House of Commons, it was stated that the consumption of tea by the whole civilized world exclusive of England was computed at 22,000,000 of pounds, while the annual consumption of Great Britain was 30,000,000 pounds.

The growth of the consumption of tea is indicated in the following table.

1726	..	..	700,000	pounds
1766	..	..	7,000,000	,,
1810	..	..	25,000,000	,,
1850	..	..	50,512,384	,,
1861	..	..	96,577,383	,,
1870	..	..	141,020,767	,,
1880	..	..	206,971,570	,,
1890	..	..	223,494,511	,,
1893	..	...	249,546,451	,,

whilst the total value of the tea imported into Great Britain in 1896 reached the enormous sum of £10,562,773.

For an article of consumption to grow at this great rate and to assume such proportions, there must be something in it that just suits the appetite and the condition of the people at large, and such consumption cannot be without its influence on the National life of the country.

In comparing the prices charged per pound for tea in its earliest days it is interesting to note that even now, fancy prices are sometimes realized for certain packets of famous and rare tea. In 1891, a consignment of tea from the Gallebode estate in Ceylon was sold at the rate of 87s. the pound in January, and was re-sold at 110s. per pound. Other samples of Ceylon tea were sold in the same year at high prices on March 10th, £10 12s. 6d. per pound. On May 5th, £17 per pound, and one on May 7th, fetching the unique price of £25 10s. 0d. per pound.

Legendary Origin of Tea Plant.

It may well be asked, how did mankind first discover the wonderful properties of a plant which finds such universal favour, and under what circumstances did it come into general use? We must turn to Chinese sources for this information, and according to their most authentic historians, and these are not much to be relied upon, the tea plant was a native of Corea, and was introduced into China in the eighth century. There receiving the approval of the Emperor, who much relished its infusion, it soon became popular with the masses. This may or may not be fact, and whether it is or not, it is not the accepted idea as to the discovery of the tea plant. It is far too prosaic a story to find popular favour in China.

The story that is believed, is that about the year 510 A.D. a very good man, full of religious zeal and pious works, in order to set an example to others, imposed upon himself many mortifications of the body, abstaining from rich and luxurious foods, foregoing many comforts, living mostly in the open air, and devoting himself to preaching and spreading a knowledge of God. Amongst other things he made a vow that he would not sleep until he had offered worship at a certain shrine. Having started upon his journey, for a long time he toiled in the day and watched during the night, but ultimately overcome by bodily suffering and exhausted nature he unfortunately fell asleep. So distressed was he at having broken his vow that in a fit of remorse, and to prevent any repetition of such backsliding, he cut off both his eyelids and flung them upon the ground. Returning by the same road, after having paid his devotions at the shrine to which he had been journeying, he came to the spot where he had thrown his eyelids, when, to his amazement, he saw two tiny plants, the like of which had never been seen before. Connecting these with some miracle in reference to his eyelids, he carefully took them home and cultivated them.

Having eaten of some of the leaves he found his body exhilarated and his vigour restored, and he therefore recommended his followers to use these leaves for similar purposes. From these, the use gradually grew and extended over the whole of the Celestial Empire.

Literal Origin of the Use of Tea.

There is no definite history on the subject and the discovery of the dietetical value of tea has been variously described. The probability is that it was first used as a medicine. Its pleasant aroma, and its palpable soothing effect upon the nervous system, together with its grateful palatability, would probably lead to its gradually being used for food instead of a medicine.

Dr. E. Lankester says " there may be good physiological reasons assigned for the use of tea. In the first place the waters of China are universally bad, and are only safe for drinking after they are boiled ; they are also flat and tasteless ; thus the demand for water in the system would be more pleasantly met by an agent like the infusion of tea. In the next place the practice of taking warm drinks is a great economy when people live on a scanty diet, and this added to the preservative effect of tea upon the tissues would lead to the use of tea. Before the introduction of tea into this country, our forefathers were in the habit of using various kinds of infusions which were drunk warm as we do tea. In this way sage was at one time extensively employed in this country, and its leaves were actually originally taken by the Dutch to China as an exchange for tea."

It is evident that warm drinks seem to be everywhere grateful to man, and this fact alone would account for the desire to seek those leaves or berries from which a pleasing and acceptable infusion could be made.

The use of the infusion of the leaves of tea as a beverage is general in the south-eastern parts of Asia, amongst the British at home, and in all their colonies, amongst the Americans and the Dutch, whilst it is also largely used in the other countries of Europe and in India and Ceylon.

TEA—*continued.*

CULTIVATION AND PREPARATION.

CHAPTER VIII.

"In far Cathay is Adam's line,
A peaceful and a sober race;
Uncultur'd there the vaunted vine—
A growth more blest supplies its place.
Though scorned the world's purveyors they; and we
Dismiss our wine for China ware and tea."

THE tea plant is an evergreen shrub belonging to the same family as the camellias. The art and the skill of the cultivator, together with climatic conditions, give many varieties of what is really the same plant. There is only one species of tea plant. Tea for domestic use is cultivated not only in China, but in Ceylon, Corea, Japan, and in certain districts of India. The plant may be called sub-tropical, although it is so hardy and ready to adapt itself to climatic conditions that it bears a tropical climate well, and it has been known to endure the frosts of an English winter in the neighbourhood of London without protection. The tea shrub (*Thea Sinensis*) when growing wild often reaches twenty to thirty feet high, but in a state of cultivation it is kept to between five and six feet in height. Probably there is no other country where the conditions of its growth are quite so perfect as they are in certain districts of China. Opinions will of course differ, but many experts hold that there is no tea possessing the same fine flavour as that which is produced and dried in China.

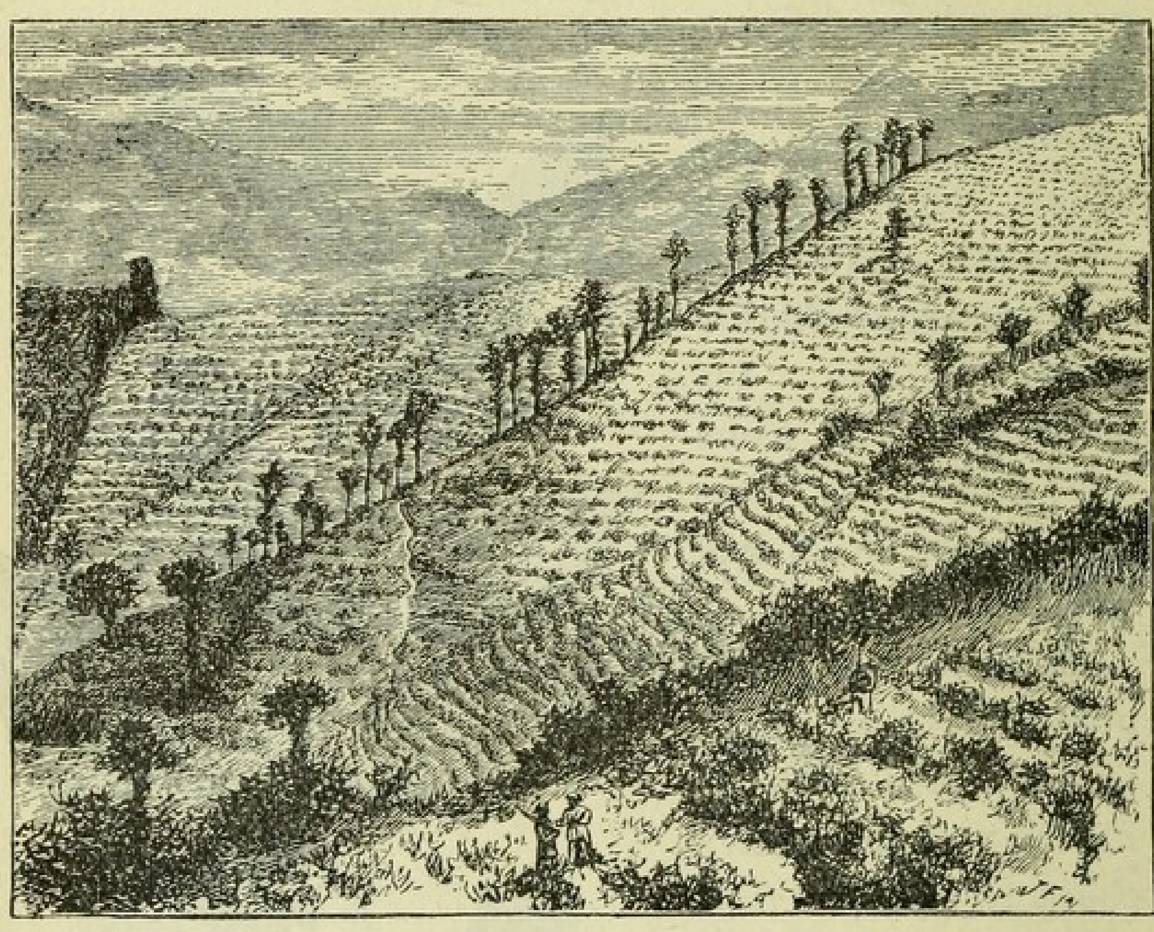
TEA PLANT.

Many of the varieties produced have come to be looked upon as having very distinctive characteristics, thus we have *Thea Viridis*, supposed to yield green tea, *Thea Bohea*, formerly supposed to yield black tea; *Thea Stricta* and *Thea Assamensis*, but they are all merely varieties of the same species.

Cultivation of Tea.

The culture and preparation of tea is a subject of great importance, for the development of its properties and flavour are greatly dependent on the care and skill displayed in the growth of the plant. A wild tea plant will not yield tea that can bear any comparison with the cultivated plant.

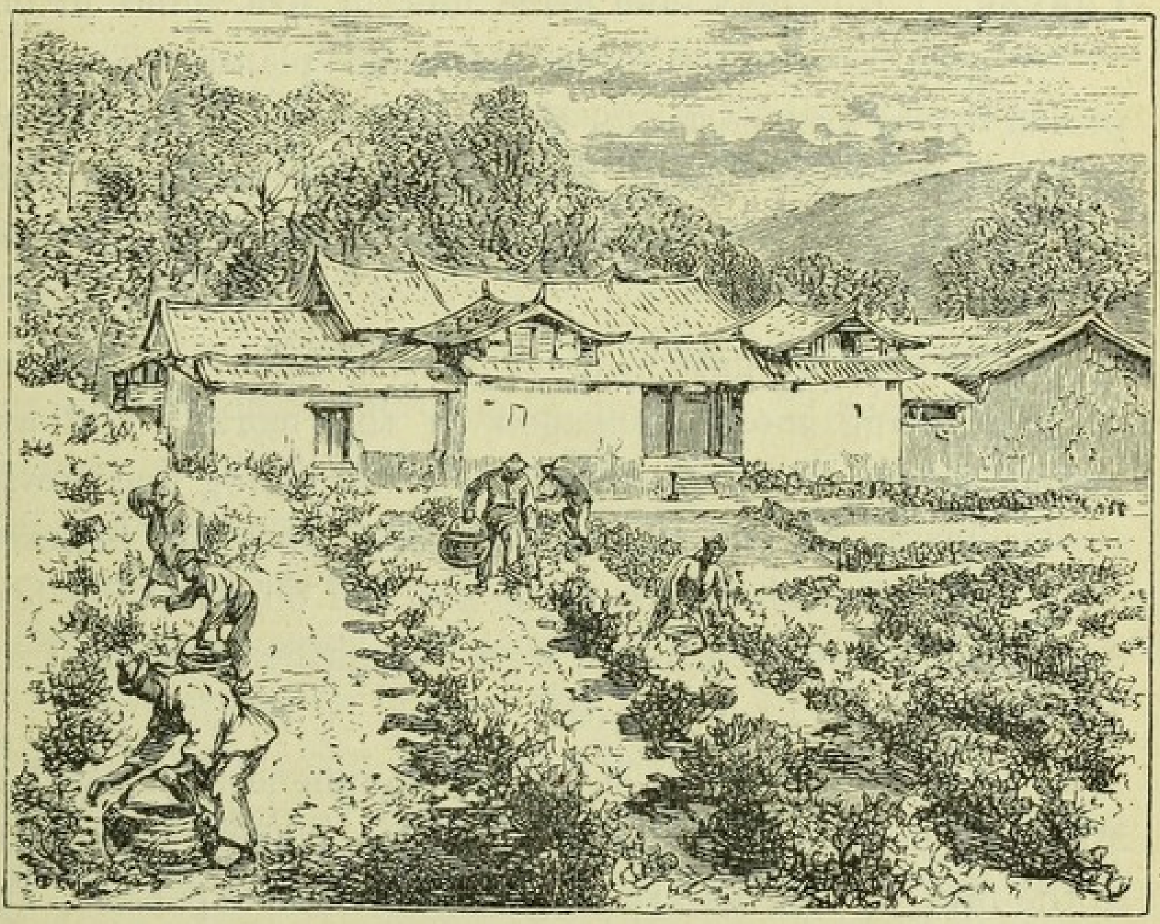
The question of both soil and climate together is of primary importance in the production of a high-class tea.



A TEA PLANTATION IN CHINA.

The soil should be a ferruginous clay or sandstone, and the climate sheltered and sub-tropical. The range of district between the twenty-seventh and the thirty-first degrees of latitude in China is found the most suitable.

The tea farms are mostly in the north of China, and are usually of small size, and like most farms require great attention. The farms always occupy the hillsides, at an elevation extending to 4,000 feet, where the soil is deep and well drained. The plants are grown from seeds, the best of which are selected and from six to ten are placed in holes dibbled into the earth. The young shrubs are planted out in rows at a distance of four feet from one another, and this space has to be well manured and kept free from weeds.



GATHERING LEAVES IN TEA HARVEST.

In some districts plants are raised from layers and cuttings. This is a common practice in South Australia, where the tea plant is being cultivated with considerable success. Each plant will yield at the end of three years about half a pound of raw leaves or about two ounces of manufactured tea, giving an average of about 80lbs. to the acre. Two years more will increase the yield tenfold, being about 1½lbs. of manufactured tea to the plant. By proper attention and careful pruning a plant will yield continuously a good supply of leaves for a period of thirty years.

Gathering the Leaves.

Great importance is attached to the time and manner of plucking the leaves, which may take place four or five times in one season over the same plants. The first picked leaves are chosen for the manufacture of the highest priced teas, and this may lead to the conclusion that the theine of the tea is in larger proportion then than at other periods.

The process of gathering is very simple, women and children being mostly engaged in the work. Old and fibrous leaves are neglected. It is the young and newly-grown leaves at the top of the stalks that are selected, about an inch of the stalk being plucked off with the leaf. A woman accustomed to the work can gather in a day from 16lbs. to 20lbs. of raw leaves.

In China the picking of leaves commences in April or May, and lasts to September. In each picking subsequent to the first, the leaves are larger and more expanded, and consequently harder and more fibrous. As the value of the leaf does not consist in its weight or structure, but in the juices contained in it, and which are at their best just after the rise of the sap, it will easily be understood why the first pickings are the most valued. The greater the development and the age of the leaf, so much the less is its value as a first-class tea.

These earliest pickings of the buds yield what is known as fine young Hyson. Containing as it does a larger proportion of the juices than the older teas, its preparation for use is a matter of difficulty owing to its liability to set up fermentation. It is this tea that is principally reserved for the use of the wealthy Chinese, and some of which is also conveyed overland by caravans in small packets to Russia, it being apt to spoil if conveyed in larger masses such as are carried in the tea ships.

Sorting and Drying Tea.

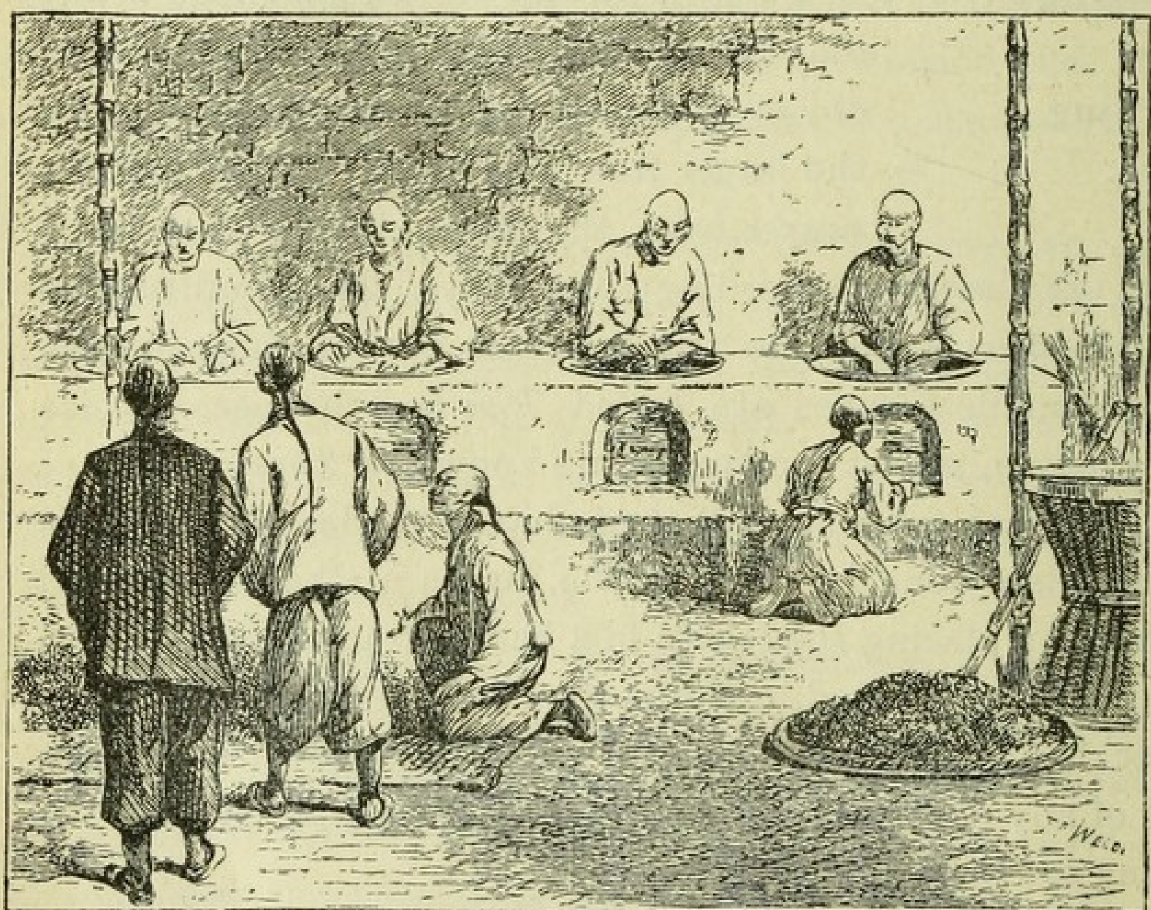
After the pickings have taken place there is much important work to be done before the tea is ready for the market. The object of the sorting is merely to separate the larger from the smaller leaves, and the coarse from the finer kinds. These sortings are classified according to quality. The familiar term *Su-chong* as applied to tea indicates one of these classes. The smallest leaves are called *Pha-ho*, the second size *Pow-chong*, whilst the largest are known as *Toy-chong*.

The next process is that of drying the leaves. This is sometimes done by tossing the leaves in the air, and at others by placing the leaves in a basket frame, wide at both ends and contracted towards the centre, and setting them over hot embers of charcoal. This is done simply to get rid of any excess of moisture, and is quite distinct from the firing or roasting of the leaves.

Roasting Tea.

The sorted and dried leaves are transferred to pans heated with charcoal without the least smoke. The quantity of leaves in each pan is such that it can easily be manipulated with the hands or by gently shaking the pan. It is evident that this roasting process is one of great importance, for chemical and other changes are set up by it, making as much difference between the freshly gathered leaf and manufactured tea as that between fresh grass and hay.

The result of these changes is to produce the flavour, aroma, and taste by which varieties of tea are distinguished. The difference between green tea and black tea simply depends upon the methods adopted during this roasting process.



FIRING AND ROASTING TEA.

For green teas the leaf is placed upon the pan as soon as can be after the gathering. After about five minutes roasting, during which they make a cracking noise, become moist and flaccid and give out a great deal of vapour, they are placed on the rolling table and rolled with the hands. They are then returned to the pans and kept in motion by the hands; in about an hour or rather more they are well dried, and their colour, which is a dull green, becomes fixed.

There are two ways of preparing the black tea. In one, it is roasted in covered pans. The moisture given out by the tea in this case cannot escape, and a kind of fermentation takes place in the pan, resulting in an alteration of the colour of the leaves, the tea produced being called black tea.

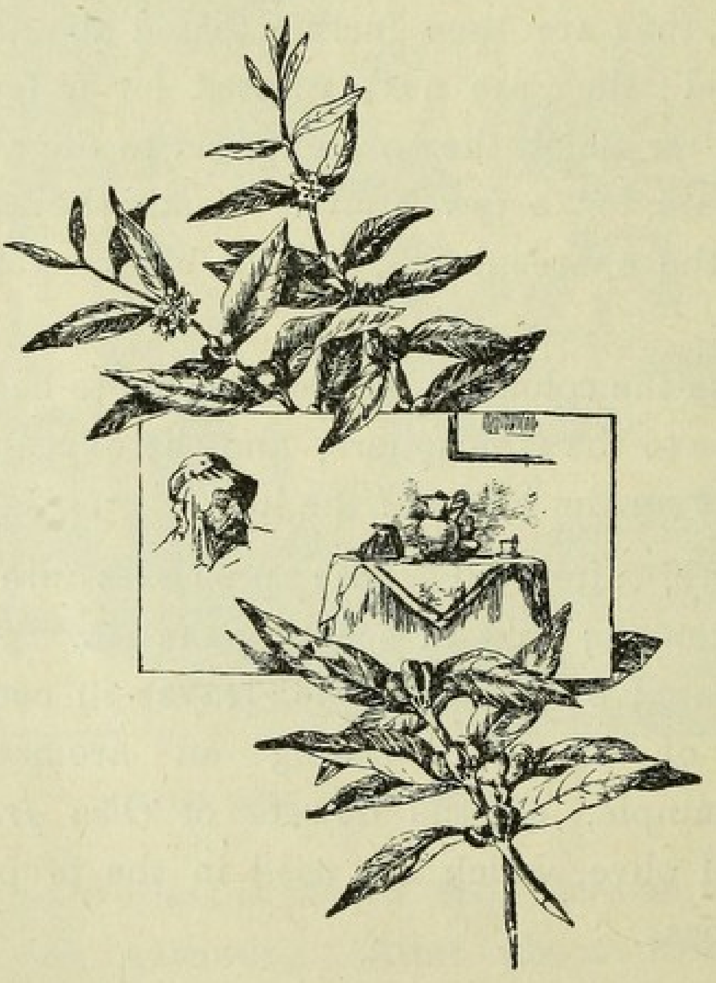
The better black teas are, however, prepared as follows:—The leaves are spread out in the air for some time after they are gathered, they are then further tossed about until they become flaccid; they are next roasted for a few minutes and rolled, after which they are exposed to the air in a soft and moist state for a few hours. Lastly they are roasted slowly over the charcoal fire, till the black colour is fairly brought out.

In this case the colour of the tea seems to be due to the long exposure to the atmosphere, and the oxygen of the air acting rapidly on the juices of the leaf.

Occasionally, after all these processes are finished another is adopted; that of scenting the tea. The flavour is communicated by placing the leaves in contact with the flowers of plants possessing an aromatic odour, such, for example, as the flowers of *Olea fragrans*, or sweet-scented olive, which are used in the preparation of scented Pekoes.

The finally prepared tea is again carefully sorted, by sifting through sieves of different meshes; and by hand-picking, which results in the removal of imperfectly dried and unsightly leaves.

The various names affixed to teas in the country of their growth indicate the quality, but the consumer in this country cannot take advantage of this because of the plan adopted in recent years of blending and mixing teas. Every considerable dealer buys his teas and mixes them according to what he deems best for his customers, and sells them under his own particular names.



TEA—*continued.*

PROPERTIES AND CHARACTERISTICS

CHAPTER IX.

Chemical Composition of Tea.

IT is not to be wondered at that a substance in such wide demand and in such common use, should afford more than usual interest to the chemist, and a knowledge of its constituents cannot be without value to everybody using it. The constituents like those of most organic substances, are of a highly complex character. The following analysis by Mulder shows the chief constituents of various samples :—

	BLACK TEA.	GREEN TEA.
Essential Oil	0·60	0·79
Chlorophyll	1·84	2·22
Wax	0·00	0·28
Resin	3·64	2·22
Gum	7·28	8·56
Tannin	12·88	17·80
Theine	0·46	0·43
Extractive Matter	21·36	22·80
Colouring Matter	19·19	23·60
Albumen	2·80	3·00
Fibre	28·33	17·80
Mineral Matter	5·24	5·56

According to Bell, the following were obtained from a pound of Congou tea at 2s. 10d., and a pound of Young Hyson at 3s. :—

		CONGOU.		YOUNG HYSON.
Moisture		8·20		5·96
Theine		3·24		2·33
Albumenous (Vegetable Casein)	Insoluble 17·20, Soluble ·70	17·90	Insoluble 16·83, Soluble ·80	17·63
Extractive Matter		6·79		7·05
Gum		—		·50
Pectin		2·60		3·22
Tannin		16·40		27·14
Chlorophyll and Resin		4·60		4·20
Cellulose		34·00		25·90
Mineral Matter		6·27		6·07
		100·00		100·00

It is only those parts of the tea that can be readily dissolved out by infusion with boiling water that we need consider. They are comprised in the theine, tannin, and the aromatic oil.

There is only a very small quantity of essential oil of tea present. When extracted it readily passes into the form of a resin on exposure to the air. It is the agent that gives the peculiar taste and the fragrant odour to tea, and possesses potent stimulating qualities. There is but little doubt that this oil is developed during the roasting process by some form of fermentation from substances pre-existing in the leaf.

The most important of the constituents of tea is theine. This is an alkaloid that has been shown to be identical with the caffeine of coffee, and has also been discovered in guarana, maté, the kola nut, and in other leaves and fruits.

It is present in fairly constant quantities in different teas.

The following amounts of theine were found by some recent analyses by Bell from 100 grains of tea:—

	GRAINS OF THEINE.
Congou, Low	2·78
Congou, Fine	3·12
Hyson	2·24
Souchong	2·97
Moning	2·93
Assam	3·42
Gunpowder	2·72

One of the peculiar properties of theine is its great richness in nitrogen, of which it contains nearly 29 per cent. compared with albumen, which has only from 15 to 16 per cent.

In large doses theine is a poison, but to the infinitely small quantities contained in the infusion of tea, together with the active volatile principle, are ascribed the beneficial properties of tea. When separated out from the leaf, theine possesses a slightly bitter taste but no odour.

The tannin of the tea is the only other constituent that we need consider, for the remainder are almost entirely insoluble, and do not therefore enter into the infusion.

There are a number of substances under the general name of tannin, consisting of carbon, hydrogen, and oxygen, possessing no smell but a well marked characteristic astringent taste, widely diffused throughout the vegetable kingdom. The bark and leaves of most forest trees, such as the oak, the willow, the elm, the pine, contain a very large quantity of this substance; and it is this quality that renders bark of such immense service in the tanning of leather.

Many fruit trees, such as the pear and the plum are also particularly rich in tannin. It is found in various combinations, and these are known as different tannic acids. Hence we have gallo-tannic acid derived from the gall nut, quino-tannic acid from cinchona bark, querce-tannic acid from oak bark, and many others. The principal feature of all these varieties is their powerful astringent quality.

Chemical and Physiological Aspects of Tea.

There are two ways in which these important considerations may be viewed. In the first place the action on the system of theine and tannin apart from tea; and secondly, the action of these substances in well-made and properly prepared tea.

It has been found by experiment that the quantity of theine contained in about one-third of an ounce of tea has the effect of diminishing the daily waste of bodily tissue, as measured by the amount of solid constituents contained in the urinary secretion. The question, however, arises whether the retardation of waste is a good thing or not. As the good health of the body depends upon waste and repair, and a speedy removal of waste matters from the body, it follows that any thing which seriously interferes with the removal of waste, must eventually prove hurtful. Dr. Edward Smith, who has paid a large amount of attention to this subject, does not accept the view that theine checks the destruction of tissue. If double the amount of theine indicated above is taken there is general excitement of the circulation, the pulse becomes more rapid, tremblings come on, and there is excitement of the imagination, and wakefulness, followed by sleep arising from exhaustion.

The injurious plan adopted by some students, when working far on into the night, of taking large and repeated doses of strong tea to keep them awake, is an illustration of the symptoms described as from theine. So much for the action of theine itself in large quantities.

On the whole, properly made tea is a very beneficial beverage. From the nutritive point of view this would not hold good, because the amount of material it can supply to build up tissue or to maintain heat is infinitesimal, still from its known action on vital functions it must be reckoned as a very valuable food adjunct.

The conclusions of Dr. Edward Smith, as resulting from a very extended set of experiments upon himself and others, are worthy of consideration.

"These proved beyond all doubt that tea is a most powerful respiratory excitant, causing an evolution of carbon in the form of carbonic acid gas greatly in excess of that which it supplies. Whilst, therefore, it does not supply nutritive matter itself, it causes the assimilation and transformation of other foods."

"The sense of ease in respiration and increase of general comfort after taking tea is well known, as is also the fact that tea tends to induce perspiration and thereby to cool the body. This action on the skin is of great importance and it is not due entirely to the hot water taken with the tea, for when cold tea is taken the same effect is produced."

Dr. Smith summarises the matter thus :—

The perceptible effects of full doses of tea are—

1. A sense of wakefulness.

2. Clearness of mind and activity of thought and imagination.

3. Increased disposition to make muscular exertion.

4. Reaction, with a sense of exhaustion in the morning and following the preceding effects and in proportion to them.

The extremely small proportions of theine that are present in the ordinary infusions of tea can in no sense be regarded as poisonous.

When to drink Tea.

This is an important consideration, and we have no hesitation in at once condemning a practice coming into common use amongst certain classes of working women of drinking tea, morning, noon, and night, and on every possible occasion, in season and out of season.

Not only does the tea become hurtful because of its excessive quantity, but it is well known that it has an injurious effect upon those who have an insufficiency of food. Although occasionally tea may be taken after dinner as a change of diet, it is an exceedingly bad thing as a constant habit, for it is a well ascertained fact that tea is not well fitted to accompany meat. For the same reason the meat tea should be avoided. To take tea on an empty stomach between meals is also a thing to be strongly deprecated, for then it can only act as an irritant to the stomach.

Tea should be taken after a meal rather than with a meal.

How to make Tea.

To obtain good tea is the first consideration, and how to make it is certainly the second. A certain Chinese poet attempts to solve this problem by the following recipe: "Set a three-legged tea pot over a slow fire; fill it with water of melted snow, boil it just as long as is necessary to turn fish white or lobster red, pour it on the leaves of choice. Let it remain till the vapour subsides into a thin mist floating on the surface. Drink this precious liquid at your leisure and thus drive away the five causes of sorrow."

A flowery effusion doubtless, yet one containing a considerable amount of philosophy. The water of melted snow would be a pure and soft water, highly desirable for making good tea, for very hard waters are not suitable for the purpose. The boiling of the water for a very short time is also another important, but oft neglected item. When water is boiled for a considerable time it becomes flat and insipid, and it is hardly possible to get a good cup of tea from it. Water just freshly brought to the boil when it is bright and sparkling is the best for the purpose.

Allowing the water to remain in contact with the leaves for a limited time is also a consideration. On letting the boiling water stand for five minutes or less, the infusion so prepared will be at its best. The aromatic oil, the theine and some proportion of tannin will be dissolved out, and the tea will be of a rich, but not very dark brown, with a most pleasing and aromatic fragrance and flavour.

The whole of the tea so prepared should be poured off from the leaves into another teapot for use. The longer the water remains in contact with the leaves the greater amount of tannin will be present in the infusion, and it is highly desirable to avoid this.

Stewed or boiled tea should on no account be used.

Tea is very often charged with promoting indigestion and doubtless this is true, but it is not so much the fault of the tea as the fault of the making or the conditions under which it is used. To drink strong tea immediately with a meal when meat is eaten will doubtless in very many persons be productive of indigestion.

Over-strong, badly made, or stewed tea, will also set up causes resulting in and maintaining indigestion.

If the simple hygienic rules previously indicated be followed, the drinking of tea will prove both advantageous and pleasurable.

The practice in many parts of China is to put a quantity of tea leaves into a cup, and pour boiling water upon them, the leaves at first float to the surface but quickly sink to the bottom, the tea is then poured off and drunk without either sugar or milk.

Adulteration of Tea.

Doubtless tea like other food substances is often adulterated, and the only advice we can give to the user to guard against this is to purchase of respectable traders.

The following are some of the known adulterants :—Sand, quartz, and such like substances added to increase weight.

Colouring matters such as Turmeric, Prussian blue, indigo, etc.

Exhausted tea leaves and leaves of other plants such as the Willow, Elder, Sloe, Hawthorn, Beech, etc.

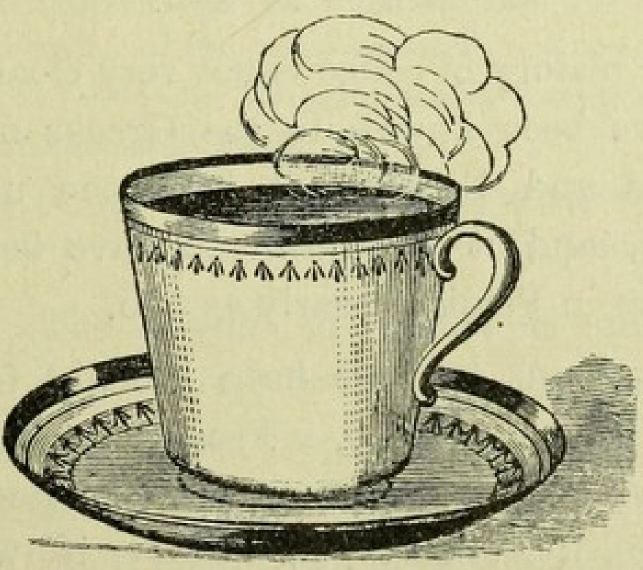
All these are capable of easy detection, the first by microscopic examination and the examination of the ash; the second by special individual chemical tests; and the third by microscopical examination of the structure of the leaves.

We may suitably conclude the study of tea by the following verses of an unknown poet :—

" Let others sing the praise of wine,
Let others deem its joys divine,
Its fleeting bliss shall ne'er be mine,
Give me a cup of tea!
The cup that soothes each aching pain,
Restores the sick to health again,
Steals not from heart, steals not from brain,
A friend when others flee.

" When sorrow frowns, what power can cheer,
Or chase away the falling tear
Without the vile effects of beer,
Like Pekoe or Bohea?
What makes the old man young and strong,
Like Hyson, Congou, or Souchong,
Which leave the burthen of this song
A welcome cup of tea.

Then hail the grave Celestial band,
With planning mind, and planting hand,
And let us bless that golden land
So far across the sea;
Whose hills and vales give fertile birth
To that fair shrub of priceless worth,
Which yields each son of mother earth
A fragrant cup of tea."



COFFEE.

HISTORICAL NOTICE.

CHAPTER X.

Earliest Records.

IT is rather a remarkable fact that coffee should come into general use at about the same time as tea, so that the two great national beverages may be regarded as twin sisters. Although there are many great and distinct differences between the two, there are, as we shall find, great similarities as well.

The early history of coffee is not very clear. It does not seem to have been known to the Greeks or Romans, but in Abyssinia and Ethiopia it has been used from time immemorial, and it is known to have been used as an article of diet in Persia as early as 875.

The plant seems to have been brought from Mocha, in Arabia, to Holland in 1616. From thence it was carried, towards the end of the century, to Batavier by Wieser, a burgomaster of Amsterdam, where it was soon very extensively planted.

? was it the parched corn mentioned in the Bible

Lev 23.14 Ruth 2.14 1 Sam 25.18 2 Sam 17.28

One of the earliest records of cultivation on a large scale is that by the Dutch at Surinam in 1718. By 1732 its plantation and culture had become general in the British and French colonies.

The use of coffee, as a beverage, is traced really to the Persians, and its widespread use as a beverage in the East has been ascribed to its being especially acceptable to Mohammedan nations, to whom wines and all alcoholic and fermented beverages were interdicted.

The following calendar from Haydn's Dictionary and other sources is interesting :—

1551. The first coffee house in Europe was established at Constantinople.

1641. Coffee brought into England by Mr. N. Canopus, a Cretan, who made it his common beverage at Balliol College, Oxford.

1650. The first coffee house in England was opened by a Jew named Jacobs at Oxford.

1652. An English Turkey merchant brought home with him Pasqua Rosee, a Greek servant, whom he established in the first coffee house in London, which was opened in George Yard, Lombard Street. Pasqua afterwards went to Holland, and opened the first coffee house in that country.

1657. The Rainbow Coffee House near Temple Bar was represented as a nuisance, because of the many assembling there.

1671. The first coffee house opened in France at Marseilles.

1672. The first coffee house in Paris.

1675. Coffee houses in London were suppressed by proclamation.

1676. This order was revoked on the petition of the traders.

Consumption of Coffee.

The trade in coffee is one of great importance, but unlike that of tea, which has grown by leaps and bounds, the last few years have shown a steady decline in the consumption of this useful and refreshing beverage. This is partly due to the increased liking for tea and the considerable cheapening in price of that article, and to the development and improvement in the manufacture of cocoa.

A good idea of the consumption of coffee twenty years ago, when the trade was at its prime, may be gathered from the following table of exports, which also indicates the great coffee producing countries.

	TONS.
Mocha, Hodeida, and other Arabian Ports	8,000
Java	55,000
Sumatra	8,000
Brazil and the Spanish Main	160,000
Hayti	16,000
Cuba and Porto Rico	7,000
British West Indies	2,000
India and Ceylon	38,000
Dutch West Indies	2,000
French West Indies	2,500
Total	298,500

The annual consumption at the same time was estimated as follows :—

	TONS.
Great Britain	16,000
Netherlands	40,000
Germany, Russia, and other countries round the Baltic	60,000
France, Spain, Italy, Turkey	55,000
United States	90,000
Canada, Australia, etc.	30,000
Total	291,000

The rise and decline in the consumption of coffee is very clearly shown by the following figures regarding the imports into Great Britain :—

YEAR.	HUNDREDWEIGHT.
1852	490,499
1866	1,134,329
1876	1,361,642
1879	1,609,386
1887	1,045,698
1890	864,454
1893	826,825

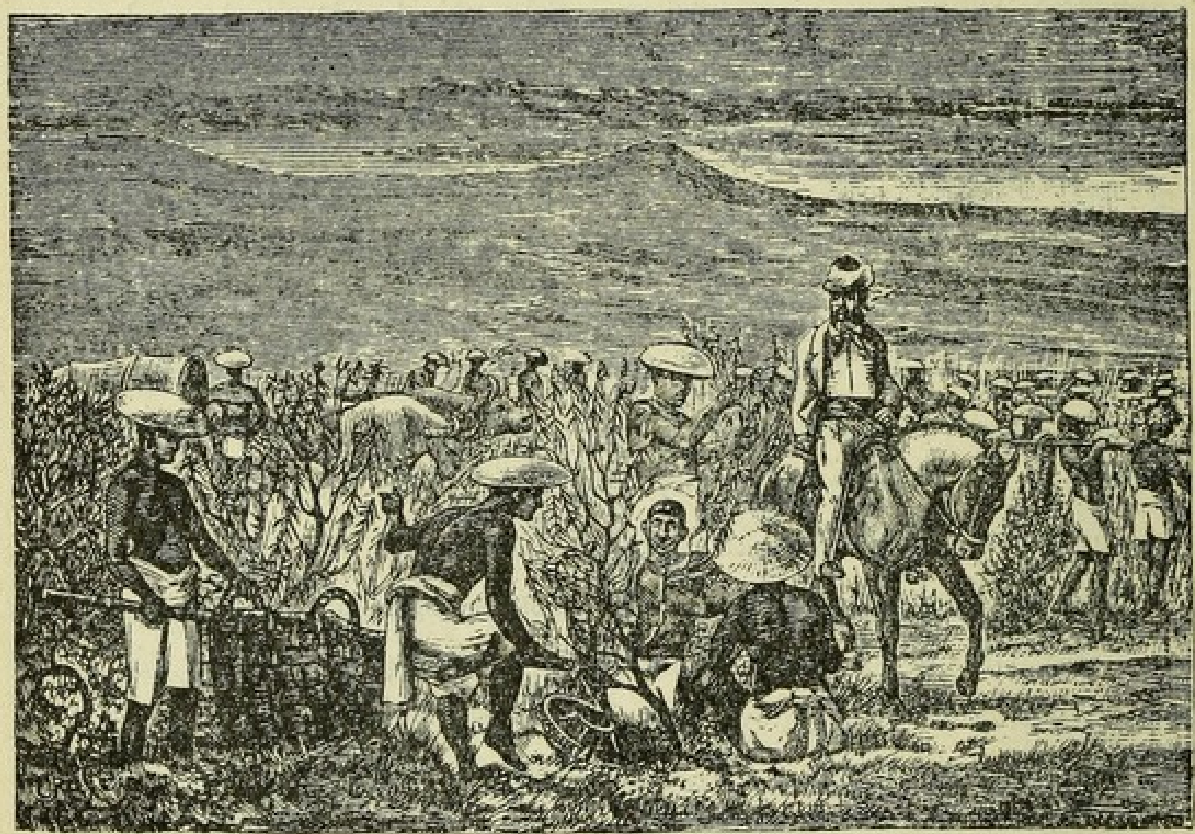
From this it will be seen that the highest point was reached in 1879. The duty on tea had, however, a few years before been reduced to 6d., and since has been further reduced to 4d., enabling that article to be sold so cheaply, that it is evidently winning in the race for popular esteem.

Cultivation of Coffee.

What we know as coffee berries are really the seeds of the coffee tree (*Caffea Arabica*), a native of Abyssinia and Arabia, but now naturalized in many tropical countries, as we have seen in our list of exports. There are a number of species of *Caffea,* but this is the only one said to possess valuable properties. The plant belongs to the order of *Cinchonaceæ,* being the same order of plants that produce Peruvian bark. In its natural state it attains a growth of from fifteen to twenty feet in height, but when cultivated it is kept pruned down to a height of six feet to facilitate the growth and the gathering of the berries.

The following facts are gathered from a graphic article on "Coffee Planting in Ceylon" that appeared in an article in the *Illustrated London News* :—

"Coffee planting is a tedious and expensive branch of agriculture to invest in at first. From the day the planter claims his first bit of jungle for the reception of the coffee seeds which are to form the plants for his plantations, until the first account of sales from England reach him, a period of five years will have elapsed. The heavy forest has to be cleared, by cutting down and burning ; then begins the process of lining, as it is called, or measuring off the ground in six feet squares. A small pit, about eighteen inches diameter and about eighteen inches deep, is now dug in each square. When the rains set in these pits are filled



CULTIVATION OF COFFEE.

with fine surface soil, and the young coffee plants are then dibbled in and firmly trodden down by the coolies' bare feet. The operation of planting is now complete, but the planter will have to wait many months without seeing much symptom of growth in his plants. In the third year the trees are fit for topping, that is cutting down to a height of from three to four and a half feet, this being a convenient height for gathering the berries and for the constant pruning that is required."

When the ground is dry abundant irrigation is necessary; the supply of water, however, is withdrawn when the fruit begins to ripen. The first crop is gathered in the third year, the plant continuing in flower for about eight months, and during all that time will be bearing seed of varying degrees of ripeness.

THE COFFEE PLANT.

The plantation of coffee can only be made a success when the average temperature of the year is 64° to 70° F.

Three gatherings of the beans or berries are made annually. The appearance of the berries is very much like that of English cherries, and it would puzzle most people to distinguish a heap of coffee berries from that fruit. In each berry there are two beans placed face to face, and enclosed in a hard membrane surrounded by a fleshy shell, much in the same way that the fleshy part of a cherry surrounds the stone. This shell, when dry, becomes hard and brittle. The tissues enclosing the bean are generally distinguished, as the husk, the parchment, and the skin.

The first two are entirely removed in the preparation of the coffee for use, but the third is found in every sample of commercial coffee.

Preparation of Coffee.

The gathering of the berries is done by coolies, who are expected to bring in a bushel at each gathering. From good coffee-bearing trees some hands will gather as much as four bushels a day. The thick outer pulp is removed by machinery, and the beans are then left in a cistern till fermentation sets in, the remaining mucilage from the pulp is easily washed off, and the beans are ready to be taken to the drying ground, where the important process of drying takes place. The beans are placed on mats, or large floors, specially adapted for the purpose, where they are dried by the sun's rays, being constantly turned to ensure equal drying throughout the mass. Finally the beans undergo another process with machinery to remove the husk without hurting the beans, after which they are sorted as to size, and then packed for shipment.

The quality of coffee depends very largely on the district and the elevation at which it is grown. The general opinion is that the Arabian coffee, known as Mocha, is the best of all in quality, that of Mysore ranking next, and then that produced in Java, and finally that of Ceylon.

Roasting Coffee.

The application of heat to vegetable productions results in the setting up of certain chemical changes, generally in the volatile and aromatic oils, rendering the dried material more or less fragrant. The drying of hops in a kiln, the roasting of tea, the making of hay, are all cases in point, and the coffee bean follows the same rule. There are two reasons for roasting, firstly to bring out the aroma, and secondly to render the seed friable so that it can easily be ground. Much skill is required in the roasting, and one reason for sorting the coffee beans is, that if they were roasted large and small together, the small ones would be charred and burned before the larger ones were properly done. The roasting is generally effected by placing a quantity of the beans in a large iron cylinder, which is slowly turned by machinery over a fire. The art of roasting consists in just reaching the stage when the beans shall have developed the highest aromatic degree, without having been blackened or charred.

The beans should never be darker than a light brown colour ; if the roasting proceeds beyond this point, more or less charring occurs, and the coffee develops a burned odour which tends to overcome the pleasant aroma.

The roasting naturally lessens the weight of the coffee by the loss of water driven off in the form of steam ; the beans also increase in bulk, so that when roasted to a light brown colour there is a loss of 15 per cent. by weight, and an increase of 30 per cent. in bulk. If roasted until dark brown the loss is 25 per cent. in weight, and the increase in bulk is 50 per cent. The general tendency with coffee sold by grocers is that it is insufficiently roasted, the reason being that the lighter roasting gives greater weight with less bulk. One hundred and twelve pounds of coffee, when fairly roasted, should yield ninety-two pounds of roasted coffee.

COFFEE—*continued.*

ITS EFFECTS ON THE HUMAN BODY.

CHAPTER XI.

VERY many investigators have made a study of the composition of Coffee, and various analyses are given. The following may be regarded as an average analysis of raw coffee :—

Constituents of Coffee.

Caffeine (identical with Theine) ..	0·8
Legumin (Vegetable Caseine)	13·0
Gum and Sugar	15·5
Caffeo-tannic Acid	5·0
Fat and Volatile Oil	13·0
Woody Fibre	34·0
Ash (Mineral Salts, etc.)	6·7
Water	12·0

Chemical changes, however, occur in the roasting process, which alter these proportions considerably. These changes comprise the loss of nearly all the water, which is evaporated by the heat, and the rupture of the cells containing fat and albumen, thus increasing the bulk of the bean and allowing the escape of gases, mostly carbon dioxide. There is also the development of a fragrant aromatic substance, a single drop of which is capable of scenting a large room with the fragrant odour of coffee. There is also a considerable loss of caffeine. If a cold glass plate be held over the escaping vapours from the beans as they are roasting, crystals of caffeine will condense on the glass. There are also considerable changes in the sugar. The following comparative analysis of two coffees made by Bell will show at a glance these changes :—

Constituents.	Mocha.		East Indian.	
	Raw.	Roasted.	Raw.	Roasted.
Caffeine	1·08	·82	1·11	1·05
Sugary Matter, Gum, &c.	9·55	·43	8·90	·41
Caffeic Acids	8·46	4·74	9·58	4·52
Extract containing colouring matter, &c.	6·90	14·14	4·31	12·67
Fat and Oil	12·60	13·59	11·81	13·41
Legumin	9.87	11·23	11·23	13·13
Dextrin	·87	1·24	·84	1·38
Cellulose	37·95	48·62	38·60	47·42
Ash	3·74	4·56	3·98	4·88
Water	8·98	0·63	9·64	1·13
	100·00	100·00	100·00	100·00

In regarding such an analysis from the point of view of the action of coffee on the human body, the principal consideration is not what is present as a total, but which of the constituents shall we get in the cup of coffee as prepared. One of the most common mistakes that are made in respect to the analysis of food and food adjuncts is, to regard the whole of the constituents, whilst to be exact we should only regard those that will be brought into the body, and then proceed to consider them under three aspects, as useful and nutritious, hurtful, or neutral. In all cases where infusions, brews, extracts, and syrups are made, the important point for the general public is, not what there is in the original substances used in the preparation, but what there is in the article as prepared.

As in the case of tea, it is only the soluble constituents that we shall get in the cup of coffee, and the quantity and quality of those will largely depend upon how the coffee is made.

The two principal constituents are the aromatic oil giving fragrance and delicious odour to the coffee, and the caffeine. As it is now generally accepted that caffeine and theine are the same substance found in different places, and as the subject of theine has been discussed under the heading of tea, there is no need to repeat here a statement of its properties.

One great advantage that coffee has over tea, is that the acids containing tannin are in considerably less quantity, and that therefore coffee has not the same astringent effect that tea has. Coffee does not retard the action of the bowels as may be the case with the more astringent tea, owing first, to the lesser quantity of tannin, and secondly to the presence of the aromatic oil, which assists in promoting the action of the bowels.

Coffee tends to allay the sensation of hunger, produces an exhilarating and refreshing effect, and has in a lesser degree the same action upon the nervous system as that of tea.

The experiments made by Dr. Edward Smith led him to the following important conclusions :—" That there was after taking coffee a marked increase in the action of the respiratory organs, more air breathed in, and more carbonic acid gas breathed out. Coffee acts in the opposite way to tea in its action on the skin. Whilst tea promotes the evaporizing action of the skin, and thus cools the body, coffee diminishes the action of the skin. It increases the heart's action, and the fulness of the pulse, and excites the mucous membranes."

"Coffee is more fitted than tea for the poor and feeble. It is also more fitted for breakfast, inasmuch as the skin is then active and the heart's action feeble. In good health and with sufficient food it is not needful after dinner, but if then drunk it should be taken soon after the meal."

"Coffee produces sleeplessness in many persons when taken at night, probably by exciting the heart's action and preventing that fall which is natural at night, and requisite to permit sound sleep. There is not the same reaction after taking strong coffee as there is after taking strong tea. None of the effects described may be marked if the infusion is weak as is common among the poor, and in this respect weak coffee resembles weak tea."

Hot strong coffee is an antidote in cases of poisoning by opium.

There is a high proportion of mineral salts in coffee, and these probably have a beneficial effect upon the human system. Some observers have declared that coffee drinkers are not liable to gout, and they have ascribed the reason to the potash, phosphoric acid, and other saline matters in the coffee. It is an ascertained fact that in those countries of the East where well-made coffee is largely used, the disease of gout is almost entirely unknown. There may be of course other causes aiding in producing this result.

Those suffering from a dry skin, or who are liable to constipation should not use coffee.

How to Make Coffee.

There have been endless inventions and suggestions as to the making of coffee, and it would seem that the art of producing a really good cup of coffee is not yet very well known. At the ordinary coffee shops and coffee palaces of the working classes a cup of good coffee is unknown, and one reason for the non-success of many of the coffee taverns and coffee palaces has been the inability of the managers to produce either good tea or good coffee.

There are two great principles underlying the many suggested plans, and they are, to extract the greatest amount of aroma or body, and to obtain a clear and fragrant fluid separate from the grounds. The very best coffee can only be made from freshly roasted and finely ground coffee, but in any case the coffee should be freshly ground, or it begins to lose its aroma. Exposed to the air, ground coffee loses its aroma entirely in from two to four months. If it is impossible to secure freshly ground coffee, then that which has been packed in tightly closed tins, immediately after being ground, is the next best. Coffee can hardly be in its best condition when it has been lying open in the canister of the grocer, or done up for the customers in a paper packet. The amount requisite for each person per meal has been estimated at six-tenths of an ounce.

A plan for making a good cup of coffee has been suggested by Dr. Parkes as follows :—

" The coffee must not be boiled or the aroma is in part dissipated, but if made with water of 180° or 200° (water boils at 212°) the coffee only gives up from 19 to 25 per cent., whereas it ought to yield 30 to 35 per cent. In order to get the full benefit of the coffee, therefore, after the infusion has been poured off, the grounds should be well boiled in some more water, and the hot decoction poured over some fresh coffee so that it may take up aroma, the coffee thus partially exhausted can be used on the next occasion for boiling."

The old-fashioned plan of adding water to coffee in a jug, and covering it, and placing it near the fire for ten or fifteen minutes is capable of producing very good coffee, but the difficulty is to pour the clear liquid off without disturbing the grounds.

Various forms of hydraulic coffee pots have been introduced with a view to drawing hot water through the ground coffee and thus producing a clear and fully aromatic infusion. Some of these answer capitally, others with varying success, many of them making good coffee but not in an economical way. One of the easiest ways of making coffee without any special apparatus is to put two ounces of freshly roasted and freshly ground coffee into a common coffee pot or a small saucepan, pour over it a pint of boiling water and allow it to stand closely covered up by the fire (but not to boil) for five minutes. The liquor then may be poured off the grounds through a cloth strainer and is ready for use.

The mistake too often made is in the excessive boiling of the coffee; this always results in the loss of the aroma, and the extraction of a bitter principle which altogether spoils the flavour of the coffee.

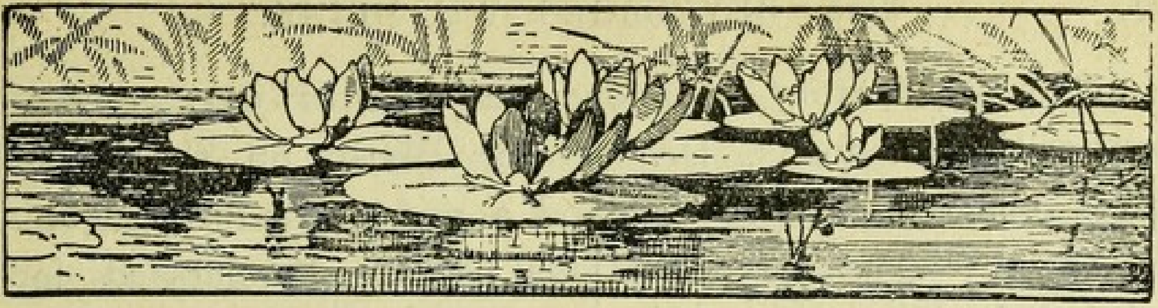
The following plan is recommended as a means of getting the largest amount of the desirable qualities out of a given quantity of coffee. Two and a half ounces of freshly-roasted and newly-ground coffee are placed in a coffee-pot and about a pint of cold water added; place this on the fire, and immediately it comes to the boil remove it, allow it to subside and pour off as clear as it will run. Pour on to the remaining grounds another pint of boiling water, place on the fire, and boil for three minutes. After allowing if to subside, pour off the clear liquid into the former quantity, which will now contain all the desirable qualities in perfection.

One ounce and a quarter to the pint of water is the least that should be allowed. The *Café Noir* or black coffee of the French contains a larger proportion than this.

The value of coffee as a food is considerably increased when milk is added to it, for the milk and the coffee are both acting over the system in the same direction.

Café au lait is an exceedingly good and useful beverage, and consists of strong coffee to which an equal quantity of hot milk is added.

The point to remember, both in making coffee and tea, is that the substances do not yield their good qualities at less than boiling point, but whilst coffee will bear boiling, tea will not.



COFFEE—*continued.*

ADULTERANTS AND SUBSTITUTES.

CHAPTER XII.

Coffee Adulteration.

IT has been said that ground coffee sold by grocers is never pure, and it is impossible to be sure that coffee is being obtained even when it is bought as coffee beans or berries. Dr. Lankester gives the following list of substances that have been used to produce coffee substitutes :—

Iris Seeds	Acorns
Broom Seeds	Beans
Fennigrec Seeds	Lupin Seeds
Spanish Acorns	Chicory Root
Chick Peas	Dandelion
Rice	Beetroot
Carrot Root	Wheat
Parsnip Root	Fruit of the Goosegrass.

In some parts of the world where coffee is difficult to be had, and expensive, many of the above are extensively employed, and there might undoubtedly be added many more.

It is satisfactory to know that one of our greatest authorities on foods, Dr. Winter Blyth, on the whole gives coffee as sold in England a pretty good character. He says, "The sophistications usually enumerated for adulterating coffee are chicory, roasted wheat and beans, rye and potato flours, mangel wurzel, lupin seeds, ground date stones, and burnt sugar. The coffee is usually adulterated when in powder, but patents have been taken out for compressing ground coffee with chicory into the shape of berries. The sophistication of coffee was at one time a regularly organized industry; and there existed years ago two manufactories in France—one at Lyons and the other at Havre—expressly established for mixing coffee with burnt cereals and the scorched outer covering of cocoa. Without venturing to assert that coffee is at the present time adulterated in England with chicory alone, it is certain that other admixtures are of the greatest rarity."

Chicory.

This is the most common adulterant of coffee, and its admixture with coffee is rendered quite legal under the Food and Drugs Act, provided the seller dispenses it in a wrapper on which it plainly and distinctly states that the article is a mixture of coffee and chicory. Failing this statement on the wrapper, the vendor renders himself liable to penalties for fraudulent dealing. Anyone can therefore demand to have pure coffee served by the grocer, but too often in the absence of this demand, the mixture of coffee and chicory is served. The best remedy against this is to purchase the coffee whole and grind it in a small mill as it is wanted for use.

A curious thing about the admixture of chicory is that many people prefer it to the pure coffee. At the same time it is difficult to see the reason for this, as the effect of the chicory is simply to lessen the good properties of the coffee, just as sand might lessen the sweetening quality of sugar.

The composition of coffee is modified by the addition of chicory as follows—It decreases the gum, chicory possessing less than coffee. It increases the sugar, chicory possessing more than coffee. It decreases the fat, chicory possessing very much less than coffee. It decreases the tannin, chicory being devoid of that substance. It decreases the caffeine, chicory not containing any of that substance, and it greatly modifies the constituents of the mineral salts by introducing silica which is not a component of coffee.

What is Chicory ?

Chicory is the wild endive, a plant of the dandelion family, known to botanists as the *Chicorium Intybus*. It is often found growing wild in calcareous soils. It is largely cultivated in Germany and exported in great quantities to this country from Hamburg. It is also grown in Yorkshire, Lincolnshire, and Suffolk. The seed is sown in April and the harvest gathered in August.

The roots are pulled up, washed, and cut across in pieces about the size of a walnut ; they are then dried upon a kiln, an operation which reduces the weight from four or five tons to one ton, due to the large quantity of water driven off. It then presents a dry shrivelled up appearance, resembling the cross sections of a parsnip. It is of a whitish colour, almost tasteless, and very light in respect to its bulk.

It is then roasted in heated iron cylinders which are kept revolving, as in coffee roasting, during which it loses about twenty-five or thirty per cent. more of its weight, and emits at the same time a disagreeable odour like that of burnt gingerbread.

A great improvement is made in the chicory, if during the roasting, about 2lbs. of lard or fat is added for every hundredweight of chicory. This communicates to it much of the lustre and general appearance of coffee.

It is then spread out in shallow boxes or coolers, and when cold it is carefully picked over, to remove any extraneous substances that may by accident have got mixed with it.

The roasted and sorted chicory, which is now of a dark brown and coffee-like colour, is ground beneath bare granite stones in a mill.

The ground chicory is then passed through sieves to ensure a certain degree of fineness, and is ready for the market.

Although to the ordinary observer chicory closely resembles coffee, it can easily and readily be distinguished. It is finer in the grain, and of a lighter colour. It soils the fingers more than coffee does when rubbed between the finger and thumb. When put into water it almost entirely dissolves, which is not the case with coffee. Its presence, when mixed with coffee, can be detected by throwing a spoonful of the mixture into a tumbler of water. If coffee alone is present it floats at the top for a long time, and the water beneath remains fairly clear, but if chicory is present it at once begins to sink and colours the water brown as it does so.

Beyond the fact that chicory contains a large amount of sugar, it possesses no nutrient quality.

The composition of roasted chicory is as follows :—

Moisture	12·8
Gummy matter	14·9
Sugar	10·4
Extractive, like burnt sugar	24·4
Fatty matter	2·2
Woody matter	28·5
Ash	6·8
	100·0

In Germany an infusion of chicory is taken as a beverage by persons in humble life. The infusion has a flavour of a sharp sweetish character resembling liquorice, and is of a dark sherry colour.

The reason assigned for the fact that many people prefer a mixture of chicory and coffee to pure coffee, is that the addition of chicory softens the somewhat bitter taste that is characteristic of pure coffee. There should never be added more than two ounces of chicory to sixteen ounces of coffee, but no doubt a great deal of fraud is carried on, as the vendor is not bound to say the quantities in which the two substances are mixed. The only safeguard the consumer has, is to buy the coffee pure and the chicory pure and mix them himself.

The great demand for chicory has led to that substance itself being largely adulterated. Roasted rye, ground peas, and damaged corn, coloured with Venetian red (one of the oxides of iron), are amongst the most common adulterants. Parsnips, and turnips sliced and dried are also sometimes used, and more objectionable things have been detected, such as ground acorns, sawdust, burnt sugar, and ground dog biscuits.

For many years chicory was so largely mixed with coffee that it became a serious matter of complaint, the loss of revenue being estimated at about £100,000 per annum. It was estimated in 1848 that for 36,000,000 lbs. of coffee 12,000,000 lbs. of chicory was sold. This led to an excise order being issued on August 3rd, 1852, interdicting the mixture of chicory with coffee.

This order was afterwards withdrawn, and the mixture was allowed provided the fact was plainly stated on every parcel sold. In 1860 the duty upon English grown chicory was 3s. per cwt.; it has since been 12s. 1d. for every cwt. of the kiln dried root.

Prussian chicory is regarded as the best, but being much dearer, the less valued but cheaper English production is mostly used.

Other Coffee Substitutes.

A preparation not long since was put upon the market under the name of "Melilotine" coffee. This really consisted of date stones roasted and ground and mixed with coffee. As the date stone is composed almost entirely of a hard and horny substance, with a little albuminous and fatty matter in its cells, the preparation could not be regarded as a very beneficial one.

"Date Coffee" is another fairly well known preparation, in which the dates themselves are dried, roasted and ground, and mixed with coffee in the proportion of one-fourth of coffee and three-fourths dates. The preparation is a very poor one, and it is not at all a proper substitute. There is an almost entire absence of caffeine, an over abundance of sugar, and a sweetish smell.

In Germany the seeds of the *Cassia Occidentalis* are roasted and ground and sold under the name of "Mogdad" coffee. These seeds are occasionally used as an adulterant to coffee in this country. If the seeds do not exceed one-fifth of the weight of coffee to which they are added, it is said that neither by taste, nor by general appearance can their addition be detected. As these seeds are destitute of theine or caffeine, their addition to the coffee cannot but be regarded with disfavour.

Coffee Taverns.

The popularizing of the sale of coffee and other non-intoxicants is a work that commends itself to our highest praise, and one way to counteract the pernicious influence of the vast number of public-houses is to have an abundance of places where innocent and refreshing beverages can be properly prepared and sold at popular prices. In many cases the great mistake has been made of going upon the "cheap and nasty" principle as opposed to the safer and better plan of giving the *best* at fair prices. It is impossible to enter upon the history of the Coffee Tavern movement, but we may mention that Dr. Barnardo, in order to counteract the influence of the public-house, opened the first in London, known as the Edinboro' Castle, at Limehouse, in 1873, followed by the Dublin Castle, in Mile End, in 1876. The movement became general about this time, and large numbers of such places were opened in the years 1877 to 1889. In many provincial towns their success has been much greater than in London.

That such places meet a public want, and can be made to pay, is evidenced by the many establishments, such as Lockhart's Rooms, Johnston's, the Aerated Bread Company, The British Tea Table, and many others of a like character.

COCOA.

HISTORICAL NOTICE.

CHAPTER XIII.

THIS important and useful article was introduced into Europe by the Spaniards in 1520, but its source and mode of manufacture were for a very long time kept secret. It is said that Columbus, on his discovery of the Western World in 1494 found it in use among the natives, and brought home samples of the article. It was esteemed very highly by the natives of the tropical climes in which it grows with great abundance. Whole forests of the order of trees to which it belongs grow in Demerara. It is now more or less extensively grown in Central

COCOA POD.

Queen Elizabeth (Tudor) 1558—1603

America, Brazil, Peru, Caracas, Venezuela, Trinidad, Ecuador, Grenada, Essequibo, Guayaquil, Surinam, and some of the West Indian Islands. Its cultivation has also been attempted in the East Indies, the Philippines, Australia, Madagascar, and the Mauritius. For the last four hundred years cocoa has been esteemed and highly valued, although, like many other innovations, its introduction into Europe was attended with difficulties, and its use grew very slowly in public favour.

Whilst cocoa was valued so highly by the natives and by those who had settled in their countries, there were not wanting those who wrote and spoke very strongly against its use. Linnaeus, the great botanist, was so fond of chocolate, one of the productions of the Cacao-tree, that he gave it the specific name of *Theo-broma*, meaning "the food of gods."

The Mexicans knew the tree by the name *Cacauatl*, whence is derived Cacao, from which we get our word Cocoa.

The tree belongs to the natural order *Byttneriaceæ*, and contains a number of species, trees of moderate size with large undivided leaves and clustered flowers, all natives of tropical parts of America.

Growth and Cultivation of the Cocoa.

The tree, as cultivated generally, rises with a bare stem to the height of about six feet, dividing after that into many branches, and reaching a height varying from twelve to twenty feet, although occasionally it rises much higher. The tree bears leaves, fruit, and flowers all the year round, and mature and unripe fruit can be seen growing at the same time. There are two chief seasons for gathering the fruit, June and December.

The tree begins to bear fruit when three years old, but it is not fully productive until the seventh or eighth year. The leaves, which grow most abundantly at the top of the tree, are from seven to ten inches in length and about two and a half to three and a half inches in breadth.

The pod, or fruit, is something between a cucumber and melon in shape, and is from six to twelve inches in length, and about three inches in diameter. It is yellow in appearance, with red coloration on the side next the sun. A great peculiarity about the cacao tree is that it cannot stand the fierce glare of the sun, and the trees are often sheltered by the planting of larger trees to afford them some degree of shelter.

The rind of the pod is about half an inch thick and somewhat watery, containing a pulpy or spongy substance, which separates from the rind when the fruit is ripe, and has a sweet and slightly acid taste. Embedded in this pulp are numerous seeds arranged in five rows, and divided from each other by partitions. They are not unlike almonds in appearance, and have a thin pale crimson fragile skin or shell, covering a dark brown, oily, aromatic, bitter kernel. These seeds are the cocoa beans of commerce, but they have to undergo considerable preparation before they are fit for the market.

Like all other things cultivated on a large scale, there are differences of procedure in different localities. Soil, climate, altitude, water supply, and other considerations have to be taken into account. Sometimes seeds are planted directly in the ground where the trees are to grow, at others, young plants are reared in nurseries and then transplanted.

Into all these points of difference we need not enter. A few general particulars will, however, be found interesting, and for these we are indebted to "Cocoa, and all about it," by Historicus. "When the crop is to be gathered a number of men, each supplied with a long bamboo rod surmounted by a cacao hook, and a cutlass, go over the plantation and pick out all the ripe pods. These are known by their colour or, better still, by tapping them. If ripe they give

GANG MUSTERING FOR WORK. THE LONG POLES ARE FOR CUTTING DOWN THE COCOA PODS BEYOND HAND REACH. TRINIDAD, 1894.

an hollow sound, as the seeds are then loose and detached from the outer shell. In gathering the higher pods the cacao hook is used, but the lower ones are taken off with the cutlass. Great care is necessary in gathering the pods for the following reasons. At the place where the pod is attached there is a soft cushion or 'eye,' from which all subsequent flowers and fruits will arise. If this 'eye' be damaged, as it inevitably would if the pod were torn off instead of being cut, the tree, as far as this point is concerned, becomes sterile. Hence, if a succession of these 'eyes' were thus treated, the tree would soon become valueless.

The gathered pods are left in small heaps near the trees, and are gathered by women into large heaps and left till the

SEPARATING THE COCOA BEANS FROM THE PODS. TRINIDAD, 1894.

next day. These large heaps are in a clear open space where the process of breaking and drawing can be carried out. A party consisting of a man with a cutlass and two or three women with wooden spoons or scalpels are told off to the heaps, by each of which they spread plantain leaves on the ground to receive the seeds. Then, while the man breaks the pods with his cutlass, the women remove the beans with the wooden spoons, clean them of the fibrous tissue by which they are surrounded, and throw them into a large heap.

All black, unripe, or damaged beans are thrown out during this process."

The next process is that of sweating or fermenting the beans, and is of the utmost importance in the production of a good cocoa.

"The beans are brought from the field and are placed either in barrels, oblong boxes, or in a close room where they are packed closely together, covered with plantain leaves, and left hermetically sealed for a period of from four to seven days. During this period a process of fermentation is set up raising the temperature to about 140° Fahr. and giving off carbonic acid gas and water.

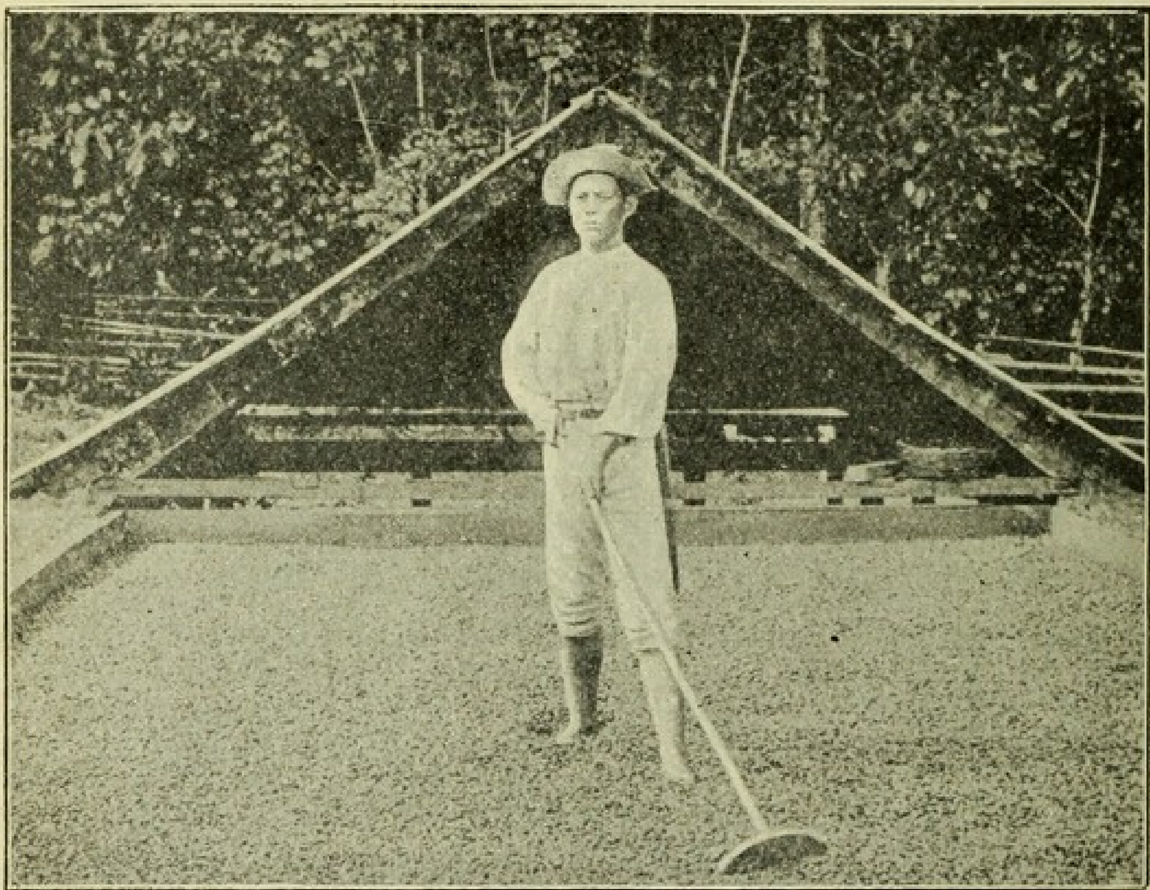
When the colour of the beans has changed to a brownish tint, the cocoa is turned out and spread on a tray, when it is carefully picked over by women. The beans are then covered with red earth and left for another day to complete the process of fermentation.

A number of women are then employed in rubbing the beans with their hands to clean them as thoroughly as possible from all gummy and mucilaginous matters. The red earth by its absorbent qualities assists in ridding the beans of the mucilage, and gives them a deep red colour. Other methods are adopted in different localities for this purpose instead of the red earth.

When the cleaning has been completed, the beans are spread out for the drying process. This is accomplished by exposing them to the influence of the sun, having an arrangement of sliding roofs over the drying boxes, by which they can be instantly covered in case of rain.

During the drying the beans must be carefully turned, and this is continued from day to day until the cocoa is thoroughly cured.

An arrangement by which the beans can be most efficiently cured, irrespective of weather, by means of hot water pipes, etc., is quickly taking the place of the system just described."



DRYING COCOA. TRINIDAD, 1894.

The cocoa is finally packed into sacks weighing from one to two cwt. ready for exportation.

Consumption of Cocoa.

The consumption of cocoa has assumed colossal proportions, and it seems to stand a fair chance of becoming a successful rival to both tea and coffee. There seems to have been formidable difficulties put upon its importation in the early part of the century, for 1s. 6d. per pound was charged as duty until 1820, besides other vexatious regulations that were enforced, and it speaks immensely in favour of the article that it has nevertheless attained so large a place in public estimation.

Some indication of this growth may be obtained by a reference to the quantities imported into the United Kingdom, chiefly from the British West Indies and Guiana.

1849..	..	1,989,477 lbs.
1855..	..	7,343,458 ,,
1861..	..	9,080,288 ,,
1870..	..	14,793,950 ,,
1879..	..	26,155,788 ,,
1887..	..	27,352,568 ,,
1893..	..	32,982,005 ,,

These figures are for total imports and not necessarily for the amount used for consumption in the United Kingdom. It will be seen, however, that cocoa has found favour with the British, if we look at the following amounts cleared for use at home.

1822..	..	523,279 lbs.
1825..	..	723,141 ,,
1830..	..	976,115 ,,
1835..	..	1,173,795 ,,
1840..	..	2,041,678 ,,
1850..	..	3,080,647 ,,
1860..	..	3,230,978 ,,
1865..	..	4,006,345 ,,
1870..	..	6,943,109 ,,
1880..	..	10,566,159 ,,
1885..	..	14,595,168 ,,
1890..	..	20,224,175 ,,
1891..	..	21,601,825 ,,
1892..	..	20,795,798 ,,
1893..	..	20,874,995 ,,
1894..	..	22,440,820 ,,

Manufacture of Cocoa.

It may be imagined that an article in so great a demand would give rise to its manufacture on a gigantic scale, for, unlike tea, cocoa is not suitable for use as it is imported, the percentage of fat or butter that it contains is far too high to render it a useful and digestible food, and it needs several processes to be gone through in order to render it palatable and attractive.

These processes in outline consist of sifting and picking the beans in order to ensure the admission of only those that are perfectly sound, and also to remove any extraneous substances.

Then, like coffee, the beans undergo the process of roasting. The taste of the fresh bean is oily, bitter, and rather unpleasant, but by roasting the starch of the bean is changed to dextrin, the amount of fatty acid increases, and the aromatic oil is formed.

The roasted beans now have their shell, a hard thin skin, beneath which is the true cocoa nib, removed by machinery. These husks are used in Ireland and elsewhere for making a light and fairly palatable beverage.

The next process is one on which greatly depends the excellence of the cocoa produced. Naturally the bean contains an excess of oil. In some cases the manufacturer, to obviate this, simply adds an excess of starch and so reduces the percentage of fat over the whole. This plan cannot be too strongly deprecated. A first class manufacturer overcomes the difficulty by removing the excess of fat, and this is done by means of pressure and heat, a creamy, oily fluid being expressed. From this the cocoa butter of commerce is obtained. The substance left, after the extraction of the fat, is reduced to powder, and forms the cocoa of domestic use.

COCOA.

CONSTITUENTS AND FOOD VALUE.

CHAPTER XIV.

Composition of Cocoa.

COCOA if properly manufactured and unadulterated is regarded by many as a highly nutritious substance. It contains larger proportions of albumen and gluten than bread, or oats or barley, and more fat and as much flesh forming material as beef, and in addition has the alkaloid known as theo-bromine, a substance very much like the theine of tea, and the caffeine of coffee but containing more nitrogen.

A comparative estimate by Drs. Playfair and Lankester shows that on an average

Tea	contains	3	per	cent.	of Theine.
Coffee	,,	$1\frac{3}{4}$	,,	,,	of Caffeine.
Cocoa	,,	2	,,	,,	of Theobromine.

Other chemists show much smaller amounts, Mitscherlich 1·5 per cent.; Wanklyn, 1·5 per cent.; Tuchen, 0·66 per cent.; Hassall, 0·78 per cent., and Muter, 0·9 per cent.

Analyses of raw cocoa differ very widely, owing to various sources of production, and different methods of fermenting drying, and packing, but a general average may be taken as follows :—

	Per Cent.		In 1 lb. ozs.	grns.
Water	5·0	....	0	350
Albumenoids	17·0	....	2	315
Fat	51·0	....	8	70
Theobromine	1·5	....	0	105
Cacao red	3·0	....	0	210
Gum	10·9	....	1	326
Cellulose and Fibre	8·0	....	1	122
Mineral Matter	3·6	....	0	252

Dr. Bell gives the following table as showing the analyses of the general composition of commercial cocoas.

Name of Cocoa.	Water.	Fat.	Starch added.	Cane Sugar added.	Non-fatty Cocoa.	Total.
Prepared Cocoa	4·95	24·94	19·19	23·03	27·89	100·
Iceland Moss Cocoa	5·47	16·86	24·70	29·23	23·74	100·
Rock Cocoa	2·58	22·76	17·56	32·20	24·90	100·
Flake Cocoa	5·49	28·24	none	none	66·27	100·
Cocoatina	3·52	23·98	none	none	72·50	100·
Chocolatine	4·40	29·60	none	none	66·00	100·
Finest Trinidad Nibs	2·60	51·77	none	none	45·63	100·
Chocolate de Santé	1·44	22·08	2·00	61·21	13·27	100·
Cocoa Extract	5·76	29·50	none	none	64·74	100·

A glance at the above table will enable us at once to see which are the purest forms of cocoa and which are the most desirable for common use. At the same time there are varying proportions of the solubility of the different cocoas, and this again to some extent governs their value. There are so many considerations, that for all ordinary purposes it is better to trust to a first class manufacturer and to pay a fair price for the article than to attempt to be guided in our purchases by the analyses given.

The peculiar constituents of cocoa are two, cocoa butter and theobromine.

The Society of Analysts lays it down, that any sample of manufactured cocoa should contain at least twenty per cent. of cocoa fat, if less, it should be regarded as adulterated. A peculiarity of pure cocoa butter is that it does not become rancid however long it is kept, unless subjected to heat or the direct rays of the sun.

While it is true that in cocoa there is a remarkable combination of nearly all the substances which constitute a perfect food, too much reliance must not be placed on statements suggesting that it can replace so much of our more solid articles of food. It properly ranks as a stimulating and refreshing beverage such as tea and coffee. Any one restricted to the nutrient quality derived from a cup of cocoa would fare badly without the addition of the usual solid foods such as bread, meat, etc., but with these it forms a much more nutritious beverage than either tea or coffee.

Dr. Bell, former principal of the Somerset House Laboratory, makes the following important comment on the food value of cocoa.

"The portion boiled out with water from pure cocoa powder, contains by far the more valuable constituents of the bean. It contains nearly all the mineral matter, alkaloids, soluble albumen, carbo-hydrates (sugar and starch) and astringent substances, all of which are much more likely to be easily assimilated than the part of the bean insoluble in water. This latter is equal to about twenty per cent. of the weight of the bean, and in round numbers consists of seven per cent. insoluble albumen, seven per cent. cellulose, and six per cent. indefinite colouring matters. If pure cocoa powder, therefore, were used in preparing the beverage by merely boiling in water and simply straining, the deficiency arising from the absence of the undissolved part of the cocoa, in a breakfast cup of the prepared solution would be more than replaced by half an ounce of bread."

It is not the thickness or soup-like condition of the beverage that is to be taken as a standard of the nutrition present. That can only be governed by the quality of the cocoa and its solubility. The mere thickness may be due, and is probably due, either to faults in manufacture or to extraneous substances such as starch that have been added. Sugar, honey, treacle, gum, flour, rice and arrowroot are amongst the added articles used by unprincipled traders.

Varieties of Cocoa.

The Mexicans roasted and powdered the cocoa and mixed it with maize-meal and spices, and from this prepared an article of food, which they called chocolatl. The drink which they made from cacao they called *cacava-atl.* From the former word *chocolatl* the Spaniards derived *chocolate,* which is still used in its original sense as the name of a preparation of cocoa. The method of manufacture is identical with that of cocoa, up to a certain point. After the extraction of the cocoa butter, the cocoa is reduced to fine paste, and mixed with pounded sugar, and spices such as cinnamon, cloves, cardamon, vanilla, etc., according to taste. The paste is then poured into moulds of enamelled iron and allowed to cool and harden.

A very pleasant and refreshing beverage is made by dissolving chocolate in either boiling water or milk.

Its general properties are analagous to those of cocoa. Chocolate is often adulterated by mixing with it rice-meal, oatmeal, flour, potato starch, roasted hazel nuts, almonds, and with flavouring materials such as benzoin, storax, etc., in place of vanilla.

Chocolate also plays a most important part in the production of an immense variety of confections.

There are several varieties of chocolate in common use. The following examples are interesting:—

French Chocolate: two beans of vanilla rubbed into a powder with sugar add 1 lb. of best sugar to every 3 lbs. of cocoa nibs.

Spanish Chocolate: Curacoa cocoa 11 parts, sugar 3 parts, vanilla $\frac{1}{16}$, cinnamon $\frac{1}{64}$, cloves $\frac{1}{128}$. Another method in use in Spain, Caracas cocoa 10 parts, sweet almonds 1 part, sugar 3 parts, vanilla $\frac{1}{64}$.

Vanilla Chocolate may be made as follows: Caracas cocoa 7 parts, Mexican vanilla $\frac{1}{16}$, cinnamon $\frac{1}{22}$, and cloves to flavour.

Another variety has the following proportions: Best chocolate paste 21 parts, vanilla 4 parts, cinnamon $\frac{1}{8}$, cloves and musk in small quantities.

Cocoa Nibs are simply the bruised roasted seeds deprived of their coverings.

Flake Cocoa is made from the whole seed nib and husk being ground up together in a particular form of mill, giving it the flake like appearance.

Rock Cocoa is prepared in the same way as the flake variety, but mixed with arrowroot and sugar.

Homeopathic Cocoa is a preparation of the same kind without the sugar.

Maravilla Cocoa contains sugar and sago flour.

Cocoa Essence, Cocoa Extract, Cocoatina, etc., consist of pure cocoa deprived of 60 to 70 per cent. of its fat.

Iceland Moss Cocoa, simply a variety in which Iceland moss is added to the other ingredients.

Pressed Cocoa (as Van Houten's), is prepared from cocoa nibs, a proportion of the cocoa butter having been previously expressed so as to leave about 30 per cent.

Vi-Cocoa, a preparation in which an extract of the kola nut is said to be added. Kola is prepared from the seeds of the *sterculia acuminata*, the so called kola nut. It has some slight fatigue dispelling power if masticated or taken when freshly ground. This probably arises from a narcotic action on nerve centres lessening the perception of fatigue, and is altogether a different thing from proper rest and refreshment. Kola also increases arterial tension.

New varieties are constantly being introduced according to the method of preparation and the ideas of the manufacturer.

Physiological Action of Cocoa

The effect of cocoa is less exciting to the nervous system than either tea or coffee, and as it contains a much larger quantity of nutritive material it is on many accounts to be preferred to them. Dr. E. Lankester says, "If cocoa be boiled with water and sugar and milk added it can hardly be called a substitute for tea and coffee; it is in fact a substitute for all other kinds of food and when taken with bread and butter, little or nothing else need be added at the meal."

The flavour of cocoa is not lessened by the addition of milk, and if boiled in milk only it forms a most agreeable and nutritious food. There are many persons who cannot take tea or coffee, and to these cocoa comes as a most agreeable and useful beverage.

On the other hand the large quantity of fat present in some preparations of cocoa tends to make the infusions thick and heavy so that they do not agree with persons who have delicate stomachs.

A very high eulogium on cocoa has been pronounced by Mr. O. L. Symonds, in his work on the "Commercial Products of the Vegetable Kingdom," in which he says, "Cocoa is of domestic drinks the most alimentary; it is without exception the cheapest food that we can conceive, as it may literally be termed meat and drink, and were our half starved artizans and over-worked factory children induced to drink it instead of the in-nutritious beverage called tea, its nutritive qualities would soon develop themselves in their improved good looks and more robust condition."

Without endorsing all that Mr. Symonds says, we can give good cocoa an unqualified recommendation as a wholesome, beneficial and pleasing beverage.

Adulterations of Cocoa.

The manufacture of cocoa offers to unprincipled persons a wide field for the practice of adulteration. Hassall, in his work "On Adulteration," mentions that on examination of 54 samples, 8 were found to be genuine, 43 to contain sugar, and 46 to contain starch; 39 out of 68 samples contained earthy colouring matter such as venetian red and umber.

Adulterations are commonly made with sugar, starches, arrowroot, sago, potato starch, venetian red and peroxide of iron. A microscopical examination will at once detect the presence of cereals, arrowroot, sago, or other kinds of starch, as the starch granules of different substances possess their own particular characteristics and are thus easily differentiated.

Sugar can be detected by its taste and the character of the solution. Chemical tests must, of course, be applied to estimate the quantities present. The addition of the peroxide of iron, of venetian red, and of other noxious substances are of extremely rare occurrence in recent years.

BEER AND MALT LIQUORS.

HISTORY AND STATISTICS.

CHAPTER XV.

Historical Notice.

BEER is often spoken of as the National Beverage of England, and undoubtedly it is the common drink of a vast number. There is probably no other article of consumption about which so many fallacies are current as about beer. Sometimes it has been deemed a food equal, if not superior, to bread. Thousands are under the impression that it gives them muscular strength and physical and mental ability. Tens of thousands use it for the simple reason that they like it, and undoubtedly the love of beer is ingrained in the nation, the result of centuries of use.

It is impossible to trace the history of brewed and fermented liquids to their first invention. Their use seems to go back to a period in the dim ages of the past. The earliest Greek writers speak of a wine as being made from barley, and of the art of making it as being derived from the Egyptians, and it is certain that this ancient people had two sorts of beer in use, one called *zythus* and the other known as *curmi*. The Greeks called this Egyptian liquor *zythum*, meaning a drink made from barley.

Herodotus, who lived 450 B.C., in his second book refers to beer, and ascribes the first discovery of the art of brewing barley wine to Isis the wife of Osiris, and a beverage of this kind is also mentioned by Xenophon 401 B.C.

Tacitus, who wrote in the first century of our own era, says, "The Romans and Germans very early learned from the Egyptians the process of preparing a liquor from corn by means of fermentation."

Pliny, who was born A.D. 23, states that in his time beer was in general use amongst all the nations who inhabited the Western part of Europe, and that the people of Spain in particular, brew this liquor so well that it will keep a long time. He describes it as made from corn and water and as being intoxicating, adding, "so exquisite is the cunning of men in gratifying their vicious appetites that they have thus invented a method to make water itself produce intoxication."

Ale was the favourite liquor of the Anglo-Saxons and Danes; it is constantly mentioned as one of the constituents of their feasts, and before the introduction of Christianity amongst the Northern nations, it was an article of belief with them, that drinking copious draughts of ale formed one of the chief felicities of their heroes in the Hall of Odin.

Ale houses are mentioned in the laws of Ina, King of Wessex; and ale is expressly mentioned as one of the liquors provided for a royal banquet in the reign of Edward the Confessor.

In the Saxon Dialogues, preserved in the Cotton Library in the British Museum, a boy who is questioned upon his habits and the uses of things, says, in answer to the enquiry as to what he drank, "Ale if I have it, or water if I have it not."

Booths were first set up in England for the sale of beer in 728, and laws were passed for their regulation.

In 1285 none but freemen were allowed to keep ale houses in the city of London.

In 1551 further laws were passed for their regulation, and in 1603 an Act of James I. says that one full quart of the best, and two quarts of small ale were to be sold for one penny.

In 1643 excise duty was imposed by Parliament on ale and beer.

During the reign of Henry the Eighth the price of ale was regulated, as should appear convenient and sufficient in the discretion of the Justices of the Peace, and the quality of the ale was ascertained by officers who were called ale-tasters or ale-conners. These officers are still appointed in some boroughs and towns in compliance with charters or ancient custom, though the duties of the office have long since fallen into disuse.

Porter was so named because this particular brew of malt was the common drink of the porters in the city of London about the year 1730, and the appellation has remained attached to it since.

The trade of the brewer seems to have been a profitable one from very early times, for on one of the first occasions on which the term is used in the year 1414, it is stated that "one William Murle, a rich maltman or bruer of Dunstable, had two horses all trapped with gold."

In these days too, the brewers as a class are a very wealthy folk.

The Magnitude of the Brewing Industry.

From a few facts we may gather the vast magnitude of the brewing and beer industries. In 1621 there were about 13,000 public houses in England. In 1790 there were 76,000 in Great Britain, and these in 1850 had increased in number to 88,496.

In 1850 the total number of licensed brewers was 2,507, the number had increased in 1882 to 15,774, but by 1897 had decreased owing to the abolition of a large number of small breweries, and their concentration into large concerns, to 8,305.

In 1887 the number of barrels of beer brewed by the whole of the brewers of the United Kingdom reached the tremendous total of 27,949,914, but the increase in consump-tion has gone on, and 1897 showed a total of 34,203,049 barrels, ~~tion has~~ each containing 36 gallons, upon which a total duty was paid of £11,320,358. This gave a consumption of over 30 gallons per head of the population.

The barley used to produce this was about 56,000,000 of bushels ; nearly 2,000,000 of acres of land being devoted to its cultivation. This would represent a piece of land as large as the four Counties of Bedford, Derby, Cambridge and Dorset put together. Besides this 22,476,702 cwts. of foreign barley were imported.

In addition to this there are 59,000 acres of British land under hop cultivation.

The beer production of the chief countries in the world in 1896 was 141,904,753 barrels, being the output from 42,838 breweries. To produce this vast quantity of liquor 6,900,000 tons of malt and 93,000 tons of hops were used.

Disregarding all the wholesale and minor retail licenses for the sale of drink, the following licenses were issued by the Inland Revenue Department in the United Kingdom during the year ending March 31st, 1896:—

Publicans	91,235
Scotch and Irish Grocers..	4,583
Refreshment Houses ("on" and "off") ..	8,853
Wine and Beer "on"	4,954
Ditto "off"	2,227
Beer and Cider "on"	30,635
Ditto "off"	12,630
	155,117

These with other retail licenses for the same year make a grand total of 169,675 places where intoxicants are sold, being nearly 4½ to every 1000 of the population.

A celebrated brewer commenting upon this, estimates that in connection with this large number of licenses no less than 775,000 persons, including all assistants and servants, are making their living directly out of the distribution of intoxicants, earning about £35,500,000 sterling per annum.

In a pamphlet issued by Professor Leone Levi in 1872, a calculation was made of all persons directly and indirectly employed in the trade of making and selling intoxicants, and the figures were worked out at an immense total as follows :—

Persons employed :—

In the production of barley	60,000
In the production of hops	12,000
In malting and brewing	66,000
In distilling and rectifying	6,000
In manufacture of corks and bottles	2,000
In the bottling of beer, spirits, and wine, in Engineering and Coopering, etc.	100,000
In Public-houses	600,000
Dependents on the above..	654,000
	1,500,000

Allowing for the growth of the trade since 1872, it is now estimated, by one of the leading brewers of the country, that the total of persons employed indirectly and directly in connection with making and distributing intoxicants, reaches considerably over 2,000,000. Some idea of the magnitude of this gigantic trade may also be gathered from a visit to one of the great breweries, say that of Messrs. Guinness and Co., of Dublin. The brewery itself covers 40 acres, and has a capital of £6,000,000. In the year 1887 this brewery alone paid £453,615 in beer duty. There are 27 fermenting tuns, containing varying quantities from 500 to 2,000 barrels each. In these the quantity and specific gravity are taken by officers of the excise, and the duty charged accordingly. This amounted, in the year mentioned, to over £1,400 per working day.

The brewery has its own system of railways, with engines and rolling stock, employs 1,600 persons, 150 horses, and 10 steam lighters on the adjoining river Liffey. There are 150 storage vats, containing from 200 to 1,700 hogsheads each. In the printing shops over 100,000,000 bottle labels are printed per year, and the cooperage can turn out 1,000 casks per week.

To further emphasize the enormous proportions of this trade, the drink Bill for each year since 1837 to 1896 is shown as follows:—

THE DRINK BILL, 1837-1896.

Year.		Drink Bill.		Average Cost Per Head.
1837	....	87,713,289	....	3 8 4
1838	....	90,246,847	....	3 9 7
1839	....	87,804,658	....	3 7 0
1840	....	87,007,756	....	3 5 8½
1841	....	76,340,434	....	2 17 1
1842	....	72,413,473	....	2 12 10½

Year.		Drink Bill.		Average cost Per Head.
1843	....	73,492,867	....	2 13 11
1844	....	78,157,971	....	2 16 9½
1845	....	80,067,478	....	2 17 7½
1846	....	89,384,448	....	3 3 7½
1847	....	76,843,734	....	2 14 11
1848	....	81,178,230	....	2 18 4
1849	....	84,781,633	....	3 1 3½
1850	....	87,725,140	....	3 3 9
1851	....	87,051,223	....	3 3 6½
1852	....	89,399,460	....	3 5 1½
1853	....	91,233,313	....	3 6 3
1854	....	84,987,738	....	3 1 5½
1855	....	75,397,267	....	2 10 7
1856	....	87,534,038	....	3 2 6
1857	....	90,617,726	....	3 4 8½
1858	....	90,834,140	....	3 4 5½
1859	....	95,679,611	....	3 7 5
1860	....	87,027,029	....	3 0 10½
1861	....	94,942,107	....	3 5 7
1862	....	88,867,563	....	3 0 10
1863	....	92,088,185	....	3 2 7
1864	....	103,720,012	....	3 9 10
1865	....	106,439,561	....	3 11 3
1866	....	113,925,558	....	3 15 9
1867	....	110,122,226	....	3 12 7
1868	....	113,464,874	....	3 14 1
1869	....	112,855,603	....	3 13 0
1870	....	118,736,279	....	3 16 1
1871	....	125,586,902	....	3 19 1
1872	....	131,601,490	....	4 2 8
1873	....	140,014,712	....	4 7 8
1874	....	141,342,997	....	4 7 2
1875	....	142,876,669	....	4 7 3
1876	....	147,288,759	....	4 9 0
1877	....	142,007,231	....	4 4 10
1878	....	142,188,900	....	4 4 1
1879	....	128,143,865	....	3 15 0
1880	....	122,297,275	....	3 10 11
1881	....	127,074,460	....	3 12 3
1882	....	126,251,359	....	3 12 0
1883	....	125,477,275	....	3 10 5

Year.		Drink Bill.		Average cost Per Head.
		£		£ s. d.
1884	....	126,349,256	....	3 10 3
1885	....	123,268,806	....	3 7 10
1886	....	122,389,045	....	3 6 10
1887	....	124,347,369	....	3 7 3
1888	....	124,611,439	....	3 6 8
1889	....	132,213,276	....	3 9 11
1890	....	139,495,470	....	3 13 0
1891	....	141,220,675	....	3 15 0
1892	....	140,866,262	....	3 13 11
1893	....	138,854,829	....	3 12 3
1894	....	138,737,828	....	3 11 6½
1895	....	142,414,812	....	3 12 9¼
1896	....	148,972,230	....	3 15 6

It might be supposed that so great an industry, and so immense a sum of money, represented an article that was absolutely necessary to the well-being of the race, but it is not so. It is computed on the fairest and most reliable possible estimate, that there are six millions of abstainers from all forms of intoxicants in Great Britain, and these are a standing testimony that whatever else may be said for the use of intoxicants, they are not necessaries. Proofs are not wanting that the abstainer is, as regards health, longevity, and physical and mental capacity, by no means a sufferer because of his abstinence. Habit, custom, appetite, and training have more to do with the use of these fermented liquors than necessity.

There is a great variety of beers in use, the following being some of those best known:—Porter, stout, Dublin stout, Burton pale ale, Burton old ale, bitter ale, mild ale, Lager beer, Bock, Vienna beer, rice beer, Pilsener beer, Bavarian beer, Budweiss, Bohemian beer, and the American Lager beers.

BEER AND MALT LIQUORS—*continued.*

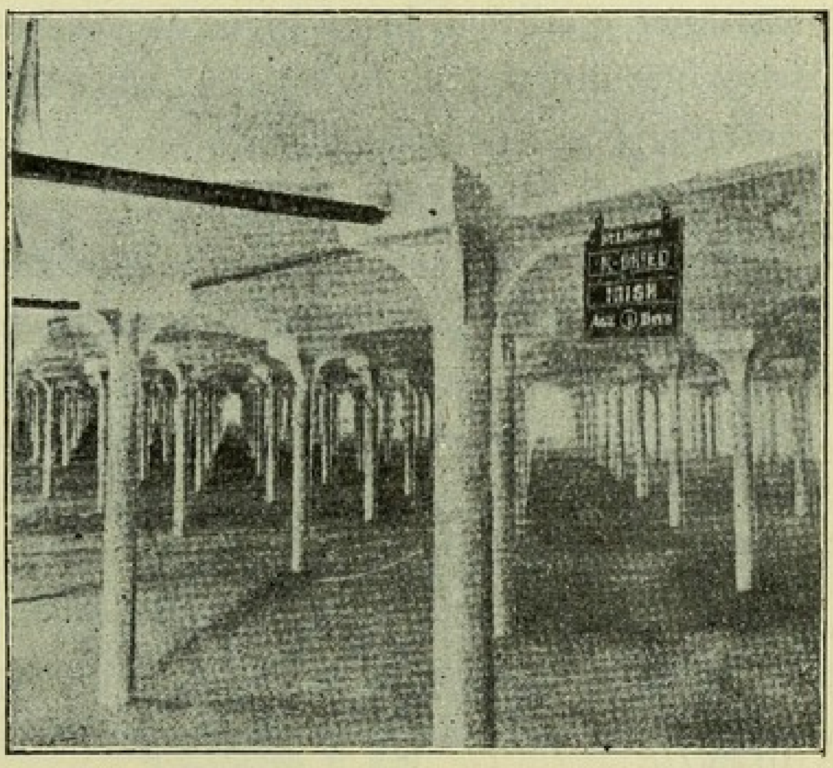
MANUFACTURE.

CHAPTER XVI.

IT is a very common belief that beer is made from barley, but whilst barley is one of the substances used, it is hardly correct to say that beer is made from it. The substance really required is a form of sugar known as maltose or glucose, and barley presents a very convenient form for obtaining this, but then, only as a result of chemical changes. The common knowledge that barley is used for beer, and a similar cereal, wheat, is used for bread, has given rise to the belief that beer is simply a

form of liquid bread, therefore a good and nutritious beverage. We must always bear in mind that chemical changes alter the properties of substances, so that it is quite possible to start with good barley, and, by a series of chemical changes, to produce something containing properties altogether different to those possessed by the original barley.

The making of beer may be divided into eight distinct operations, independent of the malting processes. First, grinding or crushing the malt; second, the operation of mashing; third, boiling; fourth, cooling; fifth, fermentation; s cleansing; seventh, racking or vatting; eighth, the fining or clearing.



MALTING. THE GERMINATING FLOOR.

Malting.

Burns, in his poem, "John Barleycorn," refers to the process of malting in the following verses:—

"They filled up a darksome pit
With water to the brim;
They heaved in John Barleycorn,
There let him sink or swim.

They laid him out upon the floor,
To work his further woe;
And still as signs of life appeared,
They toss'd him to and fro.

They wasted o'er a scorching flame
  The marrow of his bones;
But a miller used him worst of all—
  He crushed him 'tween two stones."

These lines give a fairly good description of the process. The first thing is to get the barley to germinate, for when any seed germinates, chemical changes are set up which may result in the conversion of the whole of the seed into new material.

The reason that barley is used, is not because it contains nutritious qualities in a high degree, but first, because barley germinates more quickly than other cereals, and secondly, because barley contains a large proportion of starch, and albuminous matter of such a kind and quantity as to readily develop an amount of diastase which more than suffices for the conversion of the starch into sugar.

EAR AND PLANT OF TWO-ROWED BARLEY.

In England the two-rowed barley (*Hordeum distichum*) is almost universally used, the particular variety most preferred being known as the chevalier. The best malting barleys are grown in the counties of Norfolk, Suffolk, Essex, Herts, Wilts, and Hants, on light chalky or light gravelly soil. The weight of good barley varies between 49 lbs. and 58 lbs. per bushel.

The following table shows the average composition of the principal cereals:—

	Old Wheat.	Barley.	Oats.	Rye.	Maize.	Rice.
Water	11·1	12·0	14·2	14·3	11·5	10·8
Starch	62·3	52·7	56·1	54·9	54·8	78·8
Fat	1·2	2·6	4·6	2·0	4·7	0·1
Cellulose	8·5	11·5	1·0	6·4	14·9	0·2
Gum and Sugar, &c. ..	4·4	5·2	5·9	11·8	3·6	2·0
Albuminoids	10·9	13·2	16·0	8·8	8·9	7·2
Ash	1·6	2·8	2·2	1·8	1·6	0·9
	100·0	100·0	100·0	100·0	100·0	100·0

There are four operations in Malting. 1, steeping; 2, couching; 3, flooring or germinating; 4, kiln drying. In order to start the germination of the barley, it must take up a certain amount of moisture, and the art of steeping consists in just gauging the right length of time that the barley should remain covered with water. A good deal depends on the kind of water used and upon the temperature. The time generally allowed is from forty to fifty hours, but it varies considerably in different places. In Vienna forty-eight hours are allowed, in Bohemia about twenty-six hours, in Bavaria about seventy-two hours.

The couching consists in transferring the soaked or steeped barley to a square frame, where it is nicely levelled with a depth of not more than thirty inches, and left for about twenty hours. The object of this is to promote the heating of the grain and to start the germination. Sometimes the grain is laid deeper, or it may be covered with sacks, or it may be left on the couch for a longer time. As soon as germination commences an agreeable odour is exhaled, the barley begins to sweat, and a small white bud is seen to project from the base of each corn.

The flooring of the barley must now take place, and this consists in spreading the growing grain over the floor at a depth at first of about twelve inches, and later from four to five inches. The mass must be turned every four or five hours so that it shall get equally exposed to light, heat and moisture, and that the growth may be evenly maintained throughout the whole. The average length of time occupied in this flooring process is in England from nine to thirteen days.

The final process is that of kiln drying in order to stop further growth. A good deal of care has to be exercised in managing the temperature of the kiln in order to get the best results. The barley has to be frequently turned. The result of the kiln drying is that germination is stopped, moisture is driven off, and the malt is brought to a condition in which it may be stored without spoiling. The kiln drying occupies about forty-eight hours. Patent malt may be prepared in a much shorter time by being roasted in cylinders, something like those used for roasting coffee. There is considerable loss of weight in the process of malting, from eighteen to twenty per cent., made up as follows: In steeping about two per cent. of soluble matter is removed. About two per cent. is lost on the malt floor by the evolution of carbonic acid gas, about four per cent. in the rootlets which are rubbed off after the kiln drying, and from ten to twelve per cent. of moisture.

The following is an analysis of the composition of malt by Christopher.

Water	7·51
Dextrin	5·47
Maltose	8·83
Starch	48·77
Albuminoids (insoluble)	1·84
Albuminoids (soluble)	10·71
Ash	2·50
Woody fibre, etc.	14·37
	100·00

The weight of malt varies from 39 lbs. to 44 lbs. per bushel.

Mashing. A great deal depends on the kind of water used in the making of beer. For making light colour, sound keeping clear ales, a hard water is necessary. The water used by the two great firms at Burton-on-Trent contain particularly high percentages of salts of lime and magnesia. The total grains per gallon of solid inorganic matter in the water used by Bass reaches 78·44, whilst that used by Allsopp has 65·28, and that by two Edinburgh firms of ale brewers 62·16 and 56·42 respectively. With soft waters it is difficult to get the requisite amount of clearness, so that in London and Dublin where the water is of this character, porters and stouts are made in preference to ale, as in their case clearness is not essential. Two Dublin waters give only 23·79 and 23·51 grains of solid inorganic matter per gallon, whilst the London waters are still lower, viz., Thames Companies, 18·5 grains, New River, 17·6, Kent Company 26·5. These soft waters can be artificially hardened, and that course is frequently adopted.

There are many minor differences in the practice of brewing, but the general principle is the same throughout.

The malt is first ground to break the hard outer shell and to allow of the free access of water, and is then mixed with a fairly large proportion of unmalted barley, rice, or maize, and this mixture known as grist is placed in the mash tun, an immense vessel with a false bottom and machinery that can be set in motion for stirring the whole together. Great attention is paid to the temperature of the water that is run on, it must neither be too hot nor too cold, about 170°F. being generally used. Another important consideration is the length of time the mashing process goes on.

The important work done in the mash tun is that of causing the diastase of the malt to act upon the starch in the malt and in the unmalted grain, resulting in its conversion to that form of sugar known as maltose or glucose. This is dissolved into the liquor. Some of the soluble salts of the grain and the soluble albuminoids are also dissolved. The mashing process lasts from two to five hours, but seldom beyond, as without a special plant the temperature cannot be maintained for a longer time.

The liquid at the end of the mashing process is called sweet wort.

In many breweries a proportion of cane sugar is added to the wort, and this is quickly converted into glucose or maltose. In 1896, 2,440,985 cwts. of sugar were so used in the breweries of Great Britain.

The total solids in the unboiled wort are as follows :—

Maltose	6·66 per cent.
Dextrin	3·44 ,, ,,
Other Fermentable Matter ..	3·30 ,, ,,
Unfermentable Matter	1·48 ,, ,,
Albuminoids	1·45 ,, ,,
Ash, Phosphates, etc.	0·17 ,, ,,
	16·50

The remainder of course being water.

The grains from which the sweet wort has been produced still contain a large proportion of nourishment, and they are a valuable commodity on the market for feeding cows, pigs, and cattle. In many cases the grains are dried by elaborate processes that they may be stored for a considerable time, more easily moved from place to place, and even exported.

The fact that these grains form so good a feed, is an absolute proof that the beer does not contain all the properties of the barley.

Boiling. The next process is that of boiling with hops in large coppers. The usual length of time for this operation is from an hour and a half to three hours. Its object is to absolutely prevent any after putrefactive changes, and to extract from the hop-leaf the essential bitter principle that gives to the beer its flavour, and also some degree of preservative quality.

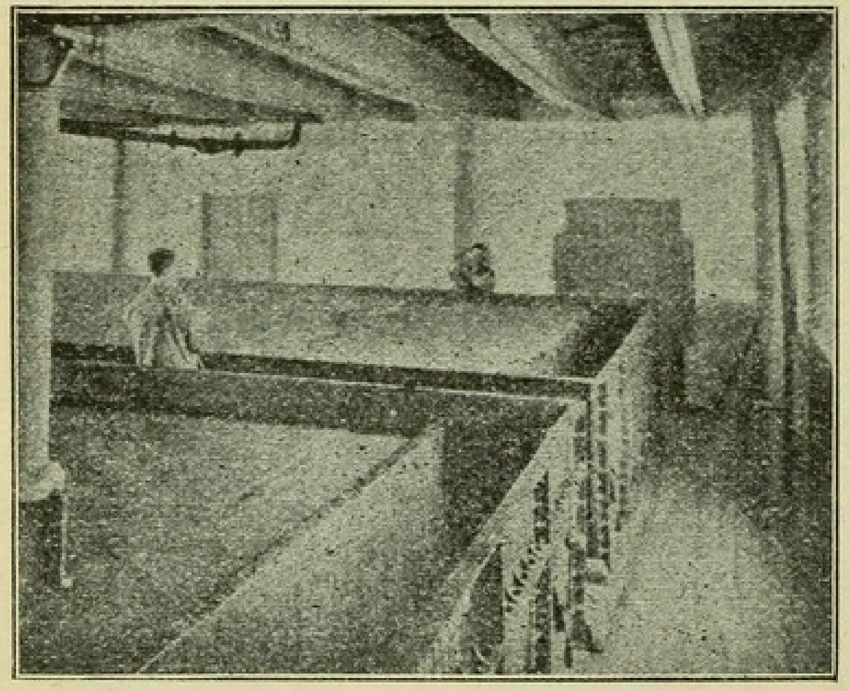
The following is a fair average composition of hops :—

Volatile Oil	2·00	per cent.
Lupulin	10·30	,,
Resin	55·00	,,
Lignin	32·00	,,
Loss	0·70	,,
	100·00	

Hop Substitutes. These are by no means uncommon, and among the many things tried may be mentioned the following: gentian, quassia, aloes, marsh trefoil, broom, wormwood, cocculus indicus, opium, grains of paradise, tobacco, picric acid, and strychnine. Fortunately most of these have dropped out of use, and some of them, such as strychnine, have only been used in the rarest cases. The three that are most commonly used are gentian, quassia, and in some cases picric acid. There is little to be said against the use of gentian and quassia; a bitter principle is obtained from them similar to that of hops, but less agreeable.

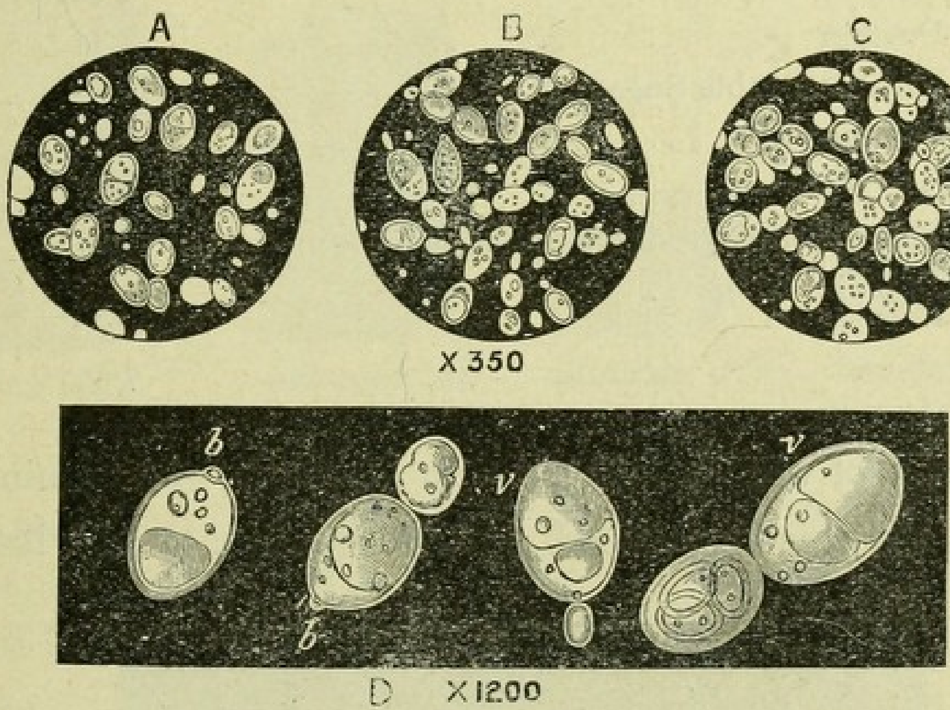
Cooling and Fermentation.

Undoubtedly the most important part of brewing is fermentation. All the other processes have been governed with a view of getting the best possible results at this stage. After the boiling, the liquor is cooled in refrigerators. One object of this is to save time, and another to render less likely objectionable putrefactive changes. It would be out of place to enter upon a study of the various theories concerning fermentive processes and of the various fermenting agents. The brief fact may be stated that when fermentation occurs, it always gives rise to chemical changes, which vary according to the substance undergoing fermentation and the fermenting agent that is at work.



FERMENTING VATS.

Yeast is the agent used in brewing. It is a peculiar low form of vegetable life, that in a suitable medium (such as sweet wort) grows with great rapidity, causing a working of the liquor, with a breaking down of the sugar (glucose), the formation of alcohol and the evolution of carbonic acid gas. There are several varieties of yeast, that in common use in



YEAST CELLS, TORULA CEREVISIÆ.

A. Cells at Rest; B. Cells Growing; C. Cells in Chains; D. Cells very highly Magnified, *b*. Bud, *v*. Vacuole or Watery Space.

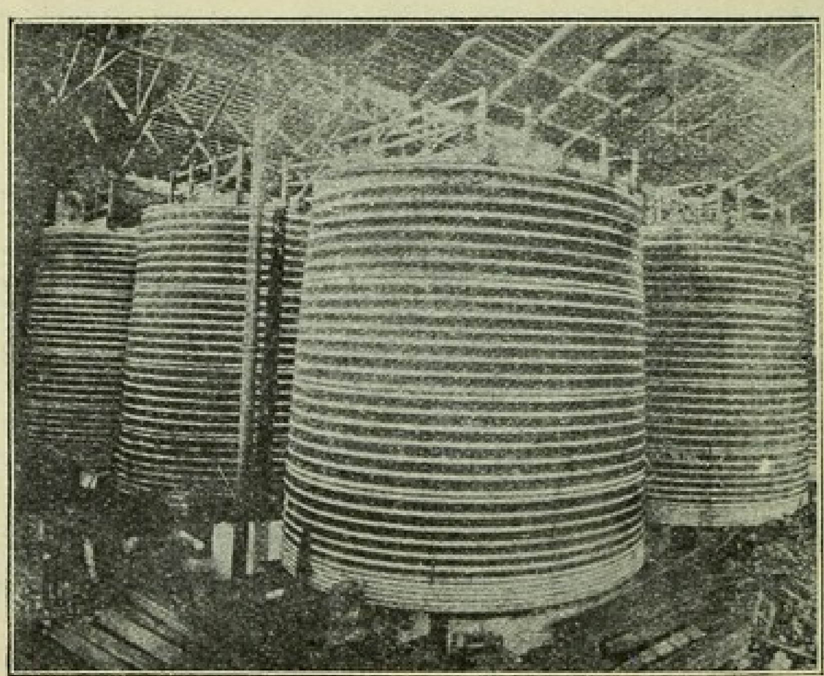
English breweries being known as the *torula* or *saccharomyces cerevisiæ*. The microscopical appearance of yeast is that of a number of round or oval cells. They are transparent, with one or two vacuoles. They propagate by the process known as budding. The yeast rises upon the surface of the fermenting liquid in the form of a thick froth or scum which is easily skimmed off.

The remaining processes are of minor importance, yet of course absolutely necessary, they consist in cleansing, maturing, and vatting the beer ready for transference to the casks by means of which it is to be distributed.

The total solids in the fermented liquid, taking an average, only amount to about 7·66 per cent. of the whole, and are made up as follows :—

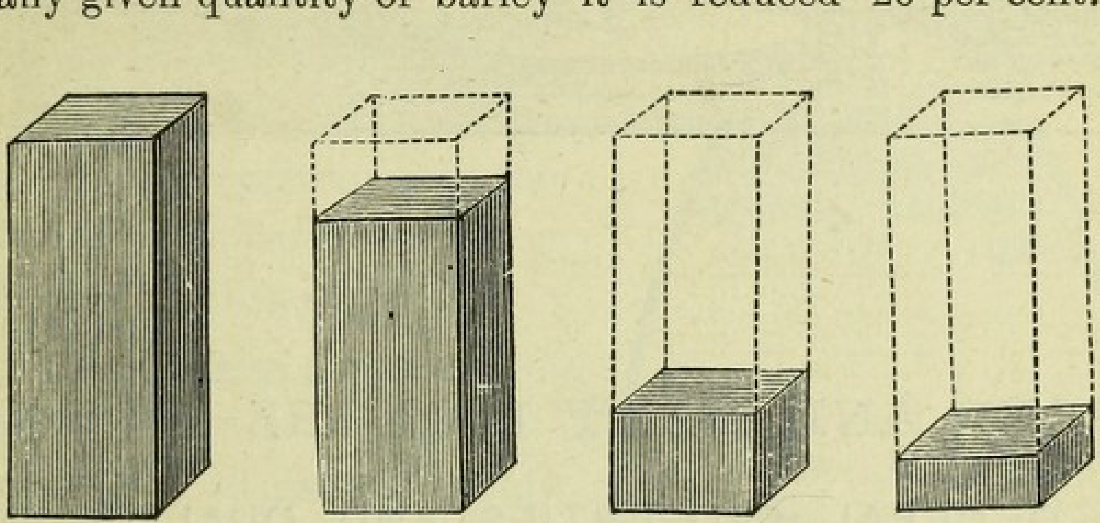
	PER CENT.
Maltose	1·52
Dextrin	3·44
Unfermentable Sugary Matter	1·00
Albumenoids	0·66
Hop Extract	0·33
Non-Volatile Products of Fermentation ..	0·47
Ash	0·24
	7·66

A barrel of wort would contain 5·546 lbs. of albuminous matter, but this is reduced by fermentation to 2·44 lbs. in



VAT HOUSE.

the barrel of beer. There is a loss then of 3·1 lbs. of albumenoids by the fermenting process. From the food standpoint there is a constant destruction or loss of nutritious material all the way through. Starting with any given quantity of barley it is reduced 20 per cent. in



BARLEY. REDUCED BY MALTING. REDUCED BY MASHING. REDUCED BY FERMENTATION

the malting. This reduction is increased to about 70 per cent. of the original in mashing, and again reduced till the final loss shows about 85 per cent. of the original qualities lost.

BEER AND MALT LIQUORS—*continued.*

GENERAL PROPERTIES AND QUALITY.

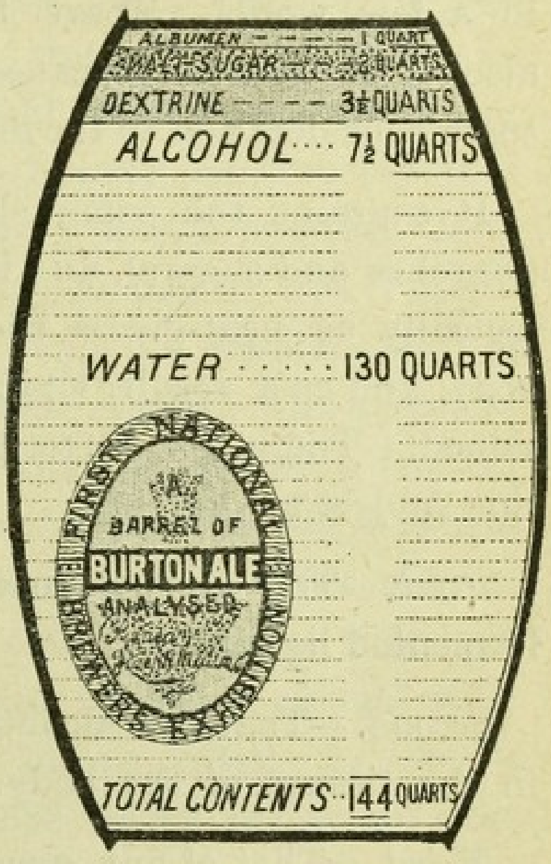
CHAPTER XVII.

Composition of Beer.

THE composition of the solids of some beers is, shown in the table at foot by Professor Charles Graham, and the respective nutrient qualities will be found to be very small. In some ales, notably India pale ale, the proportion of alcohol is considerably higher than those given in the following table.

Name of Beer.	Maltose.	Dextrine.	Albu-menoid	Ash and Color-ing.	Acetic and other Acid.	Alcohol
Burton Pale Ale ..	1·75	2·48	0·21	0·55	0·16	5·37
Burton Bitter Ale..	1·62	2·60	0·16	0·87	0·18	5·44
Mild X	1·87	1·88	0·20	1·30	0·18	4·60
Treble X	2·88	2·04	0·30	1·48	0·12	6·50
Scotch Bitter ..	1·62	2·50	0·30	0·70	0·25	5·00
Dublin Stout XX..	3·45	3·07	0·26	1·76	0·18	5·50
Dublin Stout XXX	5·35	2·09	0·43	1·40	0·29	6·78
Vienna Lager ..	1·64	2·74	0·36	1·12	0·15	4·69
Pilsen Lager ..	0·69	2·65	0·20	0·59	0·11	3·39
Munich Lager ..	1·57	3·15	0·40	1·82	0.15	4·75

One of the best illustrations of the non-nourishing quality of malt liquors is that furnished by the brewers themselves at the Brewers' Exhibition, held in London some years since, and pictorially represented in the figure of a barrel of Burton ale by Mr. Joseph Malins.



The contents of the barrel work out as follows:—Contents, 36 gallons or 144 quarts.

130	quarts	of	Water.
7½	,,	,,	Alcohol.
3½	,,	,,	Extractive (Dextrin, etc.).
2	,,	,,	Maltose (Sugar).
1	,,	,,	Albumenoid.
144			

As only the last two items can properly be termed foods, it will be seen that the proportion is exceedingly small. It is asserted that the nutriment in a gallon of ale costing two shillings is no more than that furnished by a penny loaf.

Dietetic Value of Beers.

At the best, the various forms of malt liquor can only be classed as food adjuncts, but a careful consideration of all the properties of beer, etc., would seem to remove them even from this position and relegate them to a class of beverages more or less unnecessary, and possibly injurious. The one point to which importance is attached by those who use these beverages, is that the alcohol itself is in a sense a food, and that therefore there is a great advantage in using such beverages where it is present in moderate quantity. The question cannot be discussed here, it being far too large a one to be dismissed in a few words. Apart from the positive injury that alcohol is known to cause physiologically, we may give some consideration to the one point that it is not a food.

It contains the same elements as the carbo-hydrates, (starches and sugars), and fats. These are known physiologically as heat-givers because they are oxidized in the body, and as a result, vitality and temperature are maintained. There are three points on which all students of this subject are agreed.

First.—That alcohol enters the body with all kinds of fermented liquids.

Second.—That the alcohol is not stored up indefinitely in the tissues of the body.

Third.—That of any given quantity of alcohol administered, only a proportion, and that not the largest, can be traced in the various excreta of the body.

The deduction commonly drawn from these facts is, that if they be true, then alcohol must be utilized in the body, and it is therefore a food. This, however, is a deduction made without a consideration of all the facts. Coal is a natural fuel for a furnace, sulphur could also be burnt to generate steam, but it would not be a proper fuel, for the action of the sulphur, although it would be burnt in the same way as the coal, yet it would cause serious deterioration in the furnace and the boiler. The illustration is not a perfect one, but it brings out this point that although the alcohol is used, its mere use does not demonstrate that it is a food, for in being used it may result in harm and not in good.

Many close scientific observers, supported by a vast amount of experience, confirm this. According to its chemical constitution alcohol should create heat if anything, and yet it is absolutely proved beyond controversy that this result is not attained. Every Arctic explorer, from Franklin to the present day, has confirmed this. Temperature is reduced by its use, and not maintained. It is not therefore a food in this sense. Its chemical composition at once proclaims that it is not a food in any other sense. A large number of observers and students of this question, including some of the most notable medical men, agree that the human body is as well, and in a vast number of cases, better without alcohol than with it. Dr. Andrew Wilson, in an article in *Lloyd's* newspaper of February 20th, 1898, after saying all that he can in favour of the use of alcohol, sums up the matter in the following emphatic words:—"But, I must add again, that it is not a necessity of healthy life, and that it is absolutely injurious to the growing body. If it may lessen our waste as adults, it will stop or arrest the nutrition of the young. It has a special action apparently on the blood globules, and hinders them in their work of nutrition, and so the young should be absolutely prohibited from its use. The gin-fed baby of the slums, in all its shrivelled weakness, is a testimony to the injury alcohol inflicts in the early stages of life."

We can only ascribe the tremendous use of this beverage then to habit, custom, and popular taste, and not to any beneficial qualities that it contains.

Adulteration of Beer.

It has been often urged that the pernicious qualities of beers do not so much result from the alcohol they contain, as from the various ingredients with which they are adulterated. It is doubtful if this is true. It is quite certain that in large and well-managed breweries the practice of adulteration is unknown. Generally the adulterants are added by unscrupulous publicans, and possibly by some brewers.

In Parke's "Practical Hygiene" the following adulterants are mentioned, and the reasons for their use :—

" Water, probably the most frequent adulterant.

" 'Sodium and calcium carbonates' added to lessen acidity.

" Common salt. The Inland Revenue Office allows fifty grains of salt per gallon; if more than this quantity is present it is an adulterant.

" Alum, salt, and ferrous sulphate is a mixture that is added to give 'head' to the beer.

" Sulphuric acid is added to give beer the hard flavour of age."

The chief adulterants in use are perhaps salicylic acid as a preservative, and the various bitter principles as substitutes for hops.

Cases are not unknown where bulk has been increased by water, and then treacle, liquorice, salt and narcotic substances used to disguise the fact that water had been added.

Advertisements of various preparations are not uncommon in trade journals, proposing to help the brewer to make his wares more attractive, such as priming crystals, saccharosite carameline, etc. One of these advertisements in the Inland Revenue Year Book for 1897, runs thus :—

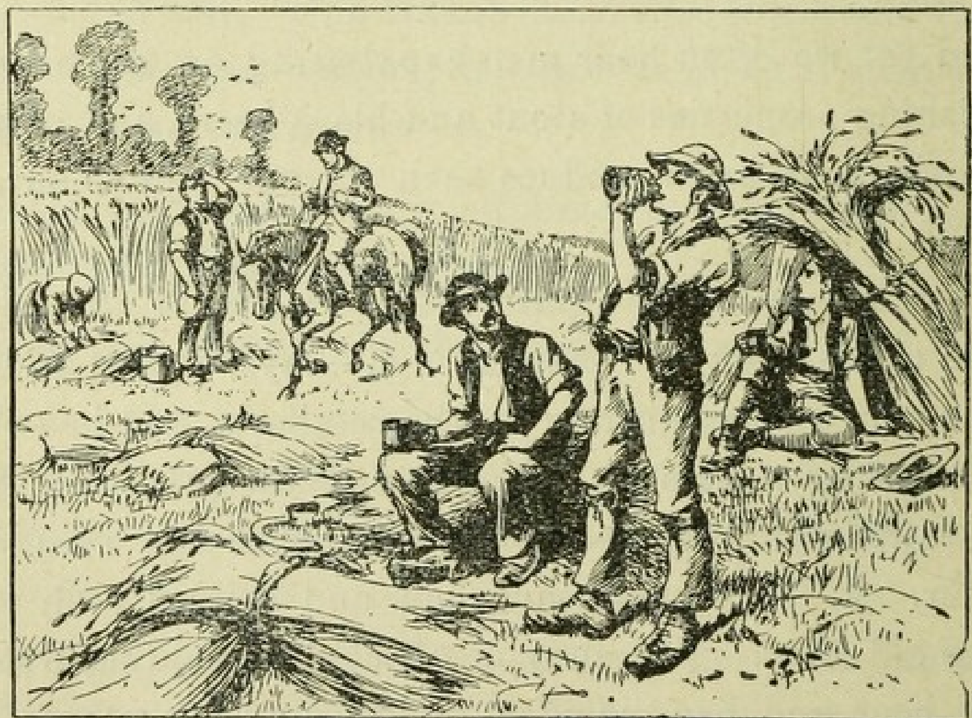
"Carameline, for flavour, a most important point in stout production. Two hundredweight of this article is sufficient for every fifty barrels of wort in copper. Brewers wishing to increase their black beer trade should not fail to give carameline a trial. It is a thoroughly reliable article, easy of manipulation, giving to black beers a lasting, luscious flavour and palate fulness and a rich brown head."

Another advertisement appearing in the "Brewers' Almanack" for 1898, of brewing requisites, includes finings, sulphurous acid, bisulphites, isinglass, hydrosulphites of magnesia, potassium and sodium, sulphite of lime, heading powder, and bicarbonates of potassium and sodium.

And yet we often hear men expatiating on the excellent nourishing properties of stout and black beers, and how rich the malt must be to produce such flavour, and colour, and "head."

We may sum up this matter in the words of Dr. Edward Smith in his work on "Foods." He says, "The adulteration occurs almost entirely at the retailer's, and has one of the following objects :—1. To increase the quantity. 2. To give intoxicating power. 3. To increase the colour and flavour. 4. To create pungency and thirst ; and, 5. To revive old beer. The first is effected by adding water or weak beer and has the effect of lowering the proportion of all the constituents and of lessening the flavour. The second is effected by adding tobacco or the seeds of the *coculus indicus ;* the third by adding burnt sugar, liquorice, or treacle, quassia instead of hops, coriander and carraway seeds; the fourth by the addition of cayenne pepper or common salt, and the fifth by shaking stale ale with green vitriol, alum and common salt."

A committee appointed by the Treasury is sitting at the present time to take evidence on this subject and to report thereon. At the eleventh meeting of this committee a Mr. Stopes was under examination, and in his evidence he handed in a list of the names of materials for use in brewing advertised in the *Brewing Trade Review* and the *Brewers' Journal*, the different substances amounting to a total of 190. Some of these he submitted were deleterious. (*Extract from Brewers' Almanack*, 1898, p. 114).



Wine is ... the natural food of the ...
It is the duty of the drinking classes to drink ...
André L. Simon

WINES.

CHAPTER XVIII.

NEXT to water and milk, wine is certainly the most ancient beverage in the world. Of its actual discovery nothing is known. The earliest record of its use is that given in Genesis ix. 20, "Noah planted a vineyard and drank of the vine." This would be about 2347 B.C. In an Italian treatise "On the Art of making Wine," published last century, the following is attributed to *Mutardi-ben-Gasif*, an Arab author, A.D. 1310 :—"Noah being come out of the ark, ordered each of his sons to build a house. Afterwards they were occupied in sowing and in planting trees, the pippins and fruit of which they had found in the ark. The vine alone was wanting, and they could not discover it.

Historical Notice.

Gabriel then informed them that the Devil had desired it, and indeed had some right to it. Thereupon Noah summoned him to appear in the field, and said to him, 'Oh cursed! why hast thou carried away the vine from me?' 'Because,' replied the Devil, 'it belonged to me.' 'Shall I part it for you?' said Gabriel. 'I consent,' answered Noah, 'and will leave him a fourth.' 'That is not sufficient for him,' said Gabriel. 'Well, I will take half,' replied Noah, 'and he shall take the other.' 'That is not sufficient, yet,' said Gabriel, he must have *two-thirds* and thou *one*; and when thy *wine* shall have boiled upon the fire until two-thirds are gone the remainder shall be assigned for your use.'" This of course would render the wine un-intoxicating.

Sir Benjamin Ward Richardson, speaking of the early use of wine, says, "In the early history of the world someone unfortunately found out wine. Grapes had fallen and rain had probably mixed with the juice of the grape—in some pit, or well, or empty fountain—and the fermenting substance on the outside of the grapes had caused them to undergo change. The sugar passed into alcohol, and that mixed with water constituted what was called wine."

Many of the ancient historians refer to the manufacture of wine. Homer, who lived 900 years B.C., and who is the most ancient of all the profane writers whose works have reached us, frequently mentions wine, bestowing on it the epithet "divine," and notices its effects on mind and body.

Democritus, 351 years B.C., refers to the fact that the Lacedæmonians boiled their wines till one fifth part was consumed, then after four years would drink them.

Aristotle, who lived about the same time, mentions that "the wines of Arcadia are so thick that they can be scraped from the skins of the bottles containing them."

Virgil, who was born 70 B.C., refers to the processes of wine-making in his "Georgics." "Or with fire boils away the moisture of sweet wine."

Columella, who was contemporary with the Apostles, mentions that "in Italy and Greece it was common to boil their wines," and Plutarch, who lived 70 A.D., refers to the fact that "wine is rendered feeble in strength when it is frequently filtered."

As showing that the ancients were not wanting in methods of sophistication the following extract is not uninteresting. "It was not merely honey that the Romans and Greeks mixed with their wines. To render these grateful and palatable to the epicures of the period, aloes, tincture of tar, bitter almonds, dried figs, thyme, and myrtle leaves were added, and what may appear more incredible, with certain kinds, such as those of Rhodes, Chio, and Lesbos, a proportion of sea water was thought to be a decided improvement. It is hardly surprising, considering this ancient mode of treating wines, that gastric maladies were common with the Greeks and Romans, and that Julius Cæsar was invariably taken ill on rising from the table."

There are records that a colony of vine dressers from Phocaea in Ionia, founded Massilia (Marseilles) and instructed the South Gauls in tillage, vine dressing, and commerce about 539 years B.C.

It is thought by some that vines are aborigines of Languedoc, Provence, and Sicily, and that they grew spontaneously on the Mediterranean shores of Italy, France, and Spain. The Vine was carried into Champagne and part of Germany by the Emperor Probus about A.D. 279. The vine and sugar cane were planted in Madeira in 1420.

Wine was sold in England in 1300 by the apothecaries. In 1381 the price was regulated by a statute of Richard II. In 1400 the price was twelve shillings a pipe.

In Stow's "Chronicles" there is a record of a hundred and fifty butts of wine being condemned as adulterated, and ordered to be staved and emptied into the channels of the streets by the Mayor of London.

The first Act for licensing sellers of wine appears to have been passed in 1661.

The cultivation of the vine beginning in the East and the Mediterranean lands, extended northward and westward until at present, France is the chief wine-producing country whilst Germany, Austria, Spain, and Portugal, have all established wine industries of vast extent.

About the Vine.

There are about twenty-one species of the vine, and the varieties into which these may be sub-divided are innumerable. Some years since the French Government, with a view to the perfection of the vine, formed a nursery at the Luxembourg, the superintendent of which collected no less than 1,400 different varieties and he was then far from possessing all the different kinds that were known in France. Soil, climate, and culture are the factors that govern the production of such an immense variety.

It is estimated that nearly two thousand varieties which are cultivated in Europe are all derived from the single species, *vitis vinifera.*

It seems that a very slight alteration in conditions changes the quality and properties of the grape. So great is the influence of a favourable position that a considerable difference will sometimes be found between the produce of one part of a vineyard and another. It is said that the famous Rhine wine, *Johannisberg*, when made from grapes growing near the castle is worth twice as much as that made from grapes growing a few hundred yards off.

The *Clos de Vougeôt* which produces the finest Burgundy is confined to a few acres. Outside the walls the wine is of but moderate quality. A certain variety of grape when grown upon the Rhine produces Hock, the same grape when raised in the valley of the Tagus yields Bucellas; whilst in the island of Madeira it produces a wine known as Sercial, which has a flavour quite distinct from either of the other two. It is the natural quality of the soil and position that govern the quality and condition of the grape, and it does not depend so much on manuring and other conditions. A celebrated vineyard many years ago in the possession of General Kellerman was much reduced in value by being manured, and it was several years before it regained its former reputation.

The vine will grow in any soil which is not in contact with stagnant waters. A dry, light, sandy soil, particularly

argilo-graveleux

those that are chalky, suit it best. In Italy and Sicily the choicest plants grow amongst the rubbish of volcanoes.

The majority of vines are planted on hilly ground and wines of the highest class are made from such as thrive amongst stone and loose pieces of rock. A long and warm summer and a district where the temperature seldom falls below 50°F. are conditions that give an abundance of mature and well flavoured fruit. Grapes that yield the most saccharine matter as a rule make the best wine.

It is unnecessary here to enter upon the many and varied points of culture such as planting, training, propping and especially judicious pruning of the vine, nor upon the various enemies that the vine grower has to contend against, such as phylloxera, an insect whose ravages were so great a few years since that the vineyards were decimated and a prize of £12,000 was offered for a remedy. The successful treatment of M. Pasteur has, to a large extent, removed this scourge.

The vine is one of the most prolific of fruit-bearing trees, and in this country with artificial heat in a vinery some extraordinary results have been produced.

A Syrian vine grown in the vineries at Welbeck Abbey, the seat of the Duke of Portland, yielded in 1781 an enormous supply, the largest bunch weighing 19½ lbs. and measuring in length 21 inches, in diameter 19 inches, and in circumference 4 ft. 6 inches.

The famous vine at Hampton Court Palace has a stem more than a foot in circumference, one of its branches measures 114 feet in length, and it has produced in one season as many as 2,200 bunches averaging one pound weight each, or nearly a ton of fruit in all.

Another well-known vine at Valentine House, Essex, has given a yield of over 2,000 bunches, whilst in 1789, a famous vine growing at Northallerton, covered a space of 137 square yards.

Besides being of a prolific character as far as quantity is concerned, the vine has remarkable endurance. Its wood is very hard and durable, and cases are not at all rare of its continuing fruitful for at least three or four hundred years. A vineyard 100 years old is considered young. Pliny speaks of a vine that had existed six hundred years, and there are many vines in Burgundy reputed upwards of 400 years old.

Properties of the Grape.

A luscious, wholesome fruit, attractive to the eye, pleasant to the taste, grateful to the palate, and full of nourishing and beneficent qualities, the grape can easily hold her own as the queen of all fruits.

It is a round or oval fruit, two-celled and four-seeded, varying greatly in size, colour, and flavour. The small Corinth grape or currant is only a quarter of an inch in diameter, whilst many of the more highly cultivated vines yield a fruit nearly an inch in diameter. There is also a seedless variety known as the Ascalon or Sultana raisin. The colours vary — green, yellow, red, purple and sometimes variegated—but are in all cases only skin deep, the juice being colourless.

CLUSTER OF GRAPES.

Recently, by what may be almost called a trick of cultivation, a grape has been produced that yields a reddish-tinted juice, but this is more of a curiosity than a marketable commodity.

The pulp of the grape is wholesome, nutritious, and gently laxative, the skin is astringent and indigestible.

Both in the dried and fresh state, the grape is of great importance, not only as an article of commerce, but because it forms a great part of the food of the inhabitants of some countries.

When dried, the grapes are known as currants and raisins, and may then be kept in a good condition for a very long time, and fill an important place in the dietary of many civilized countries. In those countries where the grape abounds, especially in Syria and the East, grapes, either fresh or dried, with bread form a staple food amongst the people.

Constituents of Grapes.

The constituents of grapes vary greatly according to kind. We have already seen that there is immense variety, and as there must be some chemical difference in order to establish varieties of flavour, etc., it follows that there must be great difference in various analyses. The following will help us to see the general properties :—

Professor Church gives the following, as being the average constituents of fresh grapes :—

	In 100 Parts.	In 1 lb. ozs.	In 1 lb. grains.
Water	80·0	12	350
Albumen	0·7	0	49
Sugar	13·0	2	35
Tartaric Acid ..	0·8	0	56
Pectose and Gum..	3·1	0	217
Cellulose	2·0	0	140
Mineral Matter ..	0·4	0	28
	100·00		

Dr. Winter Blyth gives the following :—

Water	78·17
Albumen	0·59
Acid	0·79
Sugar	14·36
Gum, etc.	1·96
Wood Fibre (Cellulose)	3·60
Mineral Matter	0·53
	100·00

The expressed grape juice gives a slightly different result owing to the removal of the skins and pips.

Three samples of grape juice analysed by Neubauer yielded the following :—

Constituents.	Neroberger Riesling, 1868.	Steinberger Auslese, 1868.	Hattenheimer, 1868.
Water	76·72	70·78	69·92
Sugar	18·06	24·24	23·56
Acid	0·42	0·43	0·46
Albumenoids	0·22	0·18	0·19
Mineral Matter	0·47	0·45	0·44
Non-Nitrogenous Extract ..	4·11	3·92	5·43
	100·00	100·00	100·00

The fresh grape is absolutely free from alcohol. It would almost seem as though nature had taken especial pains that alcohol should not be present. The constituents of the grapes show that all the conditions for the production of alcohol are there, excepting the agent to start the process of fermentation. The fermentation germs are in the air, and attach themselves to the outside of the grape in common with everything else with which they come into contact, but owing to the tough and impervious skin the fermenting germs cannot reach the juice contained within, and so in the natural fruit there is no trace of alcohol. It may be found in the rotting and decaying fruit but never in the fresh and wholesome fruit. When rotting begins there are chemical changes set up, resulting in the decomposition of the constituents, and in that general change of material a certain proportion of alcohol may be formed. The rotting fruit is that which we should naturally reject, it is the wholesome fruit devoid of alcohol, but retaining all its other good properties, that we should seek.

WINES—*continued.*

CHAPTER XIX.

Extent of the Wine Industry.

It is almost impossible for those living in England to realize the vastness of the wine industry and the important place it occupies in what are known as wine growing countries. The following table of the wine production of the world for 1888 will be interesting, as showing the enormous quantity produced, and the proportions yielded by each of the wine-growing countries. Another interesting item is, that the table shows how the vine, originally confined to a comparatively very small area, is now world-wide :—

	Gallons.
Australia	1,902,024
Austria	92,459,500
Algeria	72,072,781
Cape Colony	4,490,890
France	795,204,534
Greece	46,493,920
Hungary	184,919,000
Italy	798,242,489
Portugal	132,085,000
Roumania	18,491,900
Russia	92,459,500
Servia	52,834,000
Spain	607,591,000
Switzerland	29,058,700
Turkey	68,684,200
United States	32,000,000

Making a total of about 3,029 millions of gallons, without reckoning many minor countries and districts where wine is produced, such as Chili, Tunis, China, Morocco, Brazil, Egypt, etc.

It is difficult to get exact information where the area is so widespread, and the nationalities so different, but we may get some idea of the magnitude of wine cultivation by taking the vineyard area and production of the vintage of France, in 1873, as given by Vizetelly in his "Wines of the World."

A VINTAGE SCENE IN THE CHAMPAGNE

Total of acres laid out in vineyards, 5,883,658. Average annual produce in gallons during the preceding ten years, 1,176,076,199 gallons. Total produce in wine for the year 1873, 786,088,916 gallons. Total value of wine produced in 1873, £59,766,069.

When the Vienna Exhibition was held there was a special invitation to all wine countries to send samples, for the best of which special awards were made. In response to this comprehensive appeal over twenty thousand samples of fermented drinks were sent in, the majority being wines.

The following figures from the Reports of the Commissioners of Inland Revenue and Customs show what proportion of these foreign wines are consumed in this country :—

1852	..	6,346,061	gallons,	being	·231	of a gallon	per head.
1862	..	9,764,155	,,	,,	·334	,,	,,
1872	..	16,765,444	,,	,,	·526	,,	,,
1882	..	14,339,070	,,	,,	·407	,,	,,
1892	..	14,538,048	,,	,,	·381	,,	,,
1896	..	15,776,093	,,	,,	·403	,,	,,

In 1896 the actual quantity of wine imported was 16,695,560 gallons, but nearly a million gallons of this was exported again.

In addition to this there is an enormous consumption of the so-called British wines and home-made wines; also of cider and perry, which are true wines.

Chemical reasons for using Grapes for Wine.

All fruits, especially those containing a large amount of sugar, can easily be made into wines, and the general principles of the manufacture are the same throughout.

It may be enquired why the grape, above all other fruits, should be selected and cultivated so largely for wine making. There is a good chemical reason for this, although no doubt it was experience rather than chemical knowledge, that gave the grape the preference. All the fruits that might be suitable for wine making contain organic acids, and these acids vary very much in chemical composition, and consequently in flavour. In apples and pears malic acid is present. In oranges, citric acid. In gooseberries, currants, and other fruits, citric acid in

$H^6 C^2 O^1$ = Wine alcohol

conjunction with some other acid. Grapes contain tartaric acid. Now these acids do not exist free, and in a pure form, in these fruits. They are in combination with alkalies forming salts. These salts, with one exception, are soluble in water, and that exception occurs in the acid potassium tartrate of the grape.

In the manufacture of the wine the tartaric acid of the grape is converted into acid potassium tartrate (cream of tartar), which is insoluble in water. It is therefore deposited and the wine is not too sour.

But in the case of other fruits the acids form soluble compounds which remain in the wine, and necessitates the addition of sugar to overcome the excessive acidity.

Manufacture of Wine.

It may readily be imagined that with so extensive a range of wines, in so many various countries, there will be a great variety of method and treatment. The manufacture of champagne will widely differ from that of claret or sherry. There are general principles that apply to all, and it is those principles that will be considered here.

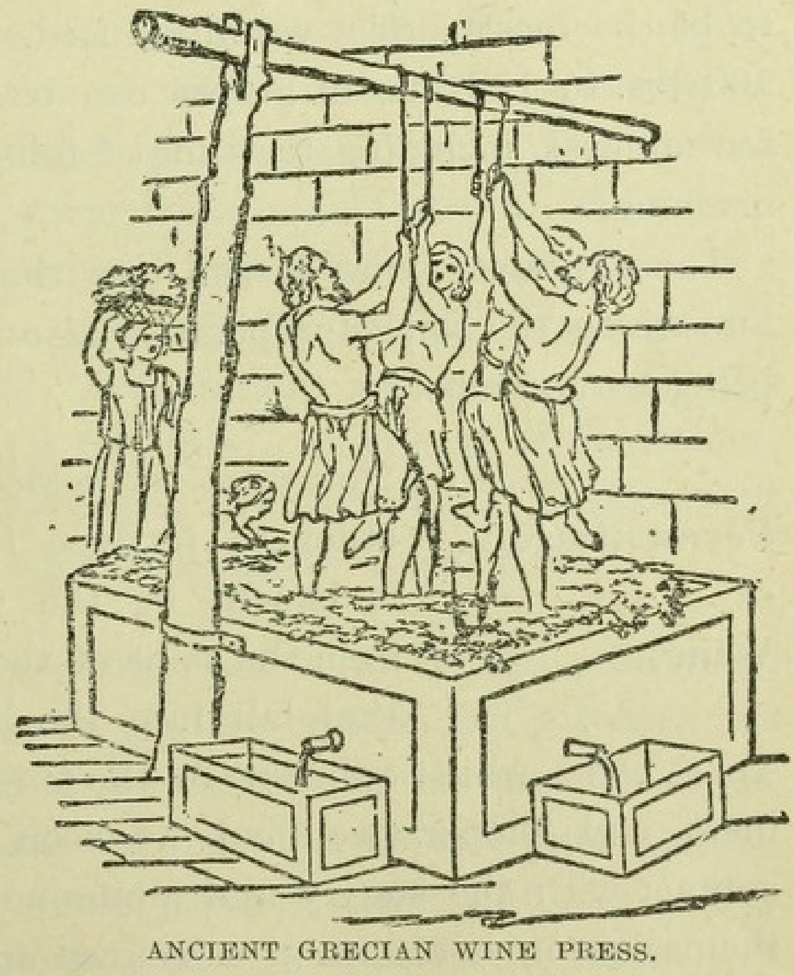
The grapes are taken for wine making only when they are fully ripe, and even a slight amount of over ripening is not objected to, as the object is to get the largest possible amount of saccharine matter developed in the fruit. The grapes of the white vine are of a brown yellow when ready for gathering for wine, and those of the red and purple variety must be extremely dark before the seed will separate from the fleshy part of the grape sufficiently for wine-making purposes.

In some cases the grapes are plucked from the stems by hand, and in others by a wooden fork.

The stalk contains much tannic acid, and it is therefore necessary that all the grapes should be thoroughly separated before pressure. In some cases where the grape itself is known to be deficient in tannic acid a few stalks are purposely allowed to remain.

Pressing the Grapes.

The wine press is one of the most ancient pieces of apparatus known. In Wilkinson's *Ancient Egyptians* there is a figure given of a wine press in which men are shown treading the grapes with their feet, the juice running into receptacles below. The men are assisted in the process by holding on to ropes attached to the roof of the press. Our figure shows a Grecian press of the same description.



ANCIENT GRECIAN WINE PRESS.

The wine presses of the ancient Jews were generally hewn out of the solid rock, and consisted of two receptacles placed at different elevations, in the upper one of which the grapes were trodden, and the juice would flow into the lower one.

In some parts of Spain, Portugal, and Madeira, the the grapes are still trodden by the feet of men, but for the most part machinery has superseded this primitive method.

There was philosophy in treading the grapes, for it is essential that neither stalks nor pips should be crushed, or the essential oil they contain would spoil the flavour of the wine. The feet of men could effectually crush the grape without reducing either the stalk or the pips.

Various forms of presses are in use, but the centrifugal machine, invented by Steinbeis of Stuttgart, in 1862, seems to be the most perfect yet introduced. With this machine 100 lbs. to 120 lbs. of grapes can be perfectly pressed in ten minutes, including the time of filling and emptying the machine.

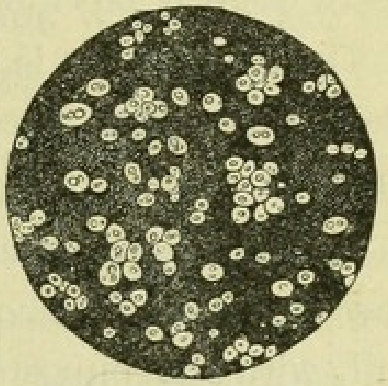
The expressed juice is run into the fermenting vessels, into which the skins and pips are also put, the whole mass being termed must.

Fermentation of Wine.

No yeast is added to the must in order to produce fermentation. This is caused by the yeast cells washed from the skins of the grapes and those that fall into the liquor from the air. These cells, whilst adherent to the outside of grapes, were inert and inoperative, but as soon as they come into contact with the sugary and albuminous liquid they find themselves in a congenial substance and at once begin to grow at a very rapid rate, and the two principal ingredients of the grape juice begin to undergo great chemical changes.

The albuminous matter is destroyed almost entirely, and the sugar is changed into alcohol and carbonic acid gas.

A good deal depends on temperature as to the kind of fermentation that occurs. It may be a surface fermentation taking place at temperatures of 15° to 26° C., as is the practice in Italy, Spain, and the south of France; or it may be a bottom fermentation taking place in cooler cellars at 5° to 12° C., as is the practice in Germany and with the finer French wines.



WINE FERMENT.

The first method produces a wine rich in alcohol, but without bouquet or aroma; the second method gives lighter wines with delicate bouquet owing to the formation of wine ethers. The fermentation process may be divided into three stages. The first or main fermentation which lasts from three to eight days in the case of the surface fermentation, and from two to four weeks in the case of the bottom fermentation; the second, or still fermentation, which lasts until the following spring; and the third, or storage fermentation, which lasts for several years, until by gradual development of its bouquet the wine becomes thoroughly ripe.

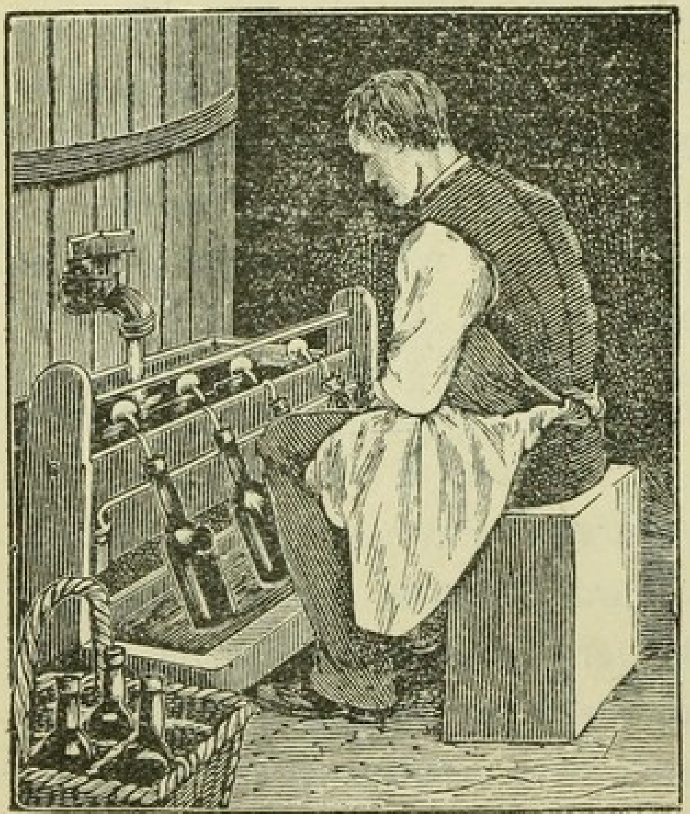
As the main fermentation comes to an end, the yeast with more or less tartar, gummy matter, and albumenoids settles to the bottom of the fermenting tub and the liquor is racked off into casks for the after or still fermentation. This racking off must take place promptly with the ending of the main fermentation, for if a considerable surface of the young wine is allowed to remain exposed to the air, Nature will take her course and start the acetic fermentation by which the alcohol will be changed into vinegar.

It would seem that in alcoholic fermentation it is not the production of alcohol that is the end of Nature's work, in all cases if left alone she would produce vinegar.

The art of man is necessary to step in at the alcoholic stage and arrest the inevitable result that Nature would produce.

The racking off into casks is the plan adopted to retain the wine at its alcoholic stage. The casks are kept perfectly full, with the bungs set loosely in place, so that the liquid shall be kept from exposure to the air.

During the still fermentation there is deposited on the interior of the casks the argol or impure potassium tartrate, with yeast and albumenoid matter.



BOTTLING WINE.

After a period of from three to six months the wine is racked off again into smaller casks to undergo the final ripening, and thence it is bottled ready for the market. The strong wines can be kept longer in casks than the weak ones, for the larger amount of alcohol tends to preserve them. The weak wines must soon be bottled or they may quickly be changed to vinegar.

Champagne is produced by somewhat modified methods. For this, the blue sweet grapes are preferred. They are quickly pressed after the gathering, and it is only the first pressing that is used. The must is run into casks in cool cellars, for the main fermentation which is retarded as much as possible. Cognac is added to the amount of about one per cent. so as to increase the alcoholic percentage and to retard fermentation. After the main fermentation is completed the liquid is racked off into casks and left stopped until winter. It is then cleared with isinglass and transferred to other casks, the operation being repeated in a month's time. About the following April the wines of different growths are mixed and the amount of sugar determined and a calculated additional quantity added in the form of "liqueur," and it is then ready for bottling. The bottles must be specially chosen, thick enough to stand a pressure of four or five atmospheres, and must have sloping sides. The wine after being corked is thoroughly secured by an iron fastening and arranged in piles in the champagne vaults. The bottles are placed in a slanting position neck downwards, and the incline is gradually increased day by day until the bottle is nearly perpendicular. All the sediment therefore falls upon the cork. Prior to the wines being shipped this cork is cleverly withdrawn by a man known as a "disgorger," the greater part of the yeast and other solid matters being ejected. The wine is now dosed again with "liqueur," the bottles filled up, wired and foil wrapped round the neck ready for shipment. Champagnes are wines in which a further fermentation

I saw this in Merciers Caves Epernay

takes place in the bottle whereby quantities of carbonic acid gas are developed and are then dissolved in the liquid under pressure. It is the escape of this gas on opening the bottle that causes the effervescence.

Fortified Wines.

All heavy wines like sherry, Malaga, and port are characterized by a high alcoholic percentage ranging from 16 to 22 or even more. Now as 12 to 13 per cent. seems to be the highest alcoholic strength that can be obtained by direct fermentation, it follows that all wines containing more must have had alcohol added. The wine maker gives two reasons for this. First, the additional alcohol is added to give the wine greater keeping qualities; and second, the additional alcohol is added to the must to prevent further fermentation, whilst a quantity of the natural sugar of the grape is still unchanged.

Constituents of Wine.

With the immense variety of wines it is impossible to give an analysis which will cover all. As a matter of fact, no two wines are alike in their constituents. The following analyses may give a general idea of the constituents of these drinks.

	Rudesheimer. (Rhine Wine).	Concord. (American Wine).	Port.	Sherry.
Water ..	88·01	87·93	77·656	76·41
Alcohol ..	9.30	8·83	18·560	20·00
Extract ..	1·97	2·10	2·690	2·50
Sugar ..	0·00	0·00	0·433	0·00
Mineral ..	0.22	0·42	0·248	0·45
Acid ..	0·50	0·72	0·413	0·64
Total ..	100·00	100·00	100·000	100·00

It will at once be seen that the principal constituents are water and alcohol. The remainder accounts for colour and flavour; in point of nutrition these beverages are totally deficient.

The question as to whether alcohol has any use in the body is a wide one. There are a large number of medical men and others qualified to judge of the matter, who assert that alcohol is not only not necessary to the healthy body, but is absolutely injurious, and if this be the case we may see what a vast difference there is between eating the natural fruit of the vine and drinking the fermented wine that may be made from it. As in the case of malt liquors, the process of wine making is really a work of destruction and not one of improvement.

Some years since an elaborate table was constructed by Mr. Brande, showing the percentage of alcohol by volume in a large number of wines. The following are selected from his table :—

1.	Lissa	25·41	21.	White Hermitage	17·43
2.	Raisin	25·12	22.	Roussillon	18·13
3.	Marsala	25·09	23.	Claret	15·10
4.	Port	22·96	24.	Zante	17·05
5.	Madeira	22·27	25.	Malmsey Madeira	16·40
6.	Sherry	19·17	26.	Lunel	15·52
7.	Teneriffe	19·79	27.	Shiraz	15·52
8.	Colares	19·75	28.	Syracuse	15·28
9.	Lachrymæ Christi	19·70	29.	Sauterne	14·22
10.	Constantia White	19·75	30.	Burgundy	14·57
11.	Constantia Red	18·92	31.	Hock	12·08
12.	Lisbon	18·94	32.	Nice	14·63
13.	Malaga	18·94	33.	Barsac	13·86
14.	Bucellas	18·49	34.	Tent	13·30
15.	Red Madeira	20·35	35.	Champagne	12·61
16.	Cape Muscat	18·25	36.	Red Hermitage	12·32
17.	Cape Madeira	20·51	37.	Vin de Grave	13·94
18.	Calcavella	18·65	38.	Frontignac	12·79
19.	Vidonia	19·25	39.	Côté Rôtie	12·32
20.	Alba Flora	17·26	40.	Tokay	9·88

The table shows the important fact that the majority of wines named have been fortified by the addition of spirit.

The following classification shows the country from which most of the wines mentioned in the table have been derived :—

FRENCH WINES.—Champagne, Burgundy, Hermitage, Rousillon, Frontignac, Claret, Latour, Vin de Grave, Sauterne, Barsac.

SPANISH WINES.—Sherry, Tent, Malaga, Alicante.

PORTUGUESE WINES.—Port, Bucellas, Lisbon, Calcavella, and Colares.

GERMAN WINES.—Rhine, Moselle, Hock.

HUNGARIAN WINE.—Tokay.

ITALIAN WINES.—Lachrymæ Christi, Marsala, Syracuse, Lissa.

CAPE WINES.—Cape Madeira, Red and White Constantia.

PERSIAN WINES.—Shiraz.

AUSTRIAN WINES.—Vöslaner, Goldeck, Steinberg.

ENGLISH WINES.—Grape, Raisin, Currant, Gooseberry, Ginger, etc.

M Reaud Paris 1874-5
had some Frontignan
and Frontignac also

See Ellert's book
page 79

WINES—*continued.*

CHAPTER XX.

ALL that has hitherto been said, has been in reference to what may be called genuine wine, that is, wine made solely from the fruit of the vine, but in addition to this there is a huge business done in what are essentially made, or artificial wines.

Made Wines.

Though in recent years the phylloxera has made such ravages in the French vineyards, there has been no corresponding falling off in the wine produce. One should have depended entirely upon the other—no grapes, no wine. The art of man has been able to overcome the difficulty, and consequently the trade in wines made from raisins and prunes has increased enormously. A product known as "Vin de raisin sec" is a close imitation of French natural wine. Spon, in his "Encyclopedia of Industrial Arts," gives the following as being the components of such a wine:—

White Sugar ..	5 kilos.	Common Brandy ..	12 litres.
Raisins	5 kilos.	Water	95 litres.
Common Salt ..	125 grammes.	Gall Nuts (bruised) ..	20 grammes.
Tartaric Acid ..	200 grammes.	Brewer's yeast ..	200 grammes.

To give this liquid the colour of wine it is only necessary to add to the above 250 to 300 grammes of dried holly-hocks, taking care to keep them at the bottom of the cask.

The reports of the consular agents show that the manufacture of this raisin wine has become an industry of large proportions in France at the present time.

The quantity of sugar used in the wine industry is further evidence of the making of fictitious wine. In 1885 there were used in France for the manufacture of grape wine 7,933,887 kilos. of grape sugar, whilst in 1886 there was an enormous increase to 27,856,592 kilos.

As the basis of false champagne a liquid known as fruit wine is produced, and for this purpose there was used in France in 1885, 24,142 kilos. of cane sugar, and in 1886 again an extraordinary increase to 145,555 kilos.

In Ridley's Wine Trade Circular issued some years ago and quoted in "Wine Trade Revelations," the following is given as being the formula for making Elbe Sherry :—

"Take 40 gallons of fine potato spirit at 1s. 4d. per gallon, 56 gallons of pure Elbe water, cost nil, 4 gallons of Capellaire, at £1, and, to be liberal, allow that ten gallons of luscious wine or grapes are added at a cost of £2, then for cask 12s., discount for cash 4s. This mixture is shipped at Elbe at a cost of about £8 per butt of 108 gallons."

This would work out at about five pints per shilling.

There is also the practice of making new and inferior wines possess the flavour of older and more valuable vintages. It is chiefly the heavy wines that are thus dealt with. Elder flowers, orris root, iris, cloves, oil of bitter almonds, oil of orange flowers, and infusions of raspberries and walnuts are amongst the ingredients in use.

Port wine is very frequently flavoured with a mixture of elderberry juice, grape juice, brown sugar, and crude brandy.

Sherry often consists of cheap Cape wine mixed with honey, bitter almonds and brandy.

The following are the recognized methods of treating poor and inferior wine so as to make it yield a good wine :—

1. The addition of sugar, and the neutralization of an excess of acid by the addition of ground marble.
2. The addition of sugar and water to must rich in acid.
3. Repeatedly fermenting the husks with sugar water.
4. Removing the water by freezing or treatment with gypsum.
5. The addition of alcohol.
6. Treating the wine with glycerine.

These may all come under the head of legitimate means of making a poor wine into a good one.

The French law permits of the addition of brandy to wine to the extent of bringing up the alcohol to not more than 21 per cent.

Where white wines are in demand, they can be artificially produced by the simple plan of decolorising the ordinary wine, by filtering through animal charcoal.

It is quite certain that whilst there may be a good supply of genuine wine upon the market there is also a very abundant supply of fictitious wine, and many a one sitting down to a glass of his favourite brand, could he but know the truth, would find himself drinking something very different from what he thought he was imbibing.

British Wines.

British wines are thought by some to be on quite a different footing to the foreign wines, and there are many who, whilst abstaining from the imported wine, think there can be no harm in using the British wines. The only difference between the two kinds of wine is that the foreign wines are supposed to be entirely made from the grape whilst the British wines are made from a variety of fruits. Fictitious names are often given, such as British Port, British Madeira, British Claret.

The following is a recipe for making British port, and it at once shows the true character of the beverage.

Take British grape wine, or good rough cider ..	4 gals.
Recent juice of elderberries	1 gal.
Logwood, in fine chips..	4 ozs.
Rhatamy root, bruised..	½ lb.
French brandy	2 qts.

Infuse the logwood and rhatamy root in the brandy and one gallon of the grape wine or cider for one week ; then strain off the liquor, and mix it with the other ingredients, etc.

The following recipes are also instructive as shewing the constituents of these wines, and the fact that they are all thoroughly alcoholic.

Orange Wine.—" Squeeze the juice from half a chest of Seville oranges in the prime of their condition, and dissolve in it forty-eight pounds of double refined sugar, broken in lumps; take then half the quantity of the yellow peels (disengaged before the fruit was squeezed), put them into another tub, and pour upon them ten gallons of boiling water: let this stand till it is cool, then put the liquor to the sugar and juice in your cask. When the fermentation has ceased add two quarts of French brandy, etc., etc."

Ginger Wine.—" Boil well for half an hour fifty-six pounds of the best raw sugar with fifteen gallons of water, taking off the scum until no more rises. Bruise one pound of the Jamaica ginger, pare and cut thirty-six lemons, and when the syrup has boiled sufficiently, and is free from dross pour it, boiling, upon the lemons and ginger, and let them remain together until the syrup is lukewarm ; then squeeze them out, and put into the tub a little brisk yeast. Suffer it to work three days, etc., etc."

British Champagne.—" Take seven pounds of whitest raw sugar, eight pounds best refined sugar, one and a quarter ounces crystallized lemon or tartaric acid, eight gallons soft water, two quarts white grape, wine or cider, four quarts perry, three pints of Cognac brandy. Boil the sugar, skimming it clear, two hours. Pour it then into a tub, and dissolve in it the acid ; when 70 deg. heat add yeast and ferment in the usual manner. A pink and rich champagne may be made by adding preserved strawberry, one pound, powdered cochineal, two ounces."

Raisin Wine.—"Take thirty pounds Malaga raisins, picked clean from the stalks. Let them be chopped into small pieces and thrown into a clean tub. Pour on them three gallons of hot water. Throw the whole into a hair-cloth or canvas bag, and with a press force out the juice. On to the marc pour two gallons more of hot water, and press out as before after twelve hours. Mix the two liquors. Add three pounds of refined sugar, and dissolve perfectly. Fermentation will set in, when it is over the liquor to be racked into a cask and left bunged for three months. A quarter of an ounce of isinglass dissolved in a little wine is to be mixed with it, etc.

The following are the proportions of alcohol by volume that have been found in some British wines.

British Port	19 per cent.
,, Sherry	17½ ,,
Gooseberry Wine	11¾ ,,
Orange ,, ...	11¼ ,,
Elderberry ,, ...	8¾ ,,

An analysis of ginger wine gave the following :—

Water	79·21
Alcohol	5·97
Acid	0·49
Sugar	14·04
Mineral Matter	0·29
	100·00

A work published a few years since, entitled the "Art and Mystery of Making British Wines," gives similar recipes for fifty-two varieties of home-made wines, but the principle is the same in them all, the destruction of the albuminoids and the conversion of sugar into alcohol, the differences being due to the various fruits and the various flavouring matters used.

Unfermented Wine.

There are many who aver that wine cannot be produced unless the process of fermentation is undergone, but unfermented wine is no new thing. Various forms of it were known to the ancients, for in many countries in the olden time the wine was boiled down to the consistency of a syrup, hot water being afterwards added to render it thin enough to drink. The Opimian wine, which was held in high esteem by the Romans, was two hundred years old, and was preserved by the common custom of concentrating the grape juice or must over the fire until it was thick and syrupy. The Lacedaemonians had the practice of boiling away a fifth part of the wine, and then preserving it four years, when they regarded it as fit for use.

It is well known that when sweet juices are boiled down to a thick consistence they do not ferment, and are not easily brought into a state of fermentation when they are afterwards rendered dilute with water.

In modern times the fermentation is prevented by a process of sterilization. The grape juice is expressed, and transferred at once to bottles, which have also been thoroughly cleansed and sterilized. These bottles, full of wine, are stood immersed nearly to the top of the neck in water, the temperature of which is gradually brought up to such a degree as to effectually kill any yeast germs that may be present. In this condition, at a high temperature, the bottles are corked, and thus, so long as the juice is not exposed to the air, it remains free from any fermentation whatever. The manufactures of Messrs. Wright, Mundy and Co., of London, have for many years been before the public as wines of a high-class, and absolutely free from alcohol.

To indicate clearly that such wine can be produced, we may give the analysis of a sample of this wine purchased at a shop and analysed by Dr. J. Carter Bell, county analyst, Manchester.

Specific Gravity	1·076
Alcohol	*Nil*
Volatile Acid	·069
Ash, per cent.	·361
Ash, soluble in Water	88·089
,, insoluble ,, ...	11·911
Alkalinity of Ash as Potash	52·070

This wine does not contain a trace of Alcohol, and is, what the label states it to be, 'The true fruit of the vine and unintoxicating.'

Dr. Carter Bell, speaking of another sample, says: "My examination confirms the statement that it is pure grape juice, and free from alcohol."

Dr. Wallace, analyst for Glasgow, and Dr. Hodges, analyst for Belfast, also both testify from samples that they had examined, that the production was entirely free from alcohol.

The wines made by this firm are used almost entirely for Sacramental purposes, and so efficiently do they fulfil this sphere, that they are in use in more than FIVE THOUSAND churches of various denominations. The difficulty of not being able to keep the wine free from alcohol after opening and exposing it to the air was a serious one, but it has now been overcome by the addition of a very small amount of an innocuous antiseptic, which prevents fermentation, and allows the bottle to be kept for a considerable time after it has been opened.

The first Swiss "Sans" Alcohol Wine Company have recently introduced into England a number of preparations made in their wine factory at Berne. The process of sterilization is very efficiently carried out, and the wines are exceedingly refreshing and pleasant. They are not suitable for sacramental purposes, but form very excellent and palateable beverages, which may be freely used by total abstainers. They have all the constituents of the pure grape juice, are entirely free from alcohol, do not contain any foreign substances as antiseptics, but once a bottle is opened it must all be used, as following a natural law it will not keep more than a few days. Other preparations called grape juice are on the market, but we have not met with any of them that are not highly doctored with salicylic acid or some other artificial preservative.

Cider and Perry.

Cider is well known as a beverage, not only in England, but in France, Germany, Spain, Canada, and the United States.

Cider and Perry are not generally classed amongst wines, although there is no apparent reason why they should not be so classified. The two beverages are made in identically the same manner, the only difference being that cider is obtained from apples, and perry from pears.

The apples properly selected aré laid in a heap for a day or two to sweat, the unsound ones are then rejected, and the sound apples are pounded to a juicy pulp. The juice is then pressed out by means of a cider press and put into a hogshead, and some raisins and moist sugar are added to assist the fermentation that will ensue. When it has ceased working the clear liquor is racked off into a sweet cask. Isinglass finings are added, and the whole bunged up again until the following March, when it can be bottled as prime cider. In some parts it is a common practice to let the cider remain in the cask for two years, and then to bottle it. It is estimated that a good apple harvest in England will yield about seventy thousand hogsheads. The following are recommended to improve cider: 1 gallon of Cognac brandy, 1 lb. of alum, and 3 lbs. of sugar candy to every hogshead. The same arrangements generally apply to perry, but for improving it the following are recommended: 1 gallon of French brandy, 2 lbs. of bruised prunes, and 2 lbs. of sugar candy to the hogshead.

Cider was first used in England in 1284, and is still largely used as a beverage. It contains from 5 to 9 per cent. of alcohol according to the time allowed for fermentation and the quality of the materials used. It does not possess any tonic qualities, it quickly turns sour and becomes hard owing to the formation of acid.

Good quality cider is quite as intoxicating as good ale.

It is more than suspected that no inconsiderable quantity of so-called champagne is made from cider.

The average constituents of the apple are as follows:—

Water	83·0
Albumen	0·4
Sugar	6·8
Malic Acid	1·0
Pectose, Gum, etc.	5·2
Cellulose	3·2
Mineral Matter	0·4
	100·0

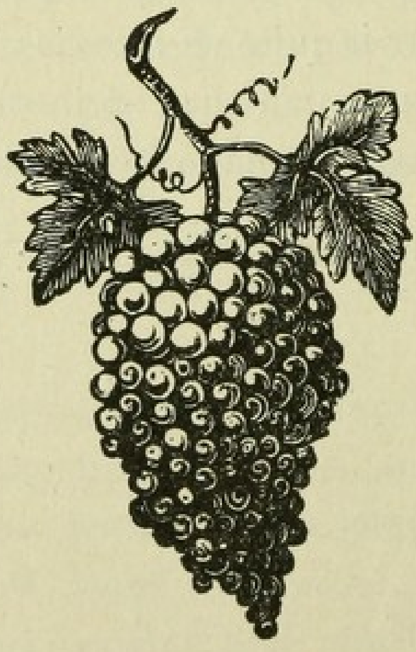
Roughly speaking, when fermented into cider and perry the constituents are changed to the following:—

	Parts.	Alcohol.	Water.
Strong Cider and Perry	100	9·87	90·13
Weak Cider	100	5·21	94·79

As in other fermentive processes, the sugar and albumen are destroyed and the alcohol produced. In 1887 France produced 182,600,000 gallons of cider.

Wine in the Bible.

The word wine being a generic term, sometimes meaning the grape, at others grape juice, at others sweet wine, and again in other cases fermented wine, occurs in all 261 times in the Bible, of which 121 are warnings, 71 warnings and reproofs, 12 pronounce it dangerous, and five totally prohibit it.



SPIRITUOUS LIQUORS.

STATISTICS AND MANUFACTURE.

CHAPTER XXI.

Historical Notice.

IT is difficult to conceive how ardent spirits can reasonably fill a place in our every day life. They cannot be regarded as foods and certainly not in the proper sense as beverages. Practically consisting of alcohol and water, they exemplify how easily a false appetite can be created, to gratify which, recourse is had to a liquid which cannot in any circumstances of health be a benefit, and which, in the vast majority of cases, is of great harm. An appetite imperceptibly beginning with malt liquors and fostered and growing with the use of wine, results in a desire for the more fiery liquids going under the generic name of spirits.

It is certain that for ages alcoholic drinks were used without any knowledge of the constituent that caused intoxication. It was not until the eleventh century, when the art of distillation had become fairly well known, that

Albucasis, an Arabian chemist, placed fermented liquor in the retort, and found that it could be separated into spirit and water. It is sometimes said that this chemist was, with many others of the age in which he lived, seeking for *Aqua Vitæ*, the water of life, which was commonly thought to be capable of restoring youth and beauty to the aged and decrepit. Whether this is so or not, and judging solely by its effects on many of its users we are almost justified in saying that in discovering alcohol, he discovered *Aqua Mortis*, the water of death.

The origin of the word alcohol is doubtful, although all authorities agree that it is of Arabic derivation, and it is thought to be compounded of the Arab article *al* and the Chaldaic *cohal*, signifying to make light or thin. Others ascribe it to the Arabic word *a'l-ka-hol*, meaning a subtle essence.

It was not until the seventeenth century that the term alcohol was generally used as applying to distilled spirit, although as far back as the thirteenth century the spirit of wine was sold as a medicine in both France and Italy, under the Arabic name of alcohol. The Genoese are said to have dealt largely in it at the same period under the name of *aqua vitæ*. They were the first Europeans who prepared it from grain, and they sold it in very small bottles at a very exorbitant rate.

Whisky is said to have been mentioned in the sixteenth century, but the common names applied to spirituous liquors are all of modern origin. The term gin was used in the latter part of the seventeenth century, and in 1750 it is recorded that no less than 1700 gin houses were suppressed in London.

Erse name Uisgué beatha

Various Kinds of Spirituous Liquors.

Besides the four principal forms of spirituous liquors—brandy, rum, gin, and whisky—in common use, we have in this country absinthe, aniseed cordial, clove cordial, cherry brandy, lovage cordial, Curaçoa liqueur, ratafia cordial, ginger brandy, Chambertin liqueur, lemon liqueur, Maraschino, crême de Noyeau, French Noyeau, orange liqueur, citron cordial, shrub cordial, West Indian shrub, and others.

The use of distilled spirits is not confined to the European peoples. The following list shows their use in different parts of the world :—

By whom employed.	Name.	Whence obtained.
Hindus, Malays ..	Arrack	Rice, Areca Nut
Greeks, Turks ..	Raki	Rice
Hindus	Tārī	Cocoa Nut and other Palms
Mahrattas	Bōjā	Eleusine Corocana
Chinese	Samshū	Rice
Japanese	Sacié	Rice
Pacific Islands ..	Kaiva	Macropipeo
Mexicans	Pulque	Agave
S. Americans ..	Chica	Maize
Tartars	Koumiss	Mares Milk
Russians, Poles ..	Vodka, Raka .	Potatoes
Abyssinians ..	Tallah	Millet

Extent of the Spirit Trade.

In the United Kingdom there are one hundred and seventy-three distilleries at work, one hundred and thirty-six of them being in Scotland, twenty-six in Ireland, and eleven in England. The quantities of grain they converted into spirits are as ollows :—

Year ended Sept. 30th.	Malt.	Unmalted Grain.	Sugar.
	Quarters.	Quarters.	Cwts.
1883	859,363	1,054,081	165,529
1889	909,971	1,071,876	242,616
1893	1,020,769	1,250,132	436,212
1896	1,220,660	1,231,777	714,243

These distilleries do not manufacture alcohol as such. Their output is what is known as proof spirit. This term is used to signify equal weights of alcohol and water mixed together. Thus one pound weight of water and one pound weight of alcohol, mixed, will practically form proof spirit. The exact proportions by weight are 50·76 per cent. of water, and 49·24 per cent. of alcohol. But equal volumes of alcohol and water will not form proof spirit as alcohol has a lighter specific gravity than water. By volume proof spirit is a mixture of 57·06 parts of alcohol and 42·94 parts of water in the hundred.

The output of proof spirits produced by the distilleries above-mentioned is as follows :—

Year ended December 31st.	No. of Gallons of Proof Spirit Distilled in			
	England and Wales.	Scotland.	Ireland.	Total.
1820 ..	2,866,684	3,278,129	4,607,296	10,752,109
1830 ..	4,656,443	9,883,413	8,694,742	23,234,598
1840 ..	5,918,435	8,821,530	7,281,429	22,021,394
1850 ..	5,913,424	11,638,429	8,293,034	25,844,887
1860 ..	7,597,763	13,312,365	7,405,593	28,315,721
1870 ..	7,280,088	13,799,071	6,599,636	27,678,795
1880 ..	9,694,420	16,558,401	11,159,349	37,412,170
1890 ..	9,061,288	20,090,935	11,817,072	40,969,295
1897 ..	11,821,182	28,518,681	14,282,843	54,622,706

It does not, however, follow that all this vast quantity of British manufactured spirit was consumed at home. As a matter of fact there is a very large export trade, on the other hand, there is a very considerable importation of foreign and colonial spirit.

The following tabulation will make the total consumption quite clear, and show to what an alarming extent the use of spirituous liquors as beverages has grown :—

Year.	Population United Kingdom.	Spirits.				Spirits of all kinds Gallons per head.
		British.		Foreign and Colonial.		
		Gallons.	Per head.	Gallons.	Per head.	
1852 ..	27,448,257	25,200,879	·918	4,866,259	·177	1·095
1862 ..	29,243,610	18,836,187	·644	5,181,245	·177	·821
1872 ..	31,874,183	26,872,183	·843	9,047,206	·283	1·126
1882 ..	35,207,613	28,554,264	·811	8,314,283	·236	1·047
1892 ..	38,109,329	31,355,267	·822	8,112,014	·212	1·034
1895 ..	39,134,166	30,830,230	·778	8,212,604	·209	·997
1896 ..	39,465,720	31,899,950	·808	8,176,239	·207	1·015

The quantity of British spirits exported from the United Kingdom for the year 1896 amounted to 4,790,181 gallons, which was distributed to the following countries—Channel Islands, France, Portugal, Sweden and Norway, Italy, Greece, Turkey, Egypt, South Africa, West Africa, India, Hong Kong, West Indies, Australia, British North America, The United States, and some other minor places.

The imports of foreign spirits show a decrease, but this is more than made up by the increase in the home-made spirits. The quantities in gallons imported are as follows :—

Year.	Rum.	Brandy.	Other Kinds.	Total.
1870	6,915,117	7,942,965	2,403,530	17,261,612
1880	5,107,661	3,006,335	936,471	10,050,467
1890	6,237,773	3,100,450	3,375,826	12,714,049
1892	6,852,240	2,986,366	2,064,763	11,903,369
1894	6,123,269	3,401,538	2,433,853	11,958,660
1896	4,509,168	2,761,507	1,830,809	10,001,484

This decrease is all the more remarkable when it is remembered that since 1870, when over seventeen millions of gallons were imported, there has been an increase of 30 per cent. in the population, and yet there has been a fall to about ten millions of gallons.

The net produce of the Excise duties collected and applied to the purposes of imperial taxation in reference to spirits for the year 1897 was £16,013,412, and the customs duties for the same year were £4,318,192.

Total Consumption of Alcohol per Head.

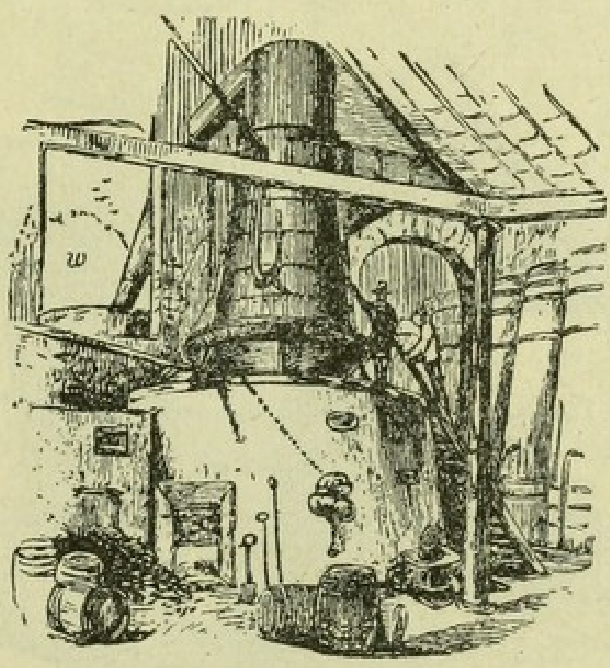
The following table is interesting as showing the total consumption of alcohol, reckoned as proof spirit, per head of the population. It will be seen that the amount is lower at the present time than it was in 1872.

Year.	Gallons.	Year.	Gallons.
1852	3·360	1890	4·145
1862	3·148	1891	4·164
1872	4·465	1892	4·121
1882	3·933	1893	4·048
1885	3·783	1894	4·016
1887	3·757	1895	4·070
1888	3·756	1896	4·205
1889	3·916	—	—

The total for 1896 is made up as follows :—

	GALLONS PER HEAD.
In Spirits	1·015
,, Wine	·120
,, Beer	3·070
	4·205

A person drinking a pint of beer a day, or half a pint of claret would, in the course of the year, consume about four gallons of proof spirit. When we take off from the population all the children, all the abstainers, and all others



WASH STILL.

who are incapacitated for drinking, it will be seen that the remainder of the population who are responsible for this consumption of liquor are fairly bibulous.

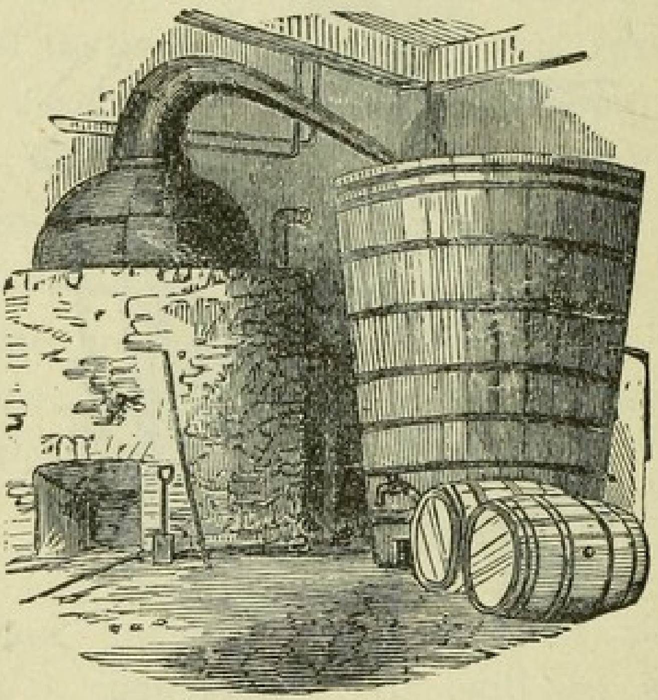
Manufacture of Distilled Spirits.

There are various descriptions of spirit, according to the substance used. Thus we have "grain" spirit, "corn" spirit, "potato" spirit. From this raw spirit, what is known as rectified spirit is obtained by the processes of rectification.

The raw materials may consist of three classes. (1)

Alcoholic liquors which, when distilled, yield the stronger spirit. (2) Some substance, such as cane sugar, grape sugar, maltose, etc., which can be either directly or indirectly fermented, and thus produce spirit. (3) Starch-containing materials, such as the cereals, potatoes, etc., which, under the influence of diastase, can produce a fermentable sugar.

The process of distillation is a comparatively simple one. The fermented material is placed in a copper or retort,



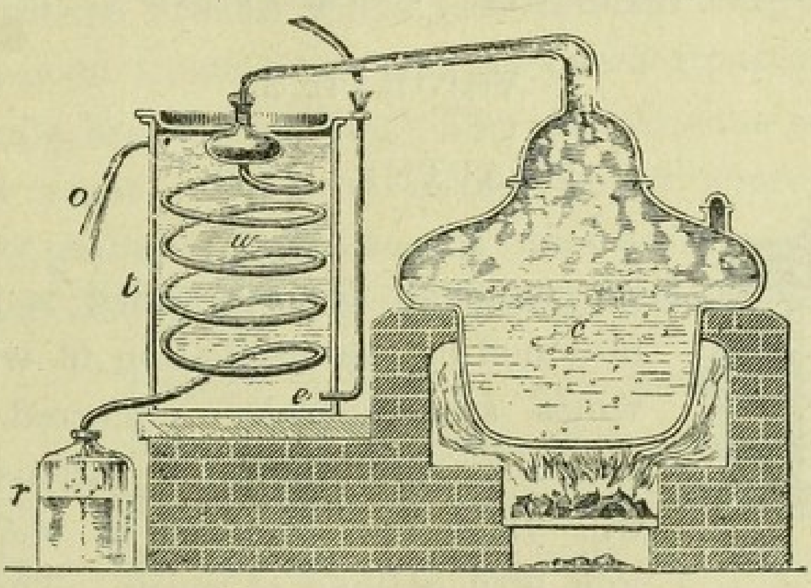
SPIRIT STILL.

and on the application of heat the alcohol, being lighter, is separated off with some water and other volatile substances.

The vapours as they rise are passed into the condenser, consisting of a pipe coiled round in a chamber filled with cold water, and known as the worm of the still.

Sugar, when fermented, yields nearly equal weights of alcohol and carbonic acid gas, so that for every pound of sugar used there should be a yield of over half a pound of proof spirit.

The different kinds of grain used, produce varying quantities of alcohol according to the amount of starch they contain that can be converted into sugar by fermentation. One hundred pounds of corn yields about forty



SMALL STILL.

(c) Cistern; (w) Worm; (t) Cooling Tank; (e) Entrance for Cold Water; (o) Outlet for Ditto; (r) Receiver.

pounds of proof spirit. A distiller of malt whisky calculates upon getting two gallons of proof spirit from one bushel of malt. The highest yield is twenty gallons of proof spirit from eight bushels of fermented malt.

SPIRITUOUS LIQUORS—*continued.*

VARIETIES.

CHAPTER XXII.

Brandy.

THIS particular form of spirit is invariably obtained by the distillation of wine. Red wines are generally preferred for the purpose. One thousand gallons of wine will yield one hundred to one hundred and fifty gallons of spirit. The yield of spirit is diluted with water till it contains from fifty to fifty-four per cent. by weight of absolute alcohol.

When first distilled brandy is clear and colourless, and is sometimes kept in this condition by being placed in glass vessels, and is then known as white brandy. In the ordinary way it is put into casks, and coming into contact with the wood it dissolves out some of the colouring matter and assumes a pale sherry tint. This is deepened at the will of the maker by adding burnt sugar or other colouring material.

The pleasant aroma is due to the presence of an ether. There is also a small quantity present of one of the heavier alcohols known as fusel oil.

The finest brandy is supposed to come from Cognac, a district in the West of France, but, as a matter of fact, very little comparatively is imported from there. A good deal of brandy is made from the red wines of Portugal and Spain, and also from the lees or refuse from the wine making, the scrapings of wine vats and casks, etc.

Much of the brandy sold in the United Kingdom is made by adding bruised French plums, some French wine vinegar, and a little good Cognac to spirit prepared from ordinary grain ferments, and re-distilling. The spirit is then coloured with burnt sugar, or placed in an empty sherry cask. Occasionally grains of Paradise and other acrid matters are added to give this artificial brandy fictitious strength.

Medical Substitutes for Brandy.

Brandy is held in high esteem by many because of its supposed medical efficiency. There are many other substances that can do all that brandy will do, without the after exhaustion that follows the use of alcohol. Dr. J. J. Ridge has prepared the following list of substitutes for Faintness, Palpitation, or relief of pain, such as Colic :—

1. **Water,** as hot as can be conveniently swallowed, either alone or slightly sweetened. To be sipped. Even cold water sipped stimulates the heart.

2. **Ginger Tea :** One teaspoonful to a teacupful of boiling water. Sweeten ; sip hot.

3. **Herb Tea :** A teaspoonful of powdered sage, mint, or similar, herb, to a teacupful of boiling water. Sweeten ; sip hot.

Chamomile Tea, taken warm, is specially suitable for the colic of infants.

4. **Meat Extract :** A teaspoonful of Liebig's Extract or Bovril in a wineglassful of hot water, with herb flavouring if preferred.

This is a special heart stimulant.

5. **Other Measures.** Flapping the face and chest with a cold wet towel ; putting the hands in hot water ; ammonia or smelling salts to the nostrils ; tickling nostrils with a feather, etc.

Rum. This form of spirit is derived from a sugar ferment. The East and West Indies being the lands of the sugar cane, are the seat of this industry. The best rum is made from a ferment of the scummings from the sugar pans, and the next best from molasses, the brown uncrystallizable syrup obtained in the refining of sugar. To this, water is added, till the whole is of the strength of about 12 per cent. of sugar, and this thin liquid is then fermented. Every ten gallons of this wort will produce rather more than one gallon of rum.

Pine apples are sometimes placed in the still, giving the variety known as Pine Apple Rum. The spirit is clear and colourless when first distilled, and it is coloured with burnt sugar or caramel.

In France a considerable amount of rum is produced from the molasses of the beetroot sugar factories.

Much of the rum sold in this country is merely plain spirit coloured with burnt sugar and flavoured with rum flavouring.

As it leaves the makers, rum contains as much as 70 per cent. of alcohol, but as retailed, it contains about 43 per cent. of absolute alcohol.

Whisky. This is essentially a spirit derived from grain. Barley, wheat, oats, rice, rye, Indian corn, buckwheat, millet all can be used. Beetroot, potatoes, molasses, sugar, together with a quantity of malt, are also used. Whatever substance is taken, it must be fermented, for it is only from the thoroughly fermented material that the spirit can be obtained.

Whisky was formerly exclusively made in Scotland and Ireland, but distilleries are now at work in England, the

United States, Prussia, Sweden, France, Holland, and Belgium. The foreign spirit is generally coarser than that produced in the United Kingdom.

New whisky, impregnated with fusel oil, is called "Pot Still Whisky." This is often blended with so-called improvers, "Hambro" sherry, wine, etc., in order to fit it for the market.

Fusel oil is highly dangerous, and men engaged in the manufacture of potato spirit suffer from headache and general nervous indisposition, unless the vapours are carried away.

When the wine crop in France is a failure, large quantities of whisky are sent to that country and returned as French brandy.

Ordinary whisky, as sold, would contain about 35 per cent. of absolute alcohol.

The difference between Irish and Scotch whiskies lies mainly in the fact that the former is distilled in a Pot Still, and the latter in the Coffey Still, the product of which is a spirit deprived of its essential oils. The Irish "Poteen" whisky has a smoky flavour, due to the use of peat fires in preparing the malt. This flavour is imitated by the addition of one or two drops of creasote to the gallon.

Gin. This is also a grain spirit, being generally made from malt or unmalted barley or other grain. It is frequently made by redistilling spirit with various added ingredients, or the adding of various essential oils to rectified spirit.

There is no standard for the manufacture of gin, each rectifier having his own particular recipe. London gin is flavoured very slightly with oil of turpentine and common salt. Usually about five fluid ounces of spirit of turpentine and three and a half pounds of salt are mixed in ten gallons of water, and these are placed in the rectifying still with eighty gallons of proof corn spirit. It is then sweetened with sugar, if desired.

The following are among the flavouring substances for gin included in the different recipes in use by the trade :—Juniper berries, Coriander seeds, Orris root, Angelica root, Cardamom seeds, Liquorice powder, grains of Paradise, and Cassia buds.

Immense quantities of gin are manufactured at Schiedam in Holland, hence we get the terms Hollands gin and Schiedam gin.

Perhaps there is no article of this kind so liable to great and injurious adulteration as gin. It is not only that innocent water is often added, but there are an immense number of recipes in use by the trade for the purpose of increasing the pungency and giving a fictitious strength to the diluted gin. Amongst the articles used for this sophistication, the following may be mentioned :—alum, carbonate of potash, oil of juniper, nutmeg, lemons, sweet fennel, caraway seeds, capsicum, creosote, sulphate of zinc, and even sulphuric acid.

Gin generally contains about 40 per cent. of absolute alcohol

Absinthe. The seat of the manufacture of this dangerous beverage is in the canton of Neuchatel, Switzerland. It is a compound in which the pounded leaves of the *Artemisia Absinthum* (wormwood), together with Angelica root, sweet flag root, star anise, and other aromatics are used. These substances are macerated for about eight days in alcohol and are then distilled, the result being an emerald coloured liquor. Peppermint, cloves, cinnamon, and the juice of spinach; nettles and parsley are also often used.

Absinthe is largely used in France and America, and its use is growing in England.

The following are the constituents of a good sample of absinthe :—

Alcohol	50·00
Oil of Wormwood	·33
Other Essential Oils	2·52
Sugar	1·50
Water	45·65
	100·00

On diluting absinthe with water, the essential oils are thrown out of solution and the liquid becomes turbid.

The preparation is much adulterated, the following substances having been found in various samples :—Copper sulphate, indigo, turmeric, and picric acid.

Absinthe drinking has a most deleterious effect on the nervous system, and regular tippling utterly deranges the digestive system, weakens the frame, induces horrible dreams, and may end in idiocy or paralysis.

Arrack. This is made from a rice ferment, and is largely used by the Hindoos and Malays. It is often adulterated with Indian hemp, and the juices from various plants.

A sample showed the following constituents :—

Alcohol	52·700
Extract	·082
Mineral	·024
Water	47·194
	100·000

Liqueurs. The name liqueur is applied to any alcoholic preparation that is flavoured, perfumed, or sweetened to suit any particular taste. There is consequently an immense variety of these preparations. *Aniseed* cordial, flavoured with aniseed, coriander, and sweet fennel seed. *Clove* cordial, flavoured with bruised cloves and coloured with burnt sugar. *Maraschino* cordial, distilled from fermented cherries. *Noyeau* is a sweet cordial, flavoured with bruised bitter almonds. *Peppermint* cordial consists of ordinary sweetened gin, flavoured with the essential oil of peppermint. *Curacoa* cordial is made by digesting curacoa oranges in sweetened spirits with cinnamon, and sometimes mace and cloves, and coloured with burnt sugar. *Shrub* consists of lime or lemon juice, to which a small quantity of rum has been added, and other flavouring substances. *Kirschwasser* is a form of cherry brandy. The cherries are gathered when quite ripe, freed from their stalks, pounded in a wooden vessel and left to ferment. The stones are afterwards broken, and the kernels thrown into the fermenting mass. By distillation the kirschwasser is obtained. *Ratafia* cordial is prepared in a variety of ways. It consists of an alcoholic liquor flavoured with some fruit syrup or essence. The following are among the flavouring agents in common use :—Bitter almonds, the kernels of the cherry, peach, apricot, plum, and other similar fruits, orange flowers, gooseberries, raspberries, aniseed, chocolate, black currants, coffee, Angelica stalks, etc., etc.

The following table of the composition of some well-known liqueurs will give an idea of what they are worth, and of their alcoholic strength :—

—		Benedictine Bitters.	Ginger Cordial.	Curacoa Cordial.	Peppermint Liqueur.	Anisette Bordeaux.	Kummel Liqueur.
Water	..	54·838	59·24	52·09	70·39	54·07	71·31
Alcohol	..	44·400	40·20	47·30	28·60	35·20	28·00
Extract	..	0·394	0·30	0·29	0·49	0·35	·33
Mineral	..	0·043	0·02	0·04	0·05	0·04	·05
Sugar	...	0·325	0·24	0·28	0·47	0·34	·31
		100·000	100·00	100·00	100·00	100·00	100·00

These liqueurs are all highly alcoholic, and should be on that account equally avoided with all kinds of spirituous liquors.

MINERAL WATERS AND TABLE WATERS.

CHAPTER XXIII.

THE medicinal and useful properties of many of the springs and wells scattered throughout Europe seem to have been known from very early times. The old Greek physicians had great faith in their power, and temples erected to Æsculapius were usually near such springs. Pliny mentions in his "Natural History" a large number of mineral springs in all parts of Europe.

Natural Waters.

The following classification of these springs is adopted by Dr. Althaus in his *Spas of Europe*—

ALKALINE WATERS, the chief contents of which in some cases are carbonic acid and bicarbonate of soda, and in others in addition a quantity of common salt, while others again may contain sulphate of soda as well. The principal alkaline springs are Vichy, Fachingen, Geilnau, Bilin, Ems, Selters, Salzbrunn, Carlsbad, and Marienbad.

BITTER WATERS are obtained from springs containing sulphates of magnesia and soda, the best known being those of Püllna, Seidlitz, Kissingen, Friederichshall, Kingswood in Gloucestershire, and Purton near Swindon in Wilts.

Muriated Waters are those which contain chloride of sodium, chloride of lithia, and iodo-bromated waters. Wiesbaden, Baden-Baden, Soden, Kissingen, Homburg, Cheltenham, Kreuznach are all of this class.

Earthy Waters are those which contain sulphate and carbonate of lime. The waters of Leuk, Bath, Lucca, and Pisa are of this character.

Indifferent Thermal Waters are those which contain a very small amount of saline matter, and whose most striking effect is to stimulate the skin and to excite the nervous system. The waters of Gastein, Toplitz, Wildbad, Clifton, and Buxton are of this class.

Chalybeate Waters are those that contain iron in solution; they may be either carbonated or sulphated. Carbonated chalybeate springs are found at Tunbridge Wells and Harrogate, whilst sulphated are found in the Isle of Wight, Vicars Bridge, Moffat, etc. Chalybeate waters are characterized by a more or less inky taste.

Sulphurous Waters are those which contain sulphuretted hydrogen or the metallic sulphides in solution. The most important of these springs are Aix-la Chapelle, Baden, Neundorf, and Harrogate.

Many of the springs mentioned are used for outward application by means of baths as well as for drinking purposes. The quantities of the various substances held in solution are as a rule very infinitesimal.

The following estimates have been made by various investigators of the solid contents in one million parts of some natural mineral waters :—

Vichy ..	.. 5160	Parts solid in 1,000,000 parts of the Water.
Bilin ..	.. 5081	
Ems ..	.. 2781	
Fachingen	.. 3298	
Toplitz ..	.. 626	
Karlsbrunn	.. 925	
Carlsbad ..	.. 5455	
Seidlitz ..	.. 16406	
Bath ..	.. 2062	
Cheltenham	.. 8174	
Selters ..	.. 3658	
Harrogate..	.. 15478	

The following is a brief account of some of the best known waters :—

Aix-la-Chappelle Water.—Sulphurous. There are six hot and two cold springs, from which the waters are obtained. They were known in the time of Charlemagne, and were much frequented as early as 1170. The hot springs are strongly sulphurous. They chiefly act upon the liver and upon the skin. The cold springs contain a proportion of iron. These waters are sold in the United Kingdom at 15s. per dozen bottles.

Apollinaris Water.—This is a highly popular table water. It is obtained from springs in Rhenish Prussia, and contains about twelve grains of carbonate of soda in the pint, with small quantities of lime and magnesia, and is highly charged with carbonic acid gas. It may be termed a natural soda water. It is supplied in bottles at six shillings per dozen.

Carlsbad Water, so named from being obtained from the famous wells and springs at Carlsbad in Bohemia. The springs are hot, ranging from 117° Fahr. to 165° Fahr. The principal spring, the Sprudel, has great volume, the water rising three feet from the ground. Altogether the daily flow of the springs is estimated at 2,000,000 gallons. The principal ingredient in the water is sulphate of soda. It is recommended in cases of habitual constipation ; also in diabetes. An analysis by Berzelius showed that the Sprudel water contained small amounts of the following substances—Calcium, Magnesia, Sodium, Iron, Carbonic Acid, Sulphurous Acid, and Chlorine. It is sold at twelve shillings per dozen.

Ems Water.—Derived from the springs at Ems, near Coblenz. The water is alkaline, its chief ingredient being carbonate of soda. It is sold at seven shillings per dozen.

Homburg Water.—These springs are at Homburg in Hesse Nassau, near Frankfort. The waters are very popular, being naturally charged with carbonic acid gas. One of the springs, the Elizabeth, contains more carbonic acid gas than any other saline spring. The waters are chalybeate and saline,and are esteemed very effective in the case of disordered liver and stomach. They are also thought useful in cases of hysteria. About 400,000 bottles of the water are sent away from Homburg annually. It is sold at twelve shillings per dozen.

Kissingen Water.—The springs are situate in a town of this name in Bavaria. Two of the springs are chalybeate and saline, whilst a third is acidulous. These waters are considered specially efficacious in cases of gout, and also for indigestion and kidney disorders. Eleven shillings per dozen bottles.

Harrogate Waters.—These are obtained from the celebrated springs at Harrogate in Yorkshire, which were discovered in 1578. These are both sulphurous and chalybeate springs. The sulphurous water is also saline and is of a laxative character. The chalybeate waters are tonic in their properties. They are in great repute for skin affections, dyspeptic disorders, gout, etc., but as they are of considerable strength and activity they should only be taken under medical advice. Ten shillings and sixpence per dozen.

Marienbad Waters.—This is a favourite table water obtained from the celebrated springs at Marienbad in Bohemia. The town is 2,000 feet above the level of the sea, the springs being very numerous. They are saline, containing sulphate of soda, and other alkaline ingredients, the different springs varying very much in their composition and qualities. The waters are regarded generally as mildly laxative. Great quantities of the waters are exported. Ten shillings per dozen.

Selters Water, commonly called Seltzer water. The springs occur in the village of Lower Selters, near Limburg, in the Duchy of Nassau. About 5,000 gallons an hour are yielded by several springs in one basin. It is both sparkling and effervescing. Its chief ingredients are carbonic acid, carbonate of soda, and common salt. It acts as a mild stimulant on the mucous membrane, and is applied in cases of chronic disorders of the digestive and respiratory systems. It is highly recommended as a beverage either alone or with sugar to those suffering from liver complaints or in hot climates. Over one and a half million of bottles of this water are exported yearly, yielding a state revenue of over £6,000. The wells were discovered early in the sixteenth century. Artificial selters water is very largely manufactured. Six shillings per dozen.

VICHY WATER.—These waters are in high repute. The springs rise at the foot of the volcanic mountains of Auvergne, the village of Vichy being about thirty-five miles south-east of Moulins in the interior of France. The waters are alkaline and chalybeate, and are efficacious for dyspepsia, gout, and disorders of the liver. Nine shillings per dozen.

A very large number of these natural waters are in common use. The following list embraces all the important ones :—

NAME.	PROPERTIES.
Æsculap	Saline, Aperient.
Aix-la-Chapelle	Sulphurous.
Apenta	Aperient.
Apollinaris	Table Water.
Biebrach	Table Water.
Bilin	Table Water.
Birmensdorf	Saline, Aperient.
Bonnes	Sulphurous.
Bourboule	Arsen., Ferruginous.
Buffalo Lithia	Alkaline, Lithiated.
Bussang	Chalybeate.
Carlsbad	Alkaline, Lithiated.
Catley Abbey	Alkaline, Acidulated.
Condal	Saline, Aperient.
Contrexeville "Le Cler".. ..	Alkaline.
Contrexeville "Pavillon" ..	Alkaline.
Ems	Alkaline, Saline.
Enghien	Sulphurous.
Evian	Alkaline, Gaseous.
Fachingen	Alkaline, Chalybeate.
Ferruginaris	Ferruginous.
Friedrichshall	Saline, Aperient.
Franz-Joseph	Saline, Aperient.
Gerolstein	Table Water.

Name.	Properties.
Giesshubler	Alkaline.
Godesberger	Table Water, Gaseous.
Harrogate	Sulphurous.
Homburg	Saline, Chalybeate.
Hunyadi-Janos	Saline, Aperient.
Kalzmar	Table Water, Gaseous.
Kissingen	Saline, Sulphurous.
Kreuznach	Saline, Bromo-Iodised.
Do. (Motherlye)	Do. Do.
Kronenquelle	Saline, Sodio-Lithiated.
Leamington Spa	Aperient.
Marienbad	Alkaline, Chalybeate.
Mont Doré	Alkaline, Muriated.
Neuenahr	Alkaline, Gaseous.
Oberbrunnen	Lithiated.
Orezza	Ferruginous.
Pougues	Alkaline.
Pullna	Saline, Aperient.
Purton Spa	Iodised.
Pyrmont	Ferruginous.
Reginaris	Table Water.
Rhens	Do.
Roisdorf	Alkaline, Muriated.
Rosbach	Table Water, Gaseous.
Royal Hungarian	Saline, Aperient.
Royal Nieder Selters	Alkaline, Acidulated.
Royat	Saline, Arsenicated.
Rubinat	Saline, Aperient.
St. Galimer "Badoit"	Table Water, Gaseous.
St. Marco	Lithiated, Gaseous.
St. Moritz	Alkaline, Chalybeate.
Salvator	Alkaline, Lithiated.
Saratoga "Congress"	Saline.
Schwalbach	Chalybeate.
Selters	Alkaline, Acidulated.
Soultzmatt	Alkaline.

Name.	Properties.
Spa	Chalybeate.
Sulis	Table Water, Gaseous.
Tarasp	Saline.
Taunus	Table Water, Gaseous.
Thonon-les-Bains	Alkaline, Gaseous.
Vals (Vivaraises)	Alkaline, Acidulated
Vals ("Société Générale")—	
Précieuse, Rig, St Jean, Désirée, Dom, Madeleine	Alkaline, Acidulated.
Vichy (State Springs)—	
Celestins, Grande-Grille, Hopital, Parc	Alkaline, Acidulated.
Villacabras	Saline, Aperient.
Vittel	Sulphated, Ferruginous.
Wiesbaden	Saline.
Wildungen	Alkaline.
Woodhall	Saline, Bromo-Iodised.

The chief springs of Great Britain are:—Bath, Bristol, Buxton, Cheltenham, Clifton, Filey, Harrogate, Brighton, Leamington, Scarborough, Malvern, Hastings, Tunbridge, Purton and Woodhall in England, and Airthrey, Bridge of Allan, Moffat and Strathpeffer in Scotland.

Aërated Waters.

Aërated waters are in common use and form delightful refreshing beverages during warm weather, and during feverish conditions of the body.

The most common of these beverages is that known as soda water, though it does not often contain soda. It is prepared by forcing carbonic acid gas into water, so that under pressure the water dissolves above five times its volume of the gas. It then becomes a brisk sparkling liquid with a pungent but pleasant acidulous taste.

The carbonic acid gas is generated on a large scale by placing whiting, chalk or carbonate of lime in a leaden vessel with water and sulphuric acid. The acid combines with the carbonate of lime to form sulphate of lime, and carbonic acid gas is freely evolved.

Several very convenient appliances are made for preparing this acidulated water for domestic use. These are known as the gazogene or the seltzogene. Powders consisting of bicarbonate of soda and tartaric acid are placed in the upper bulb. The lower globe is filled with water and when the apparatus is charged, it is then inclined so that the water from the lower globe partly fills the upper one. It is then allowed to stand at rest for a time, after which the carbonated water will flow out readily on pressing the tap at the top. The explanation of this action is simple. Carbonate of soda and tartaric acid have no action on each other when dry, but as soon as water brings the particles into closer relation with each other, action begins and tartrate of soda is formed with a free evolution of carbonic acid gas. Various preparations of powders are prepared and sold by chemists and others for use with these forms of apparatus.

Seltzer Water or *Eau de Vichy* can be made by these machines by adding some carbonate of soda to the water in the lower globe before starting the operation described above.

A good imitation of sparkling lemonade can be obtained by running the carbonated water into a tumbler containing a little syrup of lemon. Aërated fruit beverages which are very pleasant and refreshing are also obtained by placing in a glass a table spoonful of any fruit syrup and then running in the carbonated water.

The following are simple methods of making some aërated waters :—

Soda Water may be prepared by adding fifteen grains of crystallized carbonate of soda to each bottle before charging with carbonic acid water.

Potash Water.—The same method, but using twenty grains of bicarbonate of potash instead of the soda.

Seltzer Water.—By dissolving carbonate of soda and common salt in the water before charging with carbonic acid gas.

Carrara Water.—When finely divided Carrara marble is dissolved in the acid charged water.

Magnesia Water.—By using carbonate of magnesia as above instead of carbonate of soda.

Chalybeate Water.—By dissolving some compound of iron such as crystallized iron sulphate in the acid charged water.

Seidlitz Water, prepared from the well-known Seidlitz powder, forms a refreshing draught if taken instantly it is prepared. Tartrate of soda and bicarbonate of soda are in one paper and tartaric acid in the other, when both are added to water a brisk effervescence ensues, and the draught is taken during this ebullition of carbonic acid gas.

Natural aërated waters are not uncommon, and many of those enumerated under the heading of mineral waters are, in addition to the various properties mentioned, aërated.

Popular Drinks.

A tremendous industry has grown up of recent years in the manufacture of ginger beer, lemonade, and what are called mineral waters. There are about 4,000 mineral water manufacturers in the kingdom, some of the largest of whom turn out 17,000 dozen a day. If we take an average of say 300 dozen a day, and 300 working days, it would yield the enormous total of 360,000,000 dozen annually. There are, however, no exact returns of the annual output, and probably the above is a very low estimate.

This trade was established rather more than a hundred years ago, having been originated by a partner of the firm of Schweppe in Geneva, but it has been during the last twenty-five years that the most rapid strides have been made.

Ginger Beer.

This should be made by fermenting ginger, sugar, and possibly other ingredients and bottling before the fermentation is completed.

The following are amongst the best known recipes :—Five pounds of lump sugar, five ounces of the best crushed Jamaica ginger, four ounces cream of tartar, ten lemons sliced, and five gallons of boiling water. Mix these in a vessel, and stir occasionally till the whole is cool. When lukewarm add ten ounces of yeast ; fermentation is quickly set up, allow this to proceed for one day and strain through a flannel filter, let it stand for a short time, if any scum arises, take it off, and bottle. The corks should be good and tied or wired down. The resulting ginger beer will be slightly alcoholic, containing generally from one to one and a half per cent. of alcohol.

A very excellent beer containing a very small amount of alcohol is prepared as follows :—twenty pounds of white sugar, eighteen fluid ounces of lemon or lime juice, one pound of honey, twenty-two ounces of bruised ginger, and eighteen gallons of water. Boil the ginger with three gallons of water for half-an-hour, then add the sugar, the juice, and the honey, with the remainder of the water and strain through a cloth. When cold add the white of an egg and half a fluid ounce of lemon ; let it stand for four days and bottle. The bottles are to be laid on their sides in a cellar, and the beer will be ready for use in three weeks.

The following is a recipe for smaller quantities : three ounces of cream of tartar, one ounce of ginger, one and a half pounds of refined sugar, one sliced lemon, one and a half gallons of boiling water. When cool add one ounce of yeast ferment, strain and bottle as in the previous case. The same proportion of alcohol will be present.

Spurious ginger beer, very commonly sold, is prepared by adding a few drops of tincture of ginger and a little syrup in a bottle and filling it up with aërated water from the soda water machine.

Lemonade. There are few more refreshing drinks than natural lemonade, and it is a pity it is not in more general use. It is easily made by adding two lemons sliced, and two ounces of powdered white sugar to a quart of boiling water and digesting till cold. In hot weather a little ice added to this renders it a most refreshing and beneficial beverage.

A first-class lemonade can be made as follows :—Pare off the rinds of eighteen lemons and put them with three pounds of sugar into a clean earthenware pan, pour on these two gallons of boiling water. Stir till the sugar has dissolved, cover with a material of thick texture and let the whole stand for twenty-four hours. Strain off the liquid and add the juice from the eighteen lemons, add one gill of spirits of wine and let the whole stand three days. Bottle in clean and well-dried bottles. If the lemonade is required to effervesce on being poured out, add a few grains of tartaric acid to each bottle when corking them. The corks must be tied down.

A spurious lemonade is in common use under the name of natural lemonade to distinguish it from the sparkling lemonade, which is prepared by adding a preparation of essence of lemon (an artificial product) to water.

The sparkling lemonade purchased in bottles is also spurious lemonade. It is prepared by adding essence of lemons with sugar to water and aërating it from the soda water machine. It is absolutely innocent of the natural fruit.

OTHER TABLE BEVERAGES.

CHAPTER XXIV.

THERE are also a large number of beverages practically made in the same way, but going under different names, many of them being fancy registered titles. One of the most common of these is ginger ale, of which there are a great variety of different makes, the principle of which is the same throughout, the ingredients being water, essence of ginger, sugar, and carbonate water under pressure. These beverages are entirely non-alcoholic.

Ginger Ale.

There are quite a number of fancy beverages coming under this class, such as ginger champagne, orange champagne, zoedone, and many others.

Burmah Cup.

A very delightful and refreshing preparation, which ought to be better known, is on the market under the title of "Burmah Cup." It is not of the nature of the many ephemeral productions that have been introduced during the past few years in the attempt to meet the great want of a beverage, pleasant to drink, and non-alcoholic, as it was introduced some years ago under the auspices of the late Sir William Collins, Lord Provost of Glasgow, and President of the Scottish Temperance League, for use at the Civic Entertainments given during the three years of his tenure of office, and it has maintained its popularity with the public ever since. It is put up in bottles and syphons, and aërated, and this method has added greatly to the demand wherever it has been introduced.

Kops Ale.

An entirely new industry has arisen during the last few years in the manufacture of fermented beers with a percentage of alcohol so small as to fall below the quantity that renders them exciseable. In making this beverage the processes are identical with those of the ordinary brewery up to the point of fermentation, and this is kept down to the lowest possible point, and an essential part in the process is that of a very complete filtration by a patented apparatus so as to remove all organic particles that might set up after fermentation.

The process of fermentation has been so regulated, it is evident, as to reduce the alcohol to a minimum amount. Strictly speaking, Kops ale cannot be called absolutely non-alcoholic, although practically it is so; but in view of the exceedingly small quantity it contains, it would be perfectly true to describe it as non-intoxicating. Regarding ordinary ale, as containing, say, three and a half per cent. of absolute alcohol, one would require to drink about ten times more Kops in order to ingest the same amount of alcohol. An average person does not ordinarily drink more than a pint of intoxicating beer on a single occasion, and the amount of alcohol contained therein would represent a gallon and a quarter of Kops ale according to the following analysis, so that the beverage may fairly lay claim to be absolutely non-intoxicating.

A sample of the ale as it left the brewery gave the following analysis.

Water	98·113
Alcohol	0·320
Sugar	1·420
Extractive	0·120
Mineral	0·027
	100·000

The ale is bottled under pressure being charged with carbonic acid gas, and it is about as close an imitation of ordinary ale as can be obtained; it has the refreshing and tonic properties of the hop and keeps well.

Kops stout, Clayton's hop ale, Bank's beer and stout, and many others are of the same class.

Cases have not been unknown of after fermentation setting up and the limit of under two per cent. of alcohol which is the quantity allowed to go free from excise duty being exceeded.

A case recently occurred at Longridge, where a mineral water manufacturer was fined for selling dandelion stout which contained 3·2 per cent. of alcohol.

Unless every care and precaution be taken in the manufacture, clean and wholesome bottles secured, and good corks used, this after-fermentation is bound to occur as all the elements for the production of alcohol are present and if by any means a stray yeast germ gets in, the alcohol fermentation will set up.

Mason's Herb Beer.

This is a preparation that comes under the heading of fermented liquors. The beer is not sold already prepared, but only the herb extract. With this are the instructions for making the beer. These consist in taking a certain quantity of sugar and adding to it a given amount of hot water, and the introduction of yeast fermentation follows with the evolution of carbonic acid gas and alcohol. The fermenting liquid is strained and the herb extract added and the whole bottled. If in its preparation the instructions are minutely and exactly carried out the production will probably have about one per cent. of alcohol in it, but if the fermentation is allowed to proceed and other directions are negligently followed, the resulting beer may have three or four per cent. or even more of alcohol and consequently be as strong as ordinary beer. It is open to question how far such herb preparations are useful for every day use.

Lime Juice.

A very excellent and useful beverage is made from lime fruit juice and water. The lime is a fruit similar to the lemon, but considerably smaller, being only about one and a half inches in diameter and almost globular. It has a thin rind and an extremely acid juice. It is regarded as belonging to the same species as the citron and the lemon. It is a native of India and China, but has been cultivated in the West Indies and in the South of Europe. By many, the flavour of its juice is preferred to that of the lemon.

The juice is imported largely into Great Britain for the manufacture of citric acid and for use as a beverage.

One of the principal parts where the lime is cultivated is the Island of Montserrat, and the juice sold under that name has a deservedly high reputation.

After the lime harvest the fruit is sliced and squeezed and the juice promptly sealed up in casks to preserve it from contact with the air. A puncheon of 100 gallons would be worth £20. The juice undergoes very little further preparation, it is racked off, clarified and bottled, and if this is done with care it will retain its brightness and its acid flavour for an indefinite period.

It is not necessary to add spirits to lime juice to aid in its preservation.

An ounce of juice mixed with half its weight of sugar and diluted forms a most refreshing beverage.

An analysis of lime juice gave the following constituents :—

Water	90·44
Citric Acid	7·50
Glucose	0·18
Mucilage, etc.	1·54
Mineral Water	0·34
	100·00

As showing the growth of lime juice in popular favour the following extract from the *Liverpool Journal of Commerce*, December 30th, 1884, is interesting :—

"The demand for lime juice, caused by the war in Egypt, has been much in excess of previous years. The *Hilda*, which arrived at this port on Christmas Eve, brought no less than 60,000 gallons from the Island of Montserrat, all of which was consigned to Messrs. Evans, Sons & Co., the sole consignees, making the unprecedented total for the year of over 180,000 gallons. This extraordinary quantity is due to the demand for our army in Egypt, which is supplied daily with rations of Montserrat lime juice, which, we understand, is the only lime juice that meets the requirements of the Government with regard to strength and quality."

Stokos. A capital substitute for beer, in harvesting and all cases of hard work is a beverage known as " Stokos." It may be made as follows:—Put a quarter of a pound of fine ground oatmeal, about six ounces of sugar and two table-spoonfuls of lime juice in a pan, mix well together with a little warm water, then add a gallon of boiling water, stir thoroughly and cool, or the oatmeal may be added to the water boiled, stirred thoroughly and cooled, and the lime juice and sugar added afterwards. A little extra lime juice will add to the pleasantness of the beverage. It must be made fresh daily. It is nourishing, easily made, and cheap, and men who have tried it find that they can do a very hard day's work with far greater ease and comfort than they could when drinking beer. Employers and gangers should encourage the drinking of stokos instead of beer.

Mead. This is an old fashioned beverage, not much in use at the present time, but occasionally met with at farm houses and old fashioned country inns. We give an account of it here, in order that its constituents and properties may be known.

Add thirty pounds of clarified honey to thirteen gallons of soft water, mix together, boil for ten minutes skimming all the time, then add a handful of rosemary, thyme, and sweet briar leaves, and boil for half an hour longer. Strain the liquor into a tub on to five quarts of ground malt, stir until it is lukewarm, strain through a cloth and return it to the tub. Toast a piece of bread, spread it over with good yeast and add it to the liquor. Fermentation will soon set in and when the liquor is quite covered with yeast run it into a sweet barrel. Then put in a muslin bag the following spices: half ounce each of bruised cloves, mace and nutmeg, one ounce of best ginger sliced, and half ounce of green shredded laurel leaves. Suspend the bag in the cask, adding a few pebbles to sink it into the liquor. Bung securely and keep it in the cask for nine months, then rack off and bottle it. The liquor will be as alcoholic as a fairly strong wine.

There are many varieties in the way of making mead according to the locality, but they are all alcoholic and some of them very strongly so. For instance American mead embraces the following ingredients:—honey, cider, old rum, brandy, cream of tartar, bitter almonds and cloves.

Sherbet. There are many forms of powders that can be bought for adding to water to make an effervescing drink. These are, perhaps, more common in America than in England.

Some of those in use in America are as follows:—

Cream Soda..	1 to 1½ oz. to the gallon of water.
Lemon Extract	2 oz. to the gallon of syrup.
Sherbet ,, ...	1 to 1½ oz. ,, ,,
Pear Cider Extract ..	1 oz. ,, ,,
Raspberry ,, ...	1 oz. ,, ,,
Strawberry ,, ...	1 oz. ,, ,,
Pineapple ,, ...	1 oz. ,, ,,
Ginger Champagne Extract	1½ oz. ,, ,,
Belfast Ginger ,,	4 oz. ,, ,,
Club Soda ,,	1 to 1½ oz. ,, ,,
Birch Beer ,,	1 to 2 oz. ,, ,,

The most common of these powders is that known as sherbet.

A very good sherbet can be made as follows:—half pound of refined powdered sugar, quarter pound of tartaric acid, quarter pound of carbonate of soda. These must be all thoroughly dried and well ground and mixed. Then to the whole add about forty drops of essence of lemon, transfer at once to a bottle and keep well corked. Persian sherbet may be made by taking one pound of refined sugar, four ounces of tartaric acid, and four ounces of carbonate of soda, and one hundred drops of essence of lemon, rub the whole well and quickly in a mortar, transfer to a glass bottle and cork tightly, covering the cork with sealing wax.

Fruit Essences.

Fruit essences and fruit syrups are much in use. They are purely chemical preparations, but they need not be despised on that account as the chemist by his art and skill in many cases is able first to find out what nature uses in her laboratory and then to copy her closely, and in this particular kind of work he has been eminently successful. Although these fruit essences therefore are artificially prepared, they are identical in many cases with what the natural fruit would yield. Most makers have their own particular formulæ, and this will account for slight differences in flavour, etc.

The following were published some years ago by Kletzinsky, and may be taken as indicating generally the composition of the essences named.

These formulæ are given in *parts by measure* for 100 parts of alcohol and whenever acids are used they are to be previously dissolved in alcohol.

Apple.—Aldehyd, two parts; chloroform, acetic ether, nitrous ether, and oxalic acid, each one part; glycerine, four parts; amyl-valerianic ether, ten parts.

Pear.—Acetic ether, five parts, amyl-acetic ether and glycerine, each two parts.

Cherry.—Benzoic ether, acetic ether, each five parts; glycerine, three parts; œnanthic ether and benzoic acid, each one part

Black Cherry.—Benzoic ether, five parts; acetic acid, ten parts; oil of persico (peach kernels) and benzoic acid, each two parts; oxalic acid, one part.

Peach.—Formic ether, valerianic ether, butyric ether, acetic ether glycerin and oil of persico, each five parts; aldehyd and amylic alcohol, each two parts; sebacylic ether, one part.

Apricot.—Butyric ether, ten parts; valerianic ether, five parts; glycerin, four parts; amylic alcohol, two parts; amyl-butyric ether, chloroform, œnanthic ether and tartaric acid, each one part.

Plum.—Glycerin, eight parts; acetic ether and aldehyd, each five parts; oil of persico, four parts; butyric ether two parts, and formic ether, one part.

Grape.—Œnanthic ether, glycerine, each ten parts; tartaric acid, five parts; succinic acid, three parts; aldehyd, chloroform, and formic ether, each two parts: and methyl-salicylic ether, one part.

Currant.—Acetic ether, tartaric acid each five parts; benzoic acid, succinic acid, benzoic ether, aldehyd and œnanthic ether, each one part.

Strawberry.—Butyric ether and acetic ether, each five parts; amyl-acetic ether, three parts; amyl-butyric ether and glycerin, each two parts; formic ether, nitrous ether and methyl-salicylic ether, each one part.

Raspberry.—Acetic ether and tartaric acid, each five parts; glycerin, four parts; aldehyd, formic ether, benzoic ether, butyric ether, amyl-butyric ether, acetic ether, œnanthic ether, methyl-salicylic ether, nitrous ether, sebacylic ether and succinic acid, each, one part.

Pineapple.—Amyl-butyric ether, ten parts; butyric ether, five parts; glycerin, three parts; aldehyd and chloroform, each one part.

Melon.—Sebacylic ether, ten parts, valerianic ether five parts; glycerin, three parts; butyric ether, four parts; aldehyd, two parts; formic ether, one part.

ORANGE.—Oil of orange and glycerine, each ten parts; aldehyd and chloroform, each two parts; acetic ether, five parts benzoic ether, formic ether, butyric ether, amyl-acetic ether, methyl-salicylic ether and tartaric acid, each one part.

LEMON.—Oil of lemon, acetic ether and tartaric acid, each ten parts; glycerine, five parts; aldehyd, two parts; chloroform, nitrous ether and succinic acid, each, one part.

INDEX.